LilyPond

The music typesetter

Contributor's Guide

The LilyPond development team

This manual documents contributing to LilyPond version 2.18.2. It discusses technical issues and policies that contributors should follow.

This manual is not intended to be read sequentially; new contributors should only read the sections which are relevant to them. For more information about different jobs, see Section "Help us" in *General Information*.

For more information about how this manual fits with the other documentation, or to read this manual in other formats, see Section "Manuals" in *General Information*.

If you are missing any manuals, the complete documentation can be found at `http://www.lilypond.org/`.

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For LilyPond version 2.18.2

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1 Introduction to contributing

This chapter presents a quick overview of ways that people can help LilyPond.

1.1 Help us

We need you!

Thank you for your interest in helping us — we would love to see you get involved! Your contribution will help a large group of users make beautifully typeset music.

Even working on small tasks can have a big impact: taking care of them allows experienced developers work on advanced tasks, instead of spending time on those simple tasks.

For a multi-faceted project like LilyPond, sometimes it's tough to know where to begin. In addition to the avenues proposed below, you can send an e-mail to the lilypond-devel@gnu.org mailing list, and we'll help you to get started.

Simple tasks

No programming skills required!

- Mailing list support: answer questions from fellow users.
- Bug reporting: help users create proper Section "Bug reports" in *General Information*, and/or join the Bug Squad to organize Section "Issues" in *Contributor's Guide*.
- Documentation: small changes can be proposed by following the guidelines for Section "Documentation suggestions" in *Contributor's Guide*.
- LilyPond Snippet Repository (LSR): create and fix snippets following the guidelines in Section "Adding and editing snippets" in *Contributor's Guide*.
- Discussions, reviews, and testing: the developers often ask for feedback about new documentation, potential syntax changes, and testing new features. Please contribute to these discussions!

Advanced tasks

These jobs generally require that you have the source code and can compile LilyPond.

> **Note:** We suggest that contributors using Windows or MacOS X do **not** attempt to set up their own development environment; instead, use Lilydev as discussed in Section "Quick start" in *Contributor's Guide*.

Contributors using Linux or FreeBSD may also use Lilydev, but if they prefer their own development environment, they should read Section "Working with source code" in *Contributor's Guide*, and Section "Compiling" in *Contributor's Guide*.

Begin by reading Section "Summary for experienced developers" in *Contributor's Guide*.

- Documentation: for large changes, see Section "Documentation work" in *Contributor's Guide*.
- Website: the website is built from the normal documentation source. See the info about documentation, and also Section "Website work" in *Contributor's Guide*.
- Translations: see Section "Translating the documentation" in *Contributor's Guide*, and Section "Translating the website" in *Contributor's Guide*.
- Bugfixes or new features: read Section "Programming work" in *Contributor's Guide*.

1.2 Overview of work flow

> **Advanced note:** Experienced developers should skip to Section 1.3 [Summary for experienced developers], page 2.

Git is a *version control system* that tracks the history of a program's source code. The LilyPond source code is maintained as a Git repository, which contains:

- all of the source files needed to build LilyPond, and
- a record of the entire history of every change made to every file since the program was born.

The 'official' LilyPond Git repository is hosted by the GNU Savannah software forge at `http://git.sv.gnu.org`.

Changes made within one contributor's copy of the repository can be shared with other contributors using *patches*. A patch is a text file that indicates what changes have been made. If a contributor's patch is approved for inclusion (usually through the mailing list), someone on the current development team will *push* the patch to the official repository.

The Savannah software forge provides two separate interfaces for viewing the LilyPond Git repository online: cgit and gitweb.

Git is a complex and powerful tool, but tends to be confusing at first, particularly for users not familiar with the command line and/or version control systems. We have created the `lily-git` graphical user interface to ease this difficulty.

Compiling ('building') LilyPond allows developers to see how changes to the source code affect the program itself. Compiling is also needed to package the program for specific operating systems or distributions. LilyPond can be compiled from a local Git repository (for developers), or from a downloaded tarball (for packagers). Compiling LilyPond is a rather involved process, and most contributor tasks do not require it.

Contributors can contact the developers through the 'lilypond-devel' mailing list. The mailing list archive is located at `http://lists.gnu.org/archive/html/lilypond-devel/`. If you have a question for the developers, search the archives first to see if the issue has already been discussed. Otherwise, send an email to `lilypond-devel@gnu.org`. You can subscribe to the developers' mailing list here: `http://lists.gnu.org/mailman/listinfo/lilypond-devel`.

> **Note:** Contributors on Windows or MacOS X wishing to compile code or documentation are strongly advised to use our Ubuntu LilyPond Developer Remix, as discussed in Chapter 2 [Quick start], page 5.

1.3 Summary for experienced developers

If you are already familiar with typical open-source tools, here's what you need to know:

- **source repository**: hosted by GNU savannah.

  `http://git.savannah.gnu.org/gitweb/?p=lilypond.git`
- **environment variables**: many maintenance scripts, and many instructions in this guide rely on predefined Section 14.2 [Environment variables], page 164.
- **mailing lists**: given on Section "Contact" in *General Information*.
- **branches**:
  - `master`: base your work from this, but do **not push** to it.
  - `staging`: after a successful review (see below), push here.
  - `translation`: translators should base their work from this, and also push to it.
  - `dev/foo`: feel free to push any new branch name under `dev/`.

- **regression tests**: also known as "regtests"; this is a collection of more than a thousand .ly files. We track the output of those files between versions.

  If a patch introduces any unintentional changes to the regtests, we will likely reject it – make sure that you are aware and can explain any regtest changes. More info in Chapter 9 [Regression tests], page 99.

- **reviews**: after finishing work on a patch or branch:

  1. upload it with our custom `git-cl`. In addition to uploading it to the google rietveld code review tool, this adds a tracker issue so that we don't lose your patch. The "status" of your patch is kept on the issue tracker; see Chapter 8 [Issues], page 90.

     `https://github.com/gperciva/git-cl`

     Your patch will be given `Patch-new` status. More info in [Uploading a patch for review], page 24.
  2. If your patch passes some automatic tests, it will be given `Patch-review` status. This generally happens within 24 hours.
  3. After that, the patch must wait for the next "patch countdown", which occur 3 times a week. If there are a lot of patches waiting for a countdown, a subset of patches are chosen randomly. When your patch is put on a countdown, it will be given `Patch-countdown` status.
  4. The countdown is a 48-hour period which gives other developers one last chance to review the patch. If no significant problems are found, your patch will be given `Patch-push` status.
  5. You may now either push it to the `staging` branch, or email your patch (created with `git format-patch`) to somebody who will push it for you.

     Advanced note: Yes, this process means that most patches wait between 60-120 hours before reaching `master`. This is unfortunate, but given our limited resources for reviewing patches and a history of unintended breakage in `master`, this is the best compromise we have found.

1.4 Mentors

We have a semi-formal system of mentorship, similar to the medieval "journeyman/master" training system. New contributors will have a dedicated mentor to help them "learn the ropes".

> **Note:** This is subject to the availability of mentors; certain jobs have more potential mentors than others.

Contributor responsibilities

1. Ask your mentor which sections of the CG you should read.
2. If you get stuck for longer than 10 minutes, ask your mentor. They might not be able to help you with all problems, but we find that new contributors often get stuck with something that could be solved/explained with 2 or 3 sentences from a mentor.
3. If you have been working on a task much longer than was originally estimated, stop and ask your mentor. There may have been a miscommunication, or there may be some time-saving tips that could vastly simply your task.
4. Send patches to your mentor for initial comments.
5. Inform your mentor if you're going to be away for a month, or if you leave entirely. Contributing to lilypond isn't for everybody; just let your mentor know so that we can reassign that work to somebody else.

6. Inform your mentor if you're willing to do more work – we always have way more work than we have helpers available. We try to avoid overwhelming new contributors, so you'll be given less work than we think you can handle.

Mentor responsibilities

1. Respond to questions from your contributor(s) promptly, even if the response is just "sorry, I don't know" or "sorry, I'm very busy for the next 3 days; I'll get back to you then". Make sure they feel valued.
2. Inform your contributor(s) about the expected turnaround for your emails – do you work on lilypond every day, or every weekend, or what? Also, if you'll be unavailable for longer than usual (say, if you normally reply within 24 hours, but you'll be at a conference for a week), let your contributors know. Again, make sure they feel valued, and that your silence (if they ask a question during that period) isn't their fault.
3. Inform your contributor(s) if they need to do anything unusual for the builds, such as doing a "make clean / doc-clean" or switching git branches (not expected, but just in case...)
4. You don't need to be able to completely approve patches. Make sure the patch meets whatever you know of the guidelines (for doc style, code indentation, whatever), and then send it on to -devel for more comments. If you feel confident about the patch, you can push it directly (this is mainly intended for docs and translations; code patches should almost always go to -devel before being pushed).
5. Keep track of patches from your contributor. Either upload them to Rietveld yourself, or help+encourage them to upload the patches themselves. When a patch is on Rietveld, it's your responbility to get comments for it, and to add a link to the patch to the google tracker. (tag it "patch-new", or "patch-review" if you feel very confident in it)
6. Encourage your contributor to review patches, particularly your own! It doesn't matter if they're not familiar with C++ / scheme / build system / doc stuff – simply going through the process is valuable. Besides, anybody can find a typo!
7. Contact your contributor at least once a week. The goal is just to get a conversation started – there's nothing wrong with simply copy&pasting this into an email:

```
Hey there,

How are things going?  If you sent a patch and got a review, do
you know what you need to fix?  If you sent a patch but have no
reviews yet, do you know when you will get reviews?  If you are
working on a patch, what step(s) are you working on?
```

2 Quick start

Want to submit a patch for LilyPond? Great! Never created a patch before? Never compiled software before? No problem! This chapter is for you and will help you do this as quickly and easily as possible.

2.1 LilyDev

There is a disk image of a 'remix' of Ubuntu GNU/Linux available for download which includes all the necessary software and tools to compile both LilyPond and the documentation. Called the "Ubuntu LilyPond Developer Remix", but known simply as "LilyDev" for short. Although it is not possible to compile LilyPond on Windows and extremely difficult on MacOS, LilyDev can be installed and run inside a 'virtual machine' on any of these operating systems without disturbing your main operating system. The LilyDev disk image can also be burnt to a DVD and installed like any other Ubuntu GNU/Linux distribution.

Most virtualization software can be used but we recommend VirtualBox as it is available for all major operating systems and is easy to install & configure.

If you are not familiar with GNU/Linux, it may be beneficial to read a couple of "introduction to Ubuntu" web pages.

For those interested, the LilyDev remix is currently based on a 32bit version of 10.04 LTS Ubuntu (Lucid Lynx).

> **Note:** Apart from installing and configuring LilyDev in VirtualBox, the rest of the chapter assumes that you are comfortable using the command-line. While this chapter is intended for users who may have never created a patch or compiled software before, experienced developers (who prefer to use their own development environment) may still find it instructive to skim over this section.

Where to get LilyDev

Download the Ubuntu LilyPond Developer Remix CD image file (approximately 1 GB) from here:

`http://www.philholmes.net/lilypond/LilyDev/ubuntu-LilyDev-remix-2.6.iso`

Some advanced users might want this file too:

`http://www.philholmes.net/lilypond/LilyDev/ubuntu-LilyDev-remix-2.6.iso.md5`

(If you don't recognize what this file is, then you don't need it.)

An alternate site for obtaining these files is available:

`http://www.et.byu.edu/~sorensen/ubuntu-LilyDev-remix-2.6.iso`
`http://www.et.byu.edu/~sorensen/ubuntu-LilyDev-remix-2.6.iso.md5`

Installing LilyDev in VirtualBox

This section discusses how to install and use LilyDev with VirtualBox.

> **Note:** If you already know how to install a virtual machine using a disc image inside VirtualBox (or your own virtualization software) then you can skip this section and go straight to Section 2.2 [lily-git], page 7.

1. Download Virtualbox from here:

http://www.virtualbox.org/wiki/Downloads

> **Note:** In virtualization terminology, the operating system where Virtualbox is installed is known as the **host**. LilyDev will be installed 'inside' Virtualbox as a **guest**.

2. Start the VirtualBox software and click 'New' to create a new "virtual machine".

   The 'New Virtual Machine Wizard' will walk you through setting up your guest virtual machine. Choose an appropriate name for your LilyDev installation and select the 'Linux' operating system. When selecting the 'version' use 'Ubuntu' if available (but not the '64 bit' option). If you do not have that specific option choose 'Linux 2.6' (again do not choose any option that has 64 bit next to it).
3. Select the amount of RAM you will allow the LilyDev guest to use from your host operating system when it is running. If possible, use at least 700 MB of RAM; the more RAM you can spare from your host the better, although LilyDev will currently use no more than 4 GB (4096 MB) even if you are able to assign more.
4. For your 'Virtual Hard Disk', leave the 'Create new hard disk' option checked, use the default 'VDI' and "Dynamically allocated" options for the virtual hard drive. A complete compile of everything (code, docs, regression tests) can reach 10 GB so size your virtual disk and its location accordingly.
5. Verify the summary details and click 'Create', when you are satisfied. Your new guest will be displayed in the Virtualbox window. Click the 'Start' button and the 'First Run Wizard' will prompt you for the installation media. Click the browse icon and locate the LilyDev disk image and click through the wizard to start the installation process.
6. When the LilyDev disk image boots, it shows a prompt:

   ```
   ISOLINUX boot:
   ```

   Hit the Return key (or wait 30 seconds) and then when the installer screen loads, using the arrow keys select 'Install - start the installer directly' to begin the install process of LilyDev on your virtual hard disk. The Ubuntu software will walk you through the complete installation process.
7. At the "Prepare disk space" stage, do not be afraid to select "Erase and use the entire disk", since this refers to your *virtual disk*, not your machine's actual hard disk.
8. Click through the rest of the wizard, filling in any appropriate details when asked and wait for the install to complete.

   > **Note:** This will take anywhere from 10 minutes to up to an hour depending on the speed of your computer and if Ubuntu detects you are connected to the internet and needs to download any additional security updates or patches, although these updates are not required to compile LilyPond and it is possible to skip the additional downloads to speed up the install process.
9. When prompted by the Ubuntu installer wizard, restart the virtual machine and then when prompted to 'eject the CD' by virtual box, just click inside the virtual machine window and hit the return key to reboot the virtual machine. It will not try to restart the installer but start the virtual machine proper. LilyDev is now installed and running!
10. The current version of LilyPond requires the texlive-lang-cyrillic package. This package is not part of LilyDev 2.6. Add the package to LilyDev with:

    ```
    sudo apt-get install texlive-lang-cyrillic
    ```

Known issues and warnings

Not all hardware is supported in all virtualization tools. In particular, some contributors have reported problems with USB network adapters. If you have problems with network connection (for example Internet connection in the host system is lost when you launch virtual system), try installing and running LilyDev with your computer's built-in network adapter used to connect to the network. Refer to the help documentation that comes with your virtualization software.

Configuring LilyDev in VirtualBox

VirtualBox has extra 'guest additions' which although are not necessary to use LilyDev or compile Lilypond, do provide some additional features to your Virtual Machine to make it easier to work with. Such as being able to dynamically resize the LilyDev window, allow seamless interaction with your mouse pointer on both the host and guest and let you copy/paste between your host and guest if needed.

1. Select the 'Devices' menu from the virtual machine window and choose 'Install Guest Additions...'. This will automount a CD which will prompt you to autorun it. Click OK and follow the instructions. It is recommended to reboot the guest when the installation is complete.

   Other virtualization software will also have their own 'guest' additions, follow the normal procedures for your virtualization software with Ubuntu as the client.
2. Restart Ubuntu to complete the installation of the guest additions.

   > **Advanced note:** If you do any kernel upgrades, you may need to reinstall the additional software. Just follow the step above again and reboot when the reinstallation is complete.

Other items that may be helpful:

- In the settings for the virtual machine, set the network to Bridged mode to allow you to access shared folders when using Windows hosts.
- Set up any additional features, such as 'Shared Folders' between your main operating system and Ubuntu. This is distinct from the networked share folders in Windows. Consult the external documentation for this.

  Some longtime contributors have reported that 'shared folders' are rarely useful and not worth the fuss, particularly since files can be shared over a network instead.
- Pasting into a terminal is done with `Ctrl+Shift+v`.
- The "Places" top-menu has shortcuts to a graphical "navigator" like Windows Explorer or the MacOS X Finder.
- Right-click allows you to edit a file with gedit. We recommend using gedit.
- One particular change from Windows and MacOS X is that most software should be installed with your "package manager"; this vastly simplifies the process of installing and configuring software. Go to Applications → Ubuntu Software Center.

2.2 lily-git

The 'LilyPond Contributor's Git Interface' (otherwise known as `lily-git.tcl`) is a simple-to-use GUI to help you download and update the LilyPond source code as well as an aid to making software patches.

Where to get lily-git

Depending on your development environment, lily-git may already be installed on your computer.

- If you are using LilyDev (see Section 2.1 [LilyDev], page 5) then lily-git is already installed and ready to run.

- For those not using LilyDev then lily-git can be obtained by downloading the software directly. See Section 3.1 [Manually installing lily-git.tcl], page 12.
- Finally, lily-git is always part of the LilyPond source code and is located in '`$LILYPOND_GIT/scripts/auxillar/lily-git.tcl`'.

Configuring lily-git and downloading the source code

> **Note:** The rest of this manual assumes that you are using the command-line within a terminal.

1. Type (or copy&paste) into the Terminal:

   ```
   lily-git.tcl
   ```

   You will be prompted to enter your name and your email address. This information is used only to identify and label any patches you create. This information can be edited if required later. See [Configuring Git], page 13. Click on the *Submit* button to update lily-git with this information.
2. Click on the "Get source" button.

   A directory called '`$LILYPOND_GIT`' is now created within your home directory and the complete source code will start to be downloaded into it.

   > **Note:** Be patient! The complete source is around 150 Mb.

   When the source code has been downloaded, the "Command output" window in lily-git will update and display "Done" on the very last line. The button label will change to say "Update source".

   > **Note:** Some contributors have reported that occasionally nothing happens at this step at all. If this occurs, then try again in a few minutes – it could be an intermittant network problem. If the problem persists, please ask for help.

3. Close the lily-git GUI and navigate to the '`$LILYPOND_GIT`' directory to view and edit the source files.

If this is the first time you have compiled LilyPond then please go to Section 2.3 [Compiling with LilyDev], page 10 before reading on.

How to use lily-git

> **Note:** Throughout the rest of this manual, most command-line input should be entered from '`~/lilypond-git/`'. This is known as the *top source directory* and is often referred to as *$LILYPOND_GIT*.

> **Note:** Only work on one set of changes at once. Do not start work on any new changes until your first set has been accepted.

1. Update source

At the beginning of each session of lilypond work, you should click the "Update source" button to get the latest changes to the source code.

> **Note:** In some rare and unfortunate circumstances, this will result in a *merge conflict*. If this occurs, follow the instructions for "Abort changes", below. Your work will not be lost.

2a. New local commit

A single commit typically represents one logical set of related changes (such as a bug-fix), and may incorporate changes to multiple files at the same time.

When you're finished making the changes for a commit, click the "New local commit" button. This will open the "Git Commit Message" window. The message header is required, and the message body is optional.

After entering a commit message, click "OK" to finalize the commit.

> **Advanced note:** for more information regarding commits and commit messages, see Section 3.3.4 [Commits and patches], page 22.

2b. Amend previous commit

You can go back and make changes to the most recent commit with the "Amend previous commit" button. This is useful if a mistake is found after you have clicked the "New local commit" button.

To amend the most recent commit, re-edit the source files as needed and then click the "Amend previous commit" button. The earlier version of the commit is not saved, but is replaced by the new one.

> **Note:** This does not update the patch **files**; if you have a patch file from an earlier version of the commit, you will need to make another patch set when using this feature. The old patch file will not be saved, but will be replaced by the new one after you click on "Make patch set".

3. Make patch set

Before making a patch set from any commits, you should click the "Update source" button to make sure the commits are based on the most recent remote snapshot.

When you click the "Make patch set" button, `lily-git.tcl` will produce patch files for any new commits, saving them to the current directory. The command output will display the name of the new patch files near the end of the output:

```
0001-CG-add-lily-git-instructions.patch
Done.
```

Send patch files to the appropriate place:

- If you have a mentor, send it to them via email.
- Translators should send patches to `translations@lilynet.net`.
- More experienced contributors should upload the patch for web-based review. This requires additional software and use of the command-line; see [Uploading a patch for review], page 24.
- If you have trouble uploading the patch for review, ask for help on `lilypond-devel@gnu.org`.

The "Abort changes – Reset to origin" button

> **Note:** Only use this if your local commit history gets hopelessly confused!

The button labeled "Abort changes – Reset to origin" will copy all changed files to a subdirectory of '`$LILYPOND_GIT`' named '`aborted_edits/`', and will reset the repository to the current state of the remote repository (at `git.sv.gnu.org`).

2.3 Compiling with LilyDev

LilyDev is our 'remix' of Ubuntu which contains all the necessary dependencies to do lilypond development; for more information, see Section "LilyDev" in *Contributor's Guide*.

Preparing the build

To prepare the build directory, enter (or copy&paste) the below text. This should take less than a minute.

```
cd $LILYPOND_GIT
sh autogen.sh --noconfigure
mkdir -p build/
cd build/
../configure
```

Building `lilypond`

Compiling lilypond will likely take between 5 and 60 minutes, depending on your computer's speed and available RAM. We recommend that you minimize the terminal window while it is building; this can have a non-negligible effect on compilation speed.

```
cd $LILYPOND_GIT/build/
make
```

You may run the compiled `lilypond` with:

```
cd $LILYPOND_GIT/build/
out/bin/lilypond my-file.ly
```

Building the documentation

Compiling the documentation is a much more involved process, and will likely take 2 to 10 hours.

```
cd $LILYPOND_GIT/build/
make
make doc
```

The documentation is put in '`out-www/offline-root/`'. You may view the html files by entering the below text; we recommend that you bookmark the resulting page:

```
firefox $LILYPOND_GIT/build/out-www/offline-root/index.html
```

Installing

Don't. There is no reason to install lilypond within LilyDev. All development work can (and should) stay within the '`$LILYPOND_GIT`' directory, and any personal composition or typesetting work should be done with an official GUB release.

Problems and other options

To select different build options, or isolate certain parts of the build, or to use multiple CPUs while building, read Chapter 4 [Compiling], page 41.

In particular, contributors working on the documentation should be aware of some bugs in the build system, and should read the workarounds in Section 4.6.2 [Generating documentation], page 46.

2.4 Now start work!

LilyDev users may now skip to the chapter which is aimed at their intended contributions:

- Chapter 5 [Documentation work], page 53
- Section 5.8 [Translating the documentation], page 68
- Chapter 6 [Website work], page 80
- Chapter 9 [Regression tests], page 99
- Chapter 10 [Programming work], page 105

These chapters are mainly intended for people not using LilyDev, but they contain extra information about the "behind-the-scenes" activities. We recommend that you read these at your leisure, a few weeks after beginning work with LilyDev.

- Chapter 3 [Working with source code], page 12
- Chapter 4 [Compiling], page 41

3 Working with source code

> **Note:** New contributors should read Chapter 2 [Quick start], page 5, and in particular Section 2.2 [lily-git], page 7, instead of this chapter.

Advanced contributors will find this material quite useful, particularly if they are working on major new features.

3.1 Manually installing lily-git.tcl

We have created an easy-to-use GUI to simplify git for new contributors. If you are comfortable with the command-line, then skip ahead to Section 3.2 [Starting with Git], page 12.

> **Note:** These instructions are only for people who are *not* using Section 2.1 [LilyDev], page 5.

1. If you haven't already, download and install Git.
   - Windows users: download the `.exe` file labeled "Full installer for official Git" from:

     `http://code.google.com/p/msysgit/downloads/list`
   - Other operating systems: either install `git` with your package manager, or download it from the "Binaries" section of:

     `http://git-scm.com/download`
2. Download the `lily-git.tcl` script from:

   `http://git.sv.gnu.org/cgit/lilypond.git/plain/scripts/auxiliar/lily-git.tcl`
3. To run the program from the command line, navigate to the directory containing `lily-git.tcl` and enter:

   ```
   wish lily-git.tcl
   ```
4. Click on the "Get source" button.

   This will create a directory called '`lilypond-git/`' within your home directory, and will download the source code into that directory (around 150 Mb). When the process is finished, the "Command output" window will display "Done", and the button label will change to say "Update source".
5. Navigate to the '`lilypond-git/`' directory to view the source files.

> **Note:** Throughout the rest of this manual, most command-line input should be entered from '`$LILYPOND_GIT`'. This is referred to as the *top source directory*.

Further instructions are in [How to use lily-git], page 8.

3.2 Starting with Git

Using the Git program directly (as opposed to using the `lily-git.tcl` GUI) allows you to have much greater control over the contributing process. You should consider using Git if you want to work on complex projects, or if you want to work on multiple projects concurrently.

3.2.1 Setting up

> **Note:** These instructions assume that you are using the command-line version of Git 1.5 or higher. Windows users should skip to Section 3.5 [Git on Windows], page 33.

Installing Git

If you are using a Unix-based machine, the easiest way to download and install Git is through a package manager such as `rpm` or `apt-get` – the installation is generally automatic. The only required package is (usually) called `git-core`, although some of the auxiliary `git*` packages are also useful (such as `gitk`).

Alternatively, you can visit the Git website (`http://git-scm.com/`) for downloadable binaries and tarballs.

Initializing a repository

Once Git is installed, get a copy of the source code:

```
git clone git://git.sv.gnu.org/lilypond.git ~/lilypond-git
```

The above command will put the it in '`~/lilypond-git`', where `~` represents your home directory.

Technical details

This creates (within the '`$LILYPOND_GIT`' directory) a subdirectory called '`.git/`', which Git uses to keep track of changes to the repository, among other things. Normally you don't need to access it, but it's good to know it's there.

Configuring Git

> **Note:** Throughout the rest of this manual, all command-line input should be entered from the top directory of the Git repository being discussed (eg. '`$LILYPOND_GIT`'). This is referred to as the *top source directory*.

Before working with the copy of the main LilyPond repository, you should configure some basic settings with the `git config` command. Git allows you to set both global and repository-specific options.

To configure settings that affect all repositories, use the '`--global`' command line option. For example, the first two options that you should always set are your *name* and *email*, since Git needs these to keep track of commit authors:

```
git config --global user.name "John Smith"
git config --global user.email john@example.com
```

To configure Git to use colored output where possible, use:

```
git config --global color.ui auto
```

The text editor that opens when using `git commit` can also be changed. If none of your editor-related environment variables are set ($GIT_EDITOR, $VISUAL, or $EDITOR), the default editor is usually `vi` or `vim`. If you're not familiar with either of these, you should probably change the default to an editor that you know how to use. For example, to change the default editor to `nano`, enter:

```
git config --global core.editor nano
```

Finally, and in some ways most importantly, let's make sure that we know what branch we're on. If you're not using LilyDev, add this to your '`~/.bashrc`':

```
export PS1="\u@\h \w\$(__git_ps1)$ "
```

If you are not using LilyDev, you may need to install the additional `git-completion` package, but it is definitely worth it.

Technical details

Git stores the information entered with `git config --global` in the file '`.gitconfig`', located in your home directory. This file can also be modified directly, without using `git config`. The '`.gitconfig`' file generated by the above commands would look like this:

```
[user]
        name = John Smith
        email = john@example.com
[color]
        ui = auto
[core]
        editor = nano
```

Using the `git config` command *without* the '`--global`' option configures repository-specific settings, which are stored in the file '`.git/config`'. This file is created when a repository is initialized (using `git init`), and by default contains these lines:

```
[core]
        repositoryformatversion = 0
        filemode = true
        bare = false
        logallrefupdates = true
```

However, since different repository-specific options are recommended for different development tasks, it is best to avoid setting any now. Specific recommendations will be mentioned later in this manual.

3.2.2 Git for the impatient

> **Advanced note:** The intent of this subsection is to get you working on lilypond as soon as possible. If you want to learn about git, go read Section 3.7 [Other Git documentation], page 40.
> Also, these instructions are designed to eliminate the most common problems we have found in using git. If you already know git and have a different way of working, great! Feel free to ignore the advice in this subsection.

Ok, so you've been using `lily-git.tcl` for a while, but it's time to take the next step. Since our review process delays patches by 60-120 hours, and you want to be able to work on other stuff while your previous work is getting reviewed, you're going to use **branches**.

You can think of a branch as being a separate copy of the source code. But don't worry about it.

Start work: make a new branch

Let's pretend you want to add a section to the Contributor's Guide about using branches.

Start by updating the repository, then making a new branch. Call the branch anything you want as long as the name starts with `dev/`. Branch names that don't begin with `dev/` are reserved for special things in lilypond.

```
git checkout master
git pull -r origin master
git branch dev/cg
```

Switch to that branch

Nothing has happened to the files yet. Let's change into the new branch. You can think of this as "loading a file", although in this case it's really "loading a directory and subdirectories full of files".

```
git checkout dev/cg
```

Your prompt now shows you that you're on the other branch:

```
gperciva@LilyDev:~/lilypond-git (dev/cg)$
```

To be able to manage multiple lilypond issues at once, you'll need to switch branches. You should have each lilypond issue on a separate branch. Switching branches is easy:

```
git checkout master
git checkout origin/staging
git checkout origin/release/unstable
git checkout dev/cg
```

Branches that begin with `origin/` are part of the remote repository, rather than your local repository, so when you check them out you get a temporary local branch. You should never make changes directly on a branch beginning with `origin/`. You get changes into the remote repository by making them in local branches, and then pushing them to `origin/staging` as described below.

Make your changes

Edit files, then commit them.

```
git commit -a
```

Remember how I said that switching to a branch was like "loading a directory"? Well, you've just "saved a directory", so that you can "load" it later.

> **Advanced note:** If you have used `cvs` or `svn`, you may be very confused: those programs use "commit" to mean "upload my changes to the shared source repository". Unfortunately, just to be different, `git commit` means "save my changes to the files".

When you create a new file, you need to add it to git, then commit it:

```
git add input/regression/avoid-crash-on-condition.ly
git commit -a
```

Edit more files. Commit them again. Edit yet more files, commit them again. Go eat dinner. Switch to `master` so you can play with the latest changes from other developers. Switch back to your branch and edit some more. Commit those changes.

At this stage, don't worry about how many commits you have.

Save commits to external files

Branches are nerve-wracking until you get used to them. You can save your hard work as individual '`.patch`' files. Be sure to commit your changes first.

```
git commit -a
git format-patch master
```

I personally have between 4 and 20 of those files saved in a special folder at any point in time. Git experts might laugh as that behavior, but I feel a *lot* better knowing that I've got those backups.

Prepare your branch for review

After committing, you can update your branch with the latest master:

```
git commit -a
git checkout master
git pull -r origin master
git checkout dev/cg
git rebase master
```

Due to the speed of lilypond development, sometimes `master` has changed so much that your branch can no longer be applied to it. In that happens, you will have a merge conflict. Stop for a moment to either cry or have a stiff drink, then proceed to Section 3.4.1 [Merge conflicts], page 27.

Upload your branch

Finally, you're finished your changes. Time to upload for review. Make sure that you're on your branch, then upload:

```
git checkout dev/cg
git-cl upload master
```

Wait for reviews

While you're waiting for a countdown and reviews, go back to master, make a `dev/doc-beams` branch, and start adding doc suggestions from issue 12345 from the tracker. Or make a `dev/page-breaks` and fix bug in page breaking. Or whatever. Don't worry, your `dev/cg` is safe.

Combining commits (optional unless you have broken commits)

Does the history of your branch look good?

```
gitk
```

If you have a lot of commits on your branch, you might want to combine some of them. Alternately, you may like your commits, but want to edit the commit messages.

```
git rebase -i master
```

Follow instructions on the screen.

> **Note:** This step gives you the power to completely lose your work. Make a backup of your commits by saving them to '`.patch`' files before playing with this. If you do lose your work, don't despair. You can get it back by using `git reflog`. The use of `git reflog` is not covered here.

> **Note:** If any of the commits on your branch represent partial work that will not pass *make && make doc*, you **must** squash these commits into a working commit. Otherwise, your push will break staging and will not be able to be merged to master. In general, you will be safer to have one commit per push.

Push to staging

When you've got the coveted `Patch-push` status, time to prepare your upload:

```
git fetch
git rebase origin/staging dev/cg~0
```

```
gitk HEAD
```

> **Note:** Do not skip the `gitk` step; a quick 5-second check of the visual history can save a great deal of frustration later on. You should see a set of your commits that are ahead of `origin/staging`, with no label for the top commit – only a SHA1 id.

> **Note:** If `origin/staging` and `origin/master` are the same commit, your branch (`dev/cg` in the example) will also be at the top of the `gitk` tree. This is normal.

If everything looks good, push it:

```
git push origin HEAD:staging
```

Then change back to your working branch:

```
git checkout dev/cg
```

> **Note:** It is a best practice to avoid rebasing any of your branches to `origin/staging`. If `origin/staging` is broken, it will be deleted and rebuilt. If you have rebased one of your branches to `origin/staging`, the broken commits can end up in your branch. The commands given above do the rebase on a temporary branch, and avoid changing your working branch.

Delete your branch (safe)

After a few hours, if there's nothing wrong with your branch, it should be automatically moved to `origin/master`. Update, then try removing your branch:

```
git checkout master
git pull -r origin master
git branch -d dev/cg
```

The last command will fail if the contents of `dev/cg` are not present in `origin/master`.

Delete your branch (UNSAFE)

Sometimes everything goes wrong. If you want to remove a branch even though it will cause your work to be lost (that is, if the contents of `dev/cg` are **not** present in master), follow the instructions in "Delete your branch (safe)", but replace the `-d` on the final line with a `-D`.

3.2.3 Other repositories

We have a few other code repositories.

lilypond-extra

There is a separate repository for general administrative scripts, as well as pictures and media files for the website. People interested in working on the website should download this repository, and set their `$LILYPOND_WEB_MEDIA_GIT` environment variable to point to that repository.

```
https://github.com/gperciva/lilypond-extra
```

To configure an environment variable in bash (the default for most GNU/Linux distributions),

```
export LILYPOND_WEB_MEDIA_GIT=$HOME/dir/of/lilypond-extra/
```

Be aware that `lilypond-extra` is the definitive source for some binary files - in particular PDF versions of papers concerning LilyPond. To add further PDFs of this sort, all that is necessary is to add the PDF to `lilypond-extra` and then add a reference to it in the documentation. The file will then be copied to the website when `make website` is run.

However, pictures that are also used in the documentation build are mastered in the main git repository. If any of these is changed, it should be updated in git, and then the updates copied to `lilypond-extra`.

Grand Unified Builder (GUB)

Another item of interest might be the Grand Unified Builder, our cross-platform building tool. Since it is used by other projects as well, it is not stored in our gub repository. For more info, see http://lilypond.org/gub.

There are two locations for this repository: the version being used to build lilypond, which is at

http://github.com/gperciva/gub

and the original version by Jan Nieuwenhuizen, kept at

http://github.com/janneke/gub

lilypad

Our binary releases on MacOS X and Windows contain a lightweight text editor. This code is here:

`https://github.com/gperciva/lilypad`

yet more repositories

There are a few other repositories floating around, which will hopefully be documented in the near future.

3.2.4 Downloading remote branches

> **Note:** contains obsolete + misleading info

Organization of remote branches

The main LilyPond repository is organized into *branches* to facilitate development. These are often called *remote* branches to distinguish them from *local* branches you might create yourself (see Section 3.3.3 [Using local branches], page 21).

The `master` branch contains all the source files used to build LilyPond, which includes the program itself (both stable and development releases), the documentation (and its translations), and the website. Generally, the `master` branch is expected to compile successfully.

The `translation` branch is a side branch that allows translators to work without needing to worry about compilation problems. Periodically, the Translation Meister (after verifying that it doesn't break compilation), will *merge* this branch into `staging` to incorporate recent translations. Similarly, the `master` branch is usually merged into the `translation` branch after significant changes to the English documentation. See Section 5.8 [Translating the documentation], page 68 for details.

LilyPond repository sources

The recommended source for downloading a copy of the main repository is:

```
git://git.sv.gnu.org/lilypond.git
```

However, if your internet router filters out connections using the GIT protocol, or if you experience difficulty connecting via GIT, you can try these other sources:

```
ssh://git.sv.gnu.org/srv/git/lilypond.git
http://git.sv.gnu.org/r/lilypond.git
```

The SSH protocol can only be used if your system is properly set up to use it. Also, the HTTP protocol is slowest, so it should only be used as a last resort.

Downloading individual branches

> **Note:** obsolete, should be deleted!

Once you have initialized an empty Git repository on your system (see [Initializing a repository], page 13), you can download a remote branch into it. Make sure you know which branch you want to start with.

To download the `master` branch, enter the following:

```
git remote add -ft master -m master \
  origin git://git.sv.gnu.org/lilypond.git/
```

To download the `translation` branch, enter:

```
git remote add -ft translation -m \
  translation origin git://git.sv.gnu.org/lilypond.git/
```

The `git remote add` process could take up to ten minutes, depending on the speed of your connection. The output will be something like this:

```
Updating origin
remote: Counting objects: 235967, done.
remote: Compressing objects: 100% (42721/42721), done.
remote: Total 235967 (delta 195098), reused 233311 (delta 192772)
Receiving objects: 100% (235967/235967), 68.37 MiB | 479 KiB/s, done.
Resolving deltas: 100% (195098/195098), done.
From git://git.sv.gnu.org/lilypond
 * [new branch]      master     -> origin/master
From git://git.sv.gnu.org/lilypond
 * [new tag]         flower/1.0.1 -> flower/1.0.1
 * [new tag]         flower/1.0.10 -> flower/1.0.10

 * [new tag]         release/2.9.6 -> release/2.9.6
 * [new tag]         release/2.9.7 -> release/2.9.7
```

When `git remote add` is finished, the remote branch should be downloaded into your repository—though not yet in a form that you can use. In order to browse the source code files, you need to *create* and *checkout* your own local branch. In this case, however, it is easier to have Git create the branch automatically by using the `checkout` command on a non-existent branch. Enter the following:

```
git checkout -b branch origin/branch
```

where *`branch`* is the name of your tracking branch, either `master` or `translation`.

Git will issue some warnings; this is normal:

```
warning: You appear to be on a branch yet to be born.
warning: Forcing checkout of origin/master.
Branch master set up to track remote branch master from origin.
```

```
Already on 'master'
```

By now the source files should be accessible—you should be able to edit any files in the '`$LILYPOND_GIT`' directory using a text editor of your choice. But don't start just yet! Before editing any source files, learn how to keep your changes organized and prevent problems later—read Section 3.3 [Basic Git procedures], page 20.

Technical Details

The `git remote add` command should add some lines to your local repository's '`.git/config`' file:

```
[remote "origin"]
        url = git://git.sv.gnu.org/lilypond.git/
        fetch = +refs/heads/master:refs/remotes/origin/master
```

Downloading all remote branches

To download all remote branches at once, you can `clone` the entire repository:

```
git clone git://git.sv.gnu.org/lilypond.git
```

Other branches

Most contributors will never need to touch the other branches. If you wish to do so, you will need more familiarity with Git; please see Section 3.7 [Other Git documentation], page 40.

- `dev/XYZ`: These branches are for individual developers. They store code which is not yet stable enough to be added to the `master` branch.
- `stable/XYZ`: The branches are kept for archival reasons.
- `archive/XYZ`: The branches are kept for archival reasons.

3.3 Basic Git procedures

3.3.1 The Git contributor's cycle

Here is a simplified view of the contribution process on Git:

1. Update your local repository by *pulling* the most recent updates from the remote repository.
2. Edit source files within your local repository's *working directory*.
3. *Commit* the changes you've made to a local *branch*.
4. Generate a *patch* to share your changes with the developers.

3.3.2 Pulling and rebasing

When developers push new patches to the `git.sv.gnu.org` repository, your local repository is **not** automatically updated. It is important to keep your repository up-to-date by periodically *pulling* the most recent *commits* from the remote branch. Developers expect patches to be as current as possible, since outdated patches require extra work before they can be used.

Occasionally you may need to rework some of your own modifications to match changes made to the remote branch (see Section 3.4.3 [Resolving conflicts], page 28), and it's considerably easier to rework things incrementally. If you don't update your repository along the way, you may have to spend a lot of time resolving branch conflicts and reconfiguring much of the work you've already done.

Fortunately, Git is able to resolve certain types of branch conflicts automatically with a process called *rebasing*. When rebasing, Git tries to modify your old commits so they appear as new commits (based on the latest updates). For a more involved explanation, see the `git-rebase` man page.

To pull without rebasing (recommended for translators), use the following command:

```
git pull    # recommended for translators
```

If you're tracking the remote `master` branch, you should add the '`-r`' option (short for '`--rebase`') to keep commits on your local branch current:

```
git pull -r # use with caution when translating
```

If you don't edit translated documentation and don't want to type '`-r`' every time, configure the master branch to rebase by default with this command:

```
git config branch.master.rebase true
```

If pull fails because of a message like

```
error: Your local changes to 'Documentation/learning/tutorial.itely'
would be overwritten by merge.  Aborting.
```

or

```
Documentation/learning/tutorial.itely: needs update
refusing to pull with rebase: your working tree is not up-to-date
```

it means that you have modified some files in you working tree without committing changes (see Section 3.3.4 [Commits and patches], page 22); you can use the `git stash` command to work around this:

```
git stash      # save uncommitted changes
git pull -r    # pull using rebase (translators omit "-r")
git stash pop  # reapply previously saved changes
```

Note that `git stash pop` will try to apply a patch, and this may create a conflict. If this happens, see Section 3.4.3 [Resolving conflicts], page 28.

TODO: I think the next paragraph is confusing. Perhaps prepare the reader for new terms 'committish' and 'head'? -mp

> **Note:** translators and documentation editors, if you have changed committishes in the head of translated files using commits you have not yet pushed to `git.sv.gnu.org`, please do not rebase. If you want to avoid wondering whether you should rebase each time you pull, please always use committishes from master and/or translation branch on `git.sv.gnu.org`, which in particular implies that you must push your changes to documentation except committishes updates (possibly after having rebased), then update the committishes and push them.

TODO: when committishes automatic conditional update have been tested and documented, append the following to the warning above: Note that using update-committishes make target generally touches committishes.

Technical details

The `git config` command mentioned above adds the line `rebase = true` to the master branch in your local repository's '`.git/config`' file:

```
[branch "master"]
        remote = origin
        merge = refs/heads/master
        rebase = true
```

3.3.3 Using local branches

Creating and removing branches

Local branches are useful when you're working on several different projects concurrently. To create a new branch, enter:

```
git branch name
```

To delete a branch, enter:

```
git branch -d name
```

Git will ask you for confirmation if it sees that data would be lost by deleting the branch. Use '`-D`' instead of '`-d`' to bypass this. Note that you cannot delete a branch if it is currently checked out.

Listing branches and remotes

You can get the exact path or URL of all remote branches by running:

```
git remote -v
```

To list Git branches on your local repositories, run

```
git branch     # list local branches only
git branch -r  # list remote branches
git branch -a  # list all branches
```

Checking out branches

To know the currently checked out branch, i.e. the branch whose source files are present in your working tree, read the first line of the output of

```
git status
```

The currently checked out branch is also marked with an asterisk in the output of `git branch`.

You can check out another branch *`other_branch`*, i.e. check out *`other_branch`* to the working tree, by running

```
git checkout other_branch
```

Note that it is possible to check out another branch while having uncommitted changes, but it is not recommended unless you know what you are doing; it is recommended to run `git status` to check this kind of issue before checking out another branch.

Merging branches

To merge branch *`foo`* into branch *`bar`*, i.e. to "add" all changes made in branch *`foo`* to branch *`bar`*, run

```
git checkout bar
git merge foo
```

If any conflict happens, see Section 3.4.3 [Resolving conflicts], page 28.

There are common usage cases for merging: as a translator, you will often want the Translations meister to merge `master` into `translation`; on the other hand, the Translations meister wants to merge `translation` into `staging` whenever he has checked that `translation` builds successfully.

3.3.4 Commits and patches

Understanding commits

Technically, a *commit* is a single point in the history of a branch, but most developers use the term to mean a *commit object*, which stores information about a particular revision. A single commit can record changes to multiple source files, and typically represents one logical set of related changes (such as a bug-fix). You can list the ten most recent commits in your current branch with this command:

```
git log -10 --oneline
```

If you're using an older version of Git and get an 'unrecognized argument' error, use this instead:

```
git log -10 --pretty=oneline --abbrev-commit
```

More interactive lists of the commits on the remote `master` branch are available at http://git.sv.gnu.org/gitweb/?p=lilypond.git;a=shortlog and http://git.sv.gnu.org/cgit/lilypond.git/log/.

Making commits

Once you have modified some source files in your working directory, you can make a commit with the following procedure:

1. Make sure you've configured Git properly (see [Configuring Git], page 13). Check that your changes meet the requirements described in Section 10.5 [Code style], page 109 and/or Section 5.4 [Documentation policy], page 63. For advanced edits, you may also want to verify that the changes don't break the compilation process.
2. Run the following command:

   ```
   git status
   ```

   to make sure you're on the right branch, and to see which files have been modified, added or removed, etc. You may need to tell Git about any files you've added by running one of these:

   ```
   git add file  # add untracked file individually
   git add .     # add all untracked files in current directory
   ```

   After `git add`, run `git status` again to make sure you got everything. You may also need to modify '`GNUmakefile`'.
3. Preview the changes about to be committed (to make sure everything looks right) with:

   ```
   git diff HEAD
   ```

   The `HEAD` argument refers to the most recent commit on the currently checked-out branch.
4. Generate the commit with:

   ```
   git commit -a
   ```

   The '`-a`' is short for '`--all`' which includes modified and deleted files, but only those newly created files that have previously been added.

Commit messages

When you run the `git commit -a` command, Git automatically opens the default text editor so you can enter a *commit message*. If you find yourself in a foreign editing environment, you're probably in `vi` or `vim`. If you want to switch to an editor you're more familiar with, quit by typing `:q!` and pressing `<Enter>`. See [Configuring Git], page 13 for instructions on changing the default editor.

In any case, Git will open a text file for your commit message that looks like this:

```
# Please enter the commit message for your changes.  Lines starting
# with '#' will be ignored, and an empty message aborts the commit.
# On branch master
# Changes to be committed:
#   (use "git reset HEAD <file>..." to unstage)
#
# modified:   working.itexi
#
```

Your commit message should begin with a one-line summary describing the change (no more than 50 characters long), and if necessary a blank line followed by several lines giving the details:

```
Doc: add Baerenreiter and Henle solo cello suites

Added comparison of solo cello suite engravings to new essay with
high-res images, fixed cropping on Finale example.
```

Commit messages often start with a short prefix describing the general location of the changes. If a commit affects the documentation in English (or in several languages simultaneously) the commit message should be prefixed with "Doc: ". If the commit affects only one of the translations, the commit message should be prefixed with "Doc-**: ", where ** is the two-letter language code. Commits that affect the website should use "Web: " for English, and "Web-**: " for the other languages. Also, changes to a single file are often prefixed with the name of the file involved. Visit the links listed in [Understanding commits], page 22 for examples.

Making patches

If you want to share your changes with other contributors and developers, you need to generate *patches* from your commits. We prefer it if you follow the instructions in [Uploading a patch for review], page 24. However, we present an alternate method here.

You should always run `git pull -r` (translators should leave off the '`-r`') before doing this to ensure that your patches are as current as possible.

Once you have made one or more commits in your local repository, and pulled the most recent commits from the remote branch, you can generate patches from your local commits with the command:

```
git format-patch origin
```

The `origin` argument refers to the remote tracking branch at `git.sv.gnu.org`. This command generates a separate patch for each commit that's in the current branch but not in the remote branch. Patches are placed in the current working directory and will have names that look something like this:

```
0001-Doc-Fix-typos.patch
0002-Web-Remove-dead-links.patch
```

Send an email (must be less than 64 KB) to `lilypond-devel@gnu.org` briefly explaining your work, with the patch files attached. Translators should send patches to `translations@lilynet.net`. After your patches are reviewed, the developers may push one or more of them to the main repository or discuss them with you.

Uploading a patch for review

Any non-trivial change should be uploaded to our "Rietveld" code review website:

`http://codereview.appspot.com/`

`git-cl` install

LilyDev users should skip over these 'install' instructions.

1. Install `git-cl` by entering:

   ```
   git clone https://github.com/gperciva/git-cl.git
   ```

   If that command fails for some reason, try this instead:

   ```
   git clone git://github.com/gperciva/git-cl.git
   ```

2. Add the '`git-cl/`' directory to your PATH, or create a symbolic link to the `git-cl` and `upload.py` scripts in one of your PATH directories (such as '`$HOME/bin`').

In Ubuntu (and LilyDev), you can add directories to PATH by adding this line to a hidden file '`.bashrc`', located in your home directory:

```
PATH=~/type-here-directory-containing-git-cl:"${PATH}"
```

`git-cl` configuration

LilyDev users should perform these 'configuration' instructions.

1. You must have a google account; please create one if you do not have one already.

   Note that a google account does not need to be a gmail account; you can use any email address for your google account when you sign up.

2. Move into the top source directory and then configure `git cl` with the following commands:

   ```
   cd $LILYPOND_GIT
   git cl config
   ```

   For the "Rietveld server" question, the default value ("codereview.appspot.com") should be accepted by answering with a newline (CR).

   The "CC list" question should be answered with:

   ```
   lilypond-devel@gnu.org
   ```

   The "Tree status URL" value should be left blank. So should the "ViewVC URL" value, since it is used by `git cl dcommit` which is only for repositories which use `git svn` (LilyPond doesn't).

Uploading patch set

> **Note:** Unless you are familiar with branches, only work on one set of changes at once.

There are two methods, depending on your git setup.

- **Master branch**: (easy option, and used in `lily-git.tcl`)

  If you added your patch to `master`, then:

  ```
  git pull -r
  git cl upload origin/master
  ```

  If you have git push ability, make sure that you *remove* your patch (with `git rebase` or `git reset`) before pushing other stuff.

  Notifications of patches are automatically added to our issue tracker to reduce the chance of patches getting lost. To suppress this (not recommended), add the `-n / --no-code-issue` option.

- **Separate branch**: (complicated option)

  Ensure your changes are committed in a separate branch, which should differ from the reference branch to be used by just the changes to be uploaded. If the reference branch is to be origin/master, ensure this is up-to-date. If necessary, use git rebase to rebase the branch containing the changes to the head of origin/master. Finally, check out branch with the changes and enter the command:

  ```
  git cl upload <reference SHA1 ID>
  ```

  where <reference SHA1 ID> is the SHA1 ID of the commit to be used as a reference source for the patch. Generally, this will be the SHA1 ID of origin/master, and in that case the command:

  ```
  git cl upload origin/master
  ```

  can be used.

First you will see a terminal editor where you can edit the message that will accompany your patch. `git-cl` will respect the `EDITOR` environment variable if defined, otherwise it will use `vi` as the default editor.

After prompting for your Google email address and password, the patch set will be posted to Rietveld, and you will be given a URL for your patch.

> **Note:** Some installations of git-cl fail when uploading a patch with certain filename extensions. If this happens, it can generally be fixed by editing the list of exceptions at top of '`git-cl.py`'.

Announcing your patch set

You should then announce the patch by logging into the code review issue webpage and using "Publish + Mail Comments" to add a (mostly bogus) comment to your issue. The text of your comment will be sent to our developer mailing list.

> **Note:** There is no automatic notification of a new patch; you must add a comment yourself.

Revisions

As revisions are made in response to comments, successive patch sets for the same issue can be uploaded by reissuing the git-cl command with the modified branch checked out.

Sometimes in response to comments on revisions, the best way to work may require creation of a new branch in git. In order to associate the new branch with an existing Rietveld issue, the following command can be used:

```
git cl issue issue-number
```

where `issue-number` is the number of the existing Rietveld issue.

Resetting git cl

If `git cl` becomes confused, you can "reset" it by running:

```
git cl issue 0
```

Wait for a countdown

Your patch will be available for reviews for the next few hours or days. Three times a week, patches with no known problems are gathered into a "patch countdown" and their status changed to `patch-countdown`. The countdown is a 48-hour waiting period in which any final reviews or complaints should be made.

During the countdown, your patch may be set to `patch-needs_work`, indicating that you should fix something (or at least discuss why the patch needs no modification). If no problems are found, the patch will be set to `patch-push`.

Once a patch has `patch-push`, it should be sent to your mentor for uploading. If you have git push ability, look at Section 3.4.11 [Pushing to staging], page 33.

3.4 Advanced Git procedures

> **Note:** This section is not necessary for normal contributors; these commands are presented for information for people interested in learning more about git.

It is possible to work with several branches on the same local Git repository; this is especially useful for translators who may have to deal with both `translation` and a stable branch, e.g. `stable/2.12`.

Some Git commands are introduced first, then a workflow with several Git branches of LilyPond source code is presented.

3.4.1 Merge conflicts

To be filled in later, and/or moved to a different section. I just wanted to make sure that I had a stub ready somewhere.

3.4.2 Advanced Git concepts

A bit of Git vocabulary will be explained below. The following is only introductory; for a better understanding of Git concepts, you may wish to read Section 3.7 [Other Git documentation], page 40.

The `git pull origin` command above is just a shortcut for this command:

```
git pull git://git.sv.gnu.org/lilypond.git/ branch:origin/branch
```

where *`branch`* is typically `master` or `translation`; if you do not know or remember, see Section 3.2.4 [Downloading remote branches], page 18 to remember which commands you issued or which source code you wanted to get.

A *commit* is a set of changes made to the sources; it also includes the committish of the parent commit, the name and e-mail of the *author* (the person who wrote the changes), the name and e-mail of the *committer* (the person who brings these changes into the Git repository), and a commit message.

A *committish* is the SHA1 checksum of a commit, a number made of 40 hexadecimal digits, which acts as the internal unique identifier for this commit. To refer to a particular revision, don't use vague references like the (approximative) date, simply copy and paste the committish.

A *branch* is nothing more than a pointer to a particular commit, which is called the *head* of the branch; when referring to a branch, one often actually thinks about its head and the ancestor commits of the head.

Now we will explain the two last commands you used to get the source code from Git—see [Downloading individual branches], page 19.

```
git remote add -ft branch -m branch \
  origin git://git.sv.gnu.org/lilypond.git/

git checkout -b branch origin/branch
```

The `git remote` has created a branch called `origin/branch` in your local Git repository. As this branch is a copy of the remote branch web from git.sv.gnu.org LilyPond repository, it is called a *remote branch*, and is meant to track the changes on the branch from git.sv.gnu.org: it will be updated every time you run `git pull origin` or `git fetch origin`.

The `git checkout` command has created a branch named *`branch`*. At the beginning, this branch is identical to `origin/branch`, but it will differ as soon as you make changes, e.g. adding newly translated pages or editing some documentation or code source file. Whenever you pull, you merge the changes from `origin/branch` and *`branch`* since the last pulling. If you do not have push (i.e. "write") access on git.sv.gnu.org, your *`branch`* will always differ from `origin/branch`. In this case, remember that other people working like you with the remote branch *`branch`* of git://git.sv.gnu.org/lilypond.git/ (called `origin/branch` on your local repository) know nothing about your own *`branch`*: this means that whenever you use a committish or make a patch, others expect you to take the latest commit of `origin/branch` as a reference.

Finally, please remember to read the man page of every Git command you will find in this manual in case you want to discover alternate methods or just understand how it works.

3.4.3 Resolving conflicts

Occasionally an update may result in conflicts – this happens when you and somebody else have modified the same part of the same file and git cannot figure out how to merge the two versions together. When this happens, you must manually merge the two versions.

If you need some documentation to understand and resolve conflicts, see paragraphs *How conflicts are presented* and *How to resolve conflicts* in `git merge` man page.

If all else fails, you can follow the instructions in Section 3.4.4 [Reverting all local changes], page 28. Be aware that this eliminates any changes you have made!

3.4.4 Reverting all local changes

Sometimes git will become hopelessly confused, and you just want to get back to a known, stable state. This command destroys any local changes you have made in the currently checked-out branch, but at least you get back to the current online version:

```
git reset --hard origin/master
```

3.4.5 Working with remote branches

Fetching new branches from git.sv.gnu.org

To fetch and check out a new branch named *`branch`* on git.sv.gnu.org, run from top of the Git repository

```
git config --add remote.origin.fetch \
  +refs/heads/branch:refs/remotes/origin/branch

git checkout --track -b branch origin/branch
```

After this, you can pull *`branch`* from git.sv.gnu.org with:

```
git pull
```

Note that this command generally fetches all branches you added with `git remote add` (when you initialized the repository) or `git config --add`, i.e. it updates all remote branches from remote `origin`, then it merges the remote branch tracked by the current branch into the current branch. For example, if your current branch is `master`, `origin/master` will be merged into `master`.

Local clones, or having several working trees

If you play with several Git branches, e.g. `master`, `translation`, `stable/2.12`), you may want to have one source and build tree for each branch; this is possible with subdirectories of your local Git repository, used as local cloned subrepositories. To create a local clone for the branch named *`branch`*, run

```
git checkout branch
git clone -lsn . subdir
cd subdir
git reset --hard
```

Note that *`subdir`* must be a directory name which does not already exist. In *`subdir`*, you can use all Git commands to browse revisions history, commit and uncommit changes; to update the cloned subrepository with changes made on the main repository, cd into *`subdir`* and run `git pull`; to send changes made on the subrepository back to the main repository, run `git push` from *`subdir`*. Note that only one branch (the currently checked out branch) is created in the subrepository by default; it is possible to have several branches in a subrepository and do usual operations (checkout, merge, create, delete...) on these branches, but this possibility is not detailed here.

When you push *branch* from *subdir* to the main repository, and *branch* is checked out in the main repository, you must save uncommitted changes (see `git stash`) and do `git reset --hard` in the main repository in order to apply pushed changes in the working tree of the main repository.

3.4.6 Git log

The commands above don't only bring you the latest version of the sources, but also the full history of revisions (revisions, also called commits, are changes made to the sources), stored in the '`.git`' directory. You can browse this history with

```
git log     # only shows the logs (author, committish and commit message)
git log -p  # also shows diffs
gitk        # shows history graphically
```

> **Note:** The `gitk` command may require a separate `gitk` package, available in the appropriate distribution's repositories.

3.4.7 Applying remote patches

TODO: Explain how to determine if a patch was created with `git format-patch`.

Well-formed git patches created with `git format-patch` should be committed with the following command:

```
git am patch
```

Patches created without `git format-patch` can be applied in two steps. The first step is to apply the patch to the working tree and the index:

```
git apply --index patch
```

The second step is to commit the changes and give credit to the author of the patch. This can be done with the following command:

```
git commit --author="John Smith <john@example.com>"
```

Please note that using the `--index` option for patching is quite important here and *cannot* reliably be replaced by using the `-a` option when committing: that would only commit files from the working tree that are already registered with git, so every file that the patch actually *adds*, like a regtest for a fixed bug, would get lost. For the same reason, you should not use the git-independent '`patch`' program for applying patches.

3.4.8 Sending and receiving patches via email

The default `x-diff` MIME type associated with patch files (i.e., files whose name ends in `.patch`) means that the encoding of line endings may be changed from UNIX to DOS format when they are sent as attachments. Attempting to apply such an inadvertently altered patch will cause git to fail with a message about 'whitespace errors'.

The solution to such problems is surprisingly simple—just change the default file extension of patches generated by git to end in `.txt`, for example:

```
git config format.suffix '.patch.txt'
```

This should cause email programs to apply the correct base64 encoding to attached patches.

If you receive a patch with DOS instead of UNIX line-endings, it can be converted back using the `dos2unix` utility.

Lots of useful information on email complications with patches is provided on the Wine wiki at http://wiki.winehq.org/GitWine.

3.4.9 Cleaning up multiple patches

If you have been developing on your own branch for a while, you may have more commmits than is really sensible. To revise your work and condense commits, use:

```
git rebase origin/master
git rebase -i origin/master
```

> **Note:** Be a bit cautious – if you completely remove commits during the interactive session, you will... err... completely remove those commits.

3.4.10 Commit access

Most contributors are not able to commit patches directly to the main repository—only members of the LilyPond development team have *commit access*. If you are a contributor and are interested in joining the development team, contact the Project Manager through the mailing list (lilypond-devel@gnu.org). Generally, only contributors who have already provided a number of patches which have been pushed to the main repository will be considered for membership.

If you have been approved by the Project Manager, use the following procedure to obtain commit access:

1. If you don't already have one, set up a Savannah user account at https://savannah.gnu.org/account/register.php. If your web browser responds with an "untrusted connection" message when you visit the link, follow the steps for including the CAcert root certificate in your browser, given at http://savannah.gnu.org/tls/tutorial/.

   > **Note:** Savannah will silently put your username in lower-case – do not try to use capital letters.

2. After registering, if you are not logged in automatically, login at https://savannah.gnu.org/account/login.php—this should take you to your "my" page (https://savannah.gnu.org/my/).
3. Click on the "My Groups" link to access the "My Group Membership" page. From there, find the "Request for Inclusion" box and search for "LilyPond". Among the search results, check the box labeled "GNU LilyPond Music Typesetter" and write a brief (required) message for the Project Manager ("Hey it's me!" should be fine).

   Note that you will not have commit access until the Project Manager activates your membership. Once your membership is activated, LilyPond should appear under the heading "Groups I'm Contributor of" on your "My Group Membership" page.
4. Generate an SSH 'rsa' key pair. Enter the following at the command prompt:

   ```
   ssh-keygen -t rsa
   ```

   When prompted for a location to save the key, press <ENTER> to accept the default location ('`~/.ssh/id_rsa`').

   Next you are asked to enter an optional passphrase. On most systems, if you use a passphrase, you will likely be prompted for it every time you use `git push` or `git pull`. You may prefer this since it can protect you from your own mistakes (like pushing when you mean to pull), though you may find it tedious to keep re-entering it.

   You can change/enable/disable your passphrase at any time with:

   ```
   ssh-keygen -f ~/.ssh/id_rsa -p
   ```

   Note that the GNOME desktop has a feature which stores your passphrase for you for an entire GNOME session. If you use a passphrase to "protect you from yourself", you

will want to disable this feature, since you'll only be prompted once. Run the following command, then logout of GNOME and log back in:

```
gconftool-2 --set -t bool \
  /apps/gnome-keyring/daemon-components/ssh false
```

After setting up your passphrase, your private key is saved as '`~/.ssh/id_rsa`' and your public key is saved as '`~/.ssh/id_rsa.pub`'.

5. Register your public SSH 'rsa' key with Savannah. From the "My Account Configuration" page, click on "Edit SSH Keys", then paste the contents of your '`~/.ssh/id_rsa.pub`' file into one of the "Authorized keys" text fields, and click "Update".

   Savannah should respond with something like:

   ```
   Success: Key #1 seen Keys registered
   ```

6. Configure Git to use the SSH protocol (instead of the GIT protocol). From your local Git repository, enter:

   ```
   git config remote.origin.url \
     ssh://user@git.sv.gnu.org/srv/git/lilypond.git
   ```

   replacing *user* with your Savannah username.

7. After your membership has been activated and you've configured Git to use SSH, test the connection with:

   ```
   git pull --verbose
   ```

   SSH should issue the following warning:

   ```
   The authenticity of host 'git.sv.gnu.org (140.186.70.72)' can't
   be established.
   RSA key fingerprint is
   80:5a:b0:0c:ec:93:66:29:49:7e:04:2b:fd:ba:2c:d5.
   Are you sure you want to continue connecting (yes/no)?
   ```

   Make sure the RSA key fingerprint displayed matches the one above. If it doesn't, respond "no" and check that you configured Git properly in the previous step. If it does match, respond "yes". SSH should then issue another warning:

   ```
   Warning: Permanently added 'git.sv.gnu.org,140.186.70.72' (RSA) to
   the list of known hosts.
   ```

   The list of known hosts is stored in the file '`~/.ssh/known_hosts`'.

   At this point, you are prompted for your passphrase if you have one, then Git will attempt a pull.

   If `git pull --verbose` fails, you should see error messages like these:

   ```
   Permission denied (publickey).
   fatal: The remote end hung up unexpectedly
   ```

   If you get the above error, you may have made a mistake when registering your SSH key at Savannah. If the key is properly registered, you probably just need to wait for the Savannah server to activate it. It usually takes a few minutes for the key to be active after registering it, but if it still doesn't work after an hour, ask for help on the mailing list.

   If `git pull --verbose` succeeds, the output will include a 'From' line that shows 'ssh' as the protocol:

   ```
   From ssh://git.sv.gnu.org/srv/git/lilypond
   ```

   If the protocol shown is not 'ssh', check that you configured Git properly in the previous step.

8. Test your commit access with a dry run:

> **Note:** Do not push directly to master; instead, push to staging. See Section 3.4.11 [Pushing to staging], page 33.

```
git push --dry-run --verbose
```

Note that recent versions of Git (Git 1.6.3 or later) will issue a big warning if the above command is used. The simplest solution is to tell Git to push all matching branches by default:

```
git config push.default matching
```

Then `git push` should work as before. For more details, consult the `git push` man page.

9. Repeat the steps from generating an RSA key through to testing your commit access, for each machine from which you will be making commits, or you may simply copy the files from your local '`~/.ssh`' folder to the same folder on the other machine.

Technical details

- On Firefox, to view or remove the CAcert root certificate, go to: Edit > Preferences > Advanced > Encryption > View Certificates > Authorities > Certificate Name > Root CA > CA Cert Signing Authority.
- The `git config` commands above should modify your local repository's '`.git/config`' file. These lines:

```
[remote "origin"]
        url = git://git.sv.gnu.org/lilypond.git/
```

should now be changed to:

```
[remote "origin"]
        url = ssh://user@git.sv.gnu.org/srv/git/lilypond.git
```

where *user* is your login name on Savannah.

- Similarly, the `git config push.default matching` command should add these lines to '`.git/config`':

```
[push]
        default = matching
```

Known issues and warnings

Encryption protocols, including ssh, generally do not permit packet fragmentation to avoid introducing a point of insecurity. This means that the maximum packet size must not exceed the smallest MTU (Maximum Transmission Unit) set in the routers along the path. This smallest MTU is determined by a procedure during call set-up which relies on the transmission over the path of ICMP packets. If any of the routers in the path block ICMP packets this mechanism fails, resulting in the possibility of packets being transmitted which exceed the MTU of one of the routers. If this happens the packet is discarded, causing the ssh session to hang, timeout or terminate with the error message

```
ssh: connect to host <host ip addr> port 22: Bad file number
fatal: The remote end hung up unexpectedly
```

depending on precisely when in the proceedings the first large packet is transmitted. Most routers on the internet have MTU set to 1500, but routers installed in homes to connect via broadband may use a slightly smaller MTU for efficient transmission over ATM. If this problem is encountered a possible work-around is to set the MTU in the local router to 1500.

3.4.11 Pushing to staging

Do not push directly to the git `master` branch. Instead, push to `staging`.

You will not see your patch on `origin/master` until some automatic tests have been run. These tests are run every couple of hours; please wait at least 12 hours before wondering if your patch has been lost. Note that you can check the commits on `origin/staging` by looking at the git web interface on savannah.

It may happen occasionally that the staging branch breaks automated testing. In this case the automatic move of staging material to master gets halted in order to avoid broken material entering master. This is a safety net. Please do not try breaking out from it by adding fixes on top of staging: in that case the whole sequence will end up in master after all, defeating the purpose of the system. The proper fix usually involves rewriting the staging branch and is best left to core developers after discussion on the developer list.

If your work is in a patch file

Assuming that your patch is in a file called '`0001-my-patch.patch`', and you are currently on git master, do:

```
git checkout staging
git pull -r
git am 0001-my-patch.patch
gitk
git push origin staging
git checkout master
```

> **Note:** Do not skip the `gitk` step; a quick 5-second check of the visual history can save a great deal of frustration later on. You should only see that `staging` is only 1 commit ahead of `origin/staging`.

If your work is in a branch

If you are working on branches and your work in is `my_branch_name`, then do:

```
git checkout staging
git pull -r
git merge my_branch_name
gitk
git push origin staging
```

> **Note:** Do not skip the `gitk` step; a quick 5-second check of the visual history can save a great deal of frustration later on. You should see that `staging` is only ahead of `origin/staging` by the commits from your branch.

3.5 Git on Windows

> **Note:** We heavily recommend that development be done with our virtual machine Section 2.1 [LilyDev], page 5.

TODO: Decide what to do with this... Pare it down? Move paragraphs next to analogous Unix instructions? -mp

3.5.1 Background to nomenclature

Git is a system for tracking the changes made to source files by a distributed set of editors. It is designed to work without a master repository, but we have chosen to have a master repository for LilyPond files. Editors hold a local copy of the master repository together with any changes they have made locally. Local changes are held in a local 'branch', of which there may be several, but these instructions assume you are using just one. The files visible in the local repository always correspond to those on the currently 'checked out' local branch.

Files are edited on a local branch, and in that state the changes are said to be 'unstaged'. When editing is complete, the changes are moved to being 'staged for commit', and finally the changes are 'committed' to the local branch. Once committed, the changes (called a 'commit') are given a unique 40-digit hexadecimal reference number called the 'Committish' or 'SHA1 ID' which identifies the commit to Git. Such committed changes can be sent to the master repository by 'pushing' them (if you have write permission) or by sending them by email to someone who has, either as a complete file or as a 'diff' or 'patch' (which send just the differences from the master repository).

3.5.2 Installing git

Obtain Git from http://code.google.com/p/msysgit/downloads/list (note, not msysGit, which is for Git developers and not PortableGit, which is not a full git installation) and install it.

Note that most users will not need to install SSH. That is not required until you have been granted direct push permissions to the master git repository.

Start Git by clicking on the desktop icon. This will bring up a command line bash shell. This may be unfamiliar to Windows users. If so, follow these instructions carefully. Commands are entered at a $ prompt and are terminated by keying a newline.

3.5.3 Initialising Git

Decide where you wish to place your local Git repository, creating the folders in Windows as necessary. Here we call the folder to contain the repository `[path]/Git`, but if you intend using Git for other projects a directory name like `lilypond-git` might be better. You will need to have space for around 100Mbytes.

Start the Git bash shell by clicking on the desk-top icon installed with Git and type

```
cd [path]/Git
```

to position the shell at your new Git repository.

Note: if [path] contains folders with names containing spaces use

```
cd "[path]/Git"
```

Then type

```
git init
```

to initialize your Git repository.

Then type (all on one line; the shell will wrap automatically)

```
git remote add -ft master origin git://git.sv.gnu.org/lilypond.git
```

to download the lilypond master files.

> **Note:** Be patient! Even on a broadband connection this can take 10 minutes or more. Wait for lots of [new tag] messages and the $ prompt.

We now need to generate a local copy of the downloaded files in a new local branch. Your local branch needs to have a name. It is usual to call it 'master' and we shall do that here.

To do this, type

```
git checkout -b master origin/master
```

This creates a second branch called 'master'. You will see two warnings (ignore these), and a message advising you that your local branch 'master' has been set up to track the remote branch. You now have two branches, a local branch called 'master', and a tracking branch called 'origin/master', which is a shortened form of 'remotes/origin/master'.

Return to Windows Explorer and look in your Git repository. You should see lots of folders. For example, the LilyPond documentation can be found in [path]/Git/Documentation/.

The Git bash shell is terminated by typing `exit` or by clicking on the usual Windows close-window widget.

3.5.4 Git GUI

Almost all subsequent work will use the Git Graphical User Interface, which avoids having to type command line commands. To start Git GUI first start the Git bash shell by clicking on the desktop icon, and type

```
cd [path]/Git
git gui
```

The Git GUI will open in a new window. It contains four panels and 7 pull-down menus. At this stage do not use any of the commands under Branch, Commit, Merge or Remote. These will be explained later.

The top panel on the left contains the names of files which you are in the process of editing (Unstaged Changes), and the lower panel on the left contains the names of files you have finished editing and have staged ready for committing (Staged Changes). At present, these panels will be empty as you have not yet made any changes to any file. After a file has been edited and saved the top panel on the right will display the differences between the edited file selected in one of the panels on the left and the last version committed on the current branch.

The panel at bottom right is used to enter a descriptive message about the change before committing it.

The Git GUI is terminated by entering CNTL-Q while it is the active window or by clicking on the usual Windows close-window widget.

3.5.5 Personalising your local git repository

Open the Git GUI, click on

```
Edit -> Options
```

and enter your name and email address in the left-hand (Git Repository) panel. Leave everything else unchanged and save it.

Note that Windows users must leave the default setting for line endings unchanged. All files in a git repository must have lines terminated by just a LF, as this is required for Merge to work, but Windows files are terminated by CRLF by default. The git default setting causes the line endings of files in a Windows git repository to be flipped automatically between LF and CRLF as required. This enables files to be edited by any Windows editor without causing problems in the git repository.

3.5.6 Checking out a branch

At this stage you have two branches in your local repository, both identical. To see them click on

```
Branch -> Checkout
```

You should have one local branch called 'master' and one tracking branch called 'origin/master'. The latter is your local copy of the 'remotes/origin/master' branch in the master LilyPond repository. The local 'master' branch is where you will make your local changes.

When a particular branch is selected, i.e., checked out, the files visible in your repository are changed to reflect the state of the files on that branch.

3.5.7 Updating files from 'remote/origin/master'

Before starting the editing of a file, ensure your local repository contains the latest version of the files in the remote repository by first clicking

```
Remote -> Fetch from -> origin
```

in the Git GUI.

This will place the latest version of every file, including all the changes made by others, into the 'origin/master' branch of the tracking branches in your git repository. You can see these files by checking out this branch, but you must *never* edit any files while this branch is checked out. Check out your local 'master' branch again.

You then need to merge these fetched files into your local 'master' branch by clicking on

```
Merge -> Local Merge
```

and if necessary select the local 'master' branch.

Note that a merge cannot be completed if you have made any local changes which have not yet been committed.

This merge will update all the files in the 'master' branch to reflect the current state of the 'origin/master' branch. If any of the changes conflict with changes you have made yourself recently you will be notified of the conflict (see below).

3.5.8 Editing files

First ensure your 'master' branch is checked out, then simply edit the files in your local Git repository with your favourite editor and save them back there. If any file contains non-ASCII characters ensure you save it in UTF-8 format. Git will detect any changes whenever you restart Git GUI and the file names will then be listed in the Unstaged Changes panel. Or you can click the Rescan button to refresh the panel contents at any time. You may break off and resume editing any time.

The changes you have made may be displayed in diff form in the top right-hand panel of Git GUI by clicking on the file name shown in one of the left panels.

When your editing is complete, move the files from being Unstaged to Staged by clicking the document symbol to the left of each name. If you change your mind it can be moved back by clicking on the ticked box to the left of the name.

Finally the changes you have made may be committed to your 'master' branch by entering a brief message in the Commit Message box and clicking the Commit button.

If you wish to amend your changes after a commit has been made, the original version and the changes you made in that commit may be recovered by selecting

```
Commit -> Amend Last Commit
```

or by checking the Amend Last Commit radio button at bottom right. This will return the changes to the Staged state, so further editing made be carried out within that commit. This must only be done *before* the changes have been Pushed or sent to your mentor for Pushing - after that it is too late and corrections have to be made as a separate commit.

3.5.9 Sending changes to 'remotes/origin/master'

If you do not have write access to 'remotes/origin/master' you will need to send your changes by email to someone who does.

First you need to create a diff or patch file containing your changes. To create this, the file must first be committed. Then terminate the Git GUI. In the git bash shell first cd to your Git repository with

```
cd [path]/Git
```

if necessary, then produce the patch with

```
git format-patch origin
```

This will create a patch file for all the locally committed files which differ from 'origin/master'. The patch file can be found in [path]/Git and will have a name formed from the commit message.

3.5.10 Resolving merge conflicts

As soon as you have committed a changed file your local `master` branch has diverged from `origin/master`, and will remain diverged until your changes have been committed in `remotes/origin/master` and Fetched back into your `origin/master` branch. Similarly, if a new commit has been made to `remotes/origin/master` by someone else and Fetched, your local `master` branch is divergent. You can detect a divergent branch by clicking on

```
Repository -> Visualise all branch history
```

This opens up a very useful new window called 'gitk'. Use this to browse all the commits made by yourself and others.

If the diagram at top left of the resulting window does not show your `master` tag on the same node as the `remotes/origin/master` tag your branch has diverged from `origin/master`. This is quite normal if files you have modified yourself have not yet been Pushed to `remotes/origin/master` and Fetched, or if files modified and committed by others have been Fetched since you last Merged `origin/master` into your local `master` branch.

If a file being merged from `origin/master` differs from one you have modified in a way that cannot be resolved automatically by git, Merge will report a Conflict which you must resolve by editing the file to create the version you wish to keep.

This could happen if the person updating `remotes/origin/master` for you has added some changes of his own before committing your changes to `remotes/origin/master`, or if someone else has changed the same file since you last fetched the file from `remotes/origin/master`.

Open the file in your editor and look for sections which are delimited with ...

[to be completed when I next have a merge conflict to be sure I give the right instructions -td]

3.5.11 Other actions

The instructions above describe the simplest way of using git on Windows. Other git facilities which may usefully supplement these include

- Using multiple local branches (Create, Rename, Delete)
- Resetting branches
- Cherry-picking commits
- Pushing commits to remote/origin/master
- Using gitk to review history

Once familiarity with using git on Windows has been gained the standard git manuals can be used to learn about these.

3.6 Repository directory structure

```
Prebuilt Documentation and packages are available from:

    http://www.lilypond.org

LilyPond development is hosted at:

    http://savannah.gnu.org/projects/lilypond

Here is a simple explanation of the directory layout for
LilyPond's source files.


.                                                 Toplevel READMEs, ChangeLog,
|                          build bootstrapping, patches
|                          for third party programs
|
|-- Documentation/       Top sources for manuals
|   |
|   |
|   |   INDIVIDUAL CHAPTERS FOR EACH MANUAL:
|   |
|   |-- contributor/     Contributor's Guide
|   |-- essay/           Essay on automated music engraving
|   |-- extending/       Extending
|   |-- learning/        Learning Manual
|   |-- notation/        Notation Reference
|   |-- usage/           Usage
|   |-- web/             The website
|   |
|   |
|   |   TRANSLATED MANUALS:
|   |     Each language's directory can contain...
|   |       1) translated versions of:
|   |          * top sources for manuals
|   |          * individual chapters for each manual
|   |       2) a texidocs/ directory for snippet translations
|   |
|   |-- cs/              Czech
|   |-- de/              German
|   |-- es/              Spanish
|   |-- fr/              French
|   |-- hu/              Hungarian
|   |-- it/              Italian
|   |-- ja/              Japanese
|   |-- nl/              Dutch
|   |-- zh/              Chinese
|   |
|   |
|   |   MISCELLANEOUS DOC STUFF:
|   |
```

```
|   |-- css/             CSS files for HTML docs
|   |-- included/        .ly files used in the manuals
|   |-- logo/            Web logo and "note" icon
|   |-- ly-examples/     .ly files for the "Examples" webpage
|   |-- misc/            Old announcements, ChangeLogs and NEWS
|   |-- pictures/        Images used (eps/jpg/png/svg)
|   |   `-- pdf/         (pdf)
|   |-- po/              Translated build/maintenance scripts
|   |-- snippets/        Auto-generated .ly snippets (from the LSR)
|   |   `-- new/         Snippets too new for the LSR
|   `-- topdocs/         AUTHORS, INSTALL, README
|
|
|   C++ SOURCES:
|
|-- flower/              A simple C++ library
|-- lily/                C++ sources for the LilyPond binary
|
|
|   LIBRARIES:
|
|-- ly/                  .ly \include files
|-- mf/                  MetaFont sources for Emmentaler fonts
|-- ps/                  PostScript library files
|-- scm/                 Scheme sources for LilyPond and subroutine files
|-- tex/                 TeX and texinfo library files
|
|
|   SCRIPTS:
|
|-- config/              Autoconf helpers for configure script
|-- python/              Python modules, MIDI module
|   `-- auxiliar/        Python modules for build/maintenance
|-- scripts/             End-user scripts (--> lilypond/usr/bin/)
|   |-- auxiliar/        Maintenance and non-essential build scripts
|   `-- build/           Essential build scripts
|
|
|   BUILD PROCESS:
|   (also see SCRIPTS section above)
|
|-- make/                Specific make subroutine files
|-- stepmake/            Generic make subroutine files
|
|
|   REGRESSION TESTS:
|
|-- input/
|   `-- regression/      .ly regression tests
|       |-- abc2ly/      .abc regression tests
|       |-- lilypond-book/  lilypond-book regression tests
|       |-- midi/        midi2ly regression tests
```

```
|       `-- musicxml/    .xml and .itexi regression tests
|
|
|   MISCELLANEOUS:
|
|-- elisp/               Emacs LilyPond mode and syntax coloring
|-- vim/                 Vi(M) LilyPond mode and syntax coloring
`-- po/                  Translations for binaries and end-user scripts
```

3.7 Other Git documentation

- Official git man pages: http://www.kernel.org/pub/software/scm/git/docs/
- More in-depth tutorials: http://git-scm.com/documentation
- Book about git: Pro Git
- Github help: http://help.github.com/ (very highly recommended by Graham)

4 Compiling

This chapter describes the process of compiling the LilyPond program from source files.

4.1 Overview of compiling

Compiling LilyPond from source is an involved process, and is only recommended for developers and packagers. Typical program users are instead encouraged to obtain the program from a package manager (on Unix) or by downloading a precompiled binary configured for a specific operating system. Pre-compiled binaries are available on the Section "Download" in *General Information* page.

Compiling LilyPond from source is necessary if you want to build, install, or test your own version of the program.

A successful compile can also be used to generate and install the documentation, incorporating any changes you may have made. However, a successful compile is not a requirement for generating the documentation. The documentation can be built using a Git repository in conjunction with a locally installed copy of the program. For more information, see [Building documentation without compiling], page 49.

Attempts to compile LilyPond natively on Windows have been unsuccessful, though a workaround is available (see Section "LilyDev" in *Contributor's Guide*).

4.2 Requirements

4.2.1 Requirements for running LilyPond

Running LilyPond requires proper installation of the following software:

- DejaVu fonts (normally installed by default)
- FontConfig (2.4.0 or newer)
- Freetype (2.1.10 or newer)
- Ghostscript (8.60 or newer)
- Guile (1.8.2 or newer)
- Pango (1.12 or newer)
- Python (2.4 or newer)

International fonts are required to create music with international text or lyrics.

4.2.2 Requirements for compiling LilyPond

Below is a full list of packages needed to build LilyPond. However, for most common distributions there is an easy way of installing most all build dependencies in one go:

Distribution	**Command**
Debian, Ubuntu	`sudo apt-get build-dep lilypond`
Fedora, RHEL	`sudo yum-builddep lilypond`
openSUSE, SLED	`sudo zypper --build-deps-only source-install lilypond`

- Everything listed in Section 4.2.1 [Requirements for running LilyPond], page 41
- Development packages for the above items (which should include header files and libraries).

  Red Hat Fedora:

```
guile-devel-version
fontconfig-devel-version
freetype-devel-version
pango-devel-version
python-devel-version
```

Debian GNU/Linux:

```
guile-version-dev
libfontconfig1-dev
libfreetype6-dev
libpango1.0-dev
pythonversion-dev
```

- Flex
- FontForge (20060125 or newer; 20100501 or newer is recommended; must be compiled with '`--enable-double`'. Failure to do so can lead to poor intersection calculations and poorly-rendered glyphs.)
- GNU Bison
- GNU Compiler Collection (3.4 or newer, 4.*x* recommended)
- GNU gettext (0.17 or newer)
- GNU Make (3.78 or newer)
- MetaFont (mf-nowin, mf, mfw or mfont binaries), usually packaged with TEX.
- MetaPost (mpost binary), usually packaged with TEX.
- Perl
- Texinfo (4.11 or newer)
- Type 1 utilities (1.33 or newer recommended)

4.2.3 Requirements for building documentation

You can view the documentation online at `http://www.lilypond.org/doc/`, but you can also build it locally. This process requires some additional tools and packages:

- Everything listed in Section 4.2.2 [Requirements for compiling LilyPond], page 41
- ImageMagick
- Netpbm
- gzip
- rsync
- Texi2HTML (1.82)
- International fonts

  Red Hat Fedora:

```
fonts-arabic
fonts-hebrew
fonts-ja
fonts-xorg-truetype
taipeifonts
ttfonts-ja
ttfonts-zh_CN
```

  Debian GNU/Linux:

```
emacs-intl-fonts
ttf-kochi-gothic
```

```
ttf-kochi-mincho
xfonts-bolkhov-75dpi
xfonts-cronyx-75dpi
xfonts-cronyx-100dpi
xfonts-intl-.*
```

4.3 Getting the source code

Downloading the Git repository

In general, developers compile LilyPond from within a local Git repository. Setting up a local Git repository is explained in Section "Starting with Git" in *Contributor's Guide*.

Downloading a source tarball

Packagers are encouraged to use source tarballs for compiling.

The tarball for the latest stable release is available on the Section "Source" in *General Information* page.

The latest source code snapshot is also available as a tarball from the GNU Savannah Git server.

All tagged releases (including legacy stable versions and the most recent development release) are available here:

`http://download.linuxaudio.org/lilypond/source/`

Download the tarball to your '`~/src/`' directory, or some other appropriate place.

> **Note:** Be careful where you unpack the tarball! Any subdirectories of the current folder named '`lilypond/`' or '`lilypond-x.y.z/`' (where *x.y.z* is the release number) will be overwritten if there is a name clash with the tarball.

Unpack the tarball with this command:

```
tar -xzf lilypond-x.y.z.tar.gz
```

This creates a subdirectory within the current directory called '`lilypond-x.y.z/`'. Once unpacked, the source files occupy about 40 MB of disk space.

Windows users wanting to look at the source code may have to download and install the free-software 7zip archiver to extract the tarball.

4.4 Configuring `make`

4.4.1 Running `./autogen.sh`

After you unpack the tarball (or download the Git repository), the contents of your top source directory should be similar to the current source tree listed at `http://git.sv.gnu.org/gitweb/?p=lilypond.git;a=tree`.

Next, you need to create the generated files; enter the following command from your top source directory:

```
./autogen.sh --noconfigure
```

This will generate a number of files and directories to aid configuration, such as '`configure`', '`README.txt`', etc.

Next, create the build directory with:

```
mkdir build/
cd build/
```

We heavily recommend building lilypond inside a separate directory with this method.

4.4.2 Running `../configure`

Configuration options

> **Note:** make sure that you are in the '`build/`' subdirectory of your source tree.

The `../configure` command (generated by `./autogen.sh`) provides many options for configuring `make`. To see them all, run:

```
../configure --help
```

Checking build dependencies

> **Note:** make sure that you are in the '`build/`' subdirectory of your source tree.

When `../configure` is run without any arguments, it will check to make sure your system has everything required for compilation:

```
../configure
```

If any build dependency is missing, `../configure` will return with:

```
ERROR: Please install required programs:  foo
```

The following message is issued if you are missing programs that are only needed for building the documentation:

```
WARNING: Please consider installing optional programs:  bar
```

If you intend to build the documentation locally, you will need to install or update these programs accordingly.

> **Note:** `../configure` may fail to issue warnings for certain documentation build requirements that are not met. If you experience problems when building the documentation, you may need to do a manual check of Section 4.2.3 [Requirements for building documentation], page 42.

Configuring target directories

> **Note:** make sure that you are in the '`build/`' subdirectory of your source tree.

If you intend to use your local build to install a local copy of the program, you will probably want to configure the installation directory. Here are the relevant lines taken from the output of `../configure --help`:

> By default, '`make install`' will install all the files in '`/usr/local/bin`', '`/usr/local/lib`' etc. You can specify an installation prefix other than '`/usr/local`' using "`--prefix`", for instance "`--prefix=$HOME`".

A typical installation prefix is '`$HOME/usr`':

```
../configure --prefix=$HOME/usr
```

Note that if you plan to install a local build on a system where you do not have root privileges, you will need to do something like this anyway—`make install` will only succeed if the

installation prefix points to a directory where you have write permission (such as your home directory). The installation directory will be automatically created if necessary.

The location of the `lilypond` command installed by this process will be '*prefix*`/bin/lilypond`'; you may want to add '*prefix*`/bin/`' to your `$PATH` if it is not already included.

It is also possible to specify separate installation directories for different types of program files. See the full output of `../configure --help` for more information.

If you encounter any problems, please see Section 4.7 [Problems], page 49.

4.5 Compiling LilyPond

4.5.1 Using `make`

> **Note:** make sure that you are in the '`build/`' subdirectory of your source tree.

LilyPond is compiled with the `make` command. Assuming `make` is configured properly, you can simply run:

```
make
```

'`make`' is short for '`make all`'. To view a list of `make` targets, run:

```
make help
```

TODO: Describe what `make` actually does.

See also

Section 4.6.2 [Generating documentation], page 46 provides more info on the `make` targets used to build the LilyPond documentation.

4.5.2 Saving time with the '`-j`' option

If your system has multiple CPUs, you can speed up compilation by adding '`-j`*X*' to the `make` command, where '*X*' is one more than the number of cores you have. For example, a typical Core2Duo machine would use:

```
make -j3
```

If you get errors using the '`-j`' option, and '`make`' succeeds without it, try lowering the *X* value.

Because multiple jobs run in parallel when '`-j`' is used, it can be difficult to determine the source of an error when one occurs. In that case, running '`make`' without the '`-j`' is advised.

4.5.3 Compiling for multiple platforms

If you want to build multiple versions of LilyPond with different configuration settings, you can use the '`--enable-config=`*conf*' option of `configure`. You should use `make conf=`*conf* to generate the output in '`out-`*conf*'. For example, suppose you want to build with and without profiling, then use the following for the normal build

```
./configure --prefix=$HOME/usr/ --enable-checking
make
```

and for the profiling version, specify a different configuration

```
./configure --prefix=$HOME/usr/ --enable-profiling \
  --enable-config=prof --disable-checking
make conf=prof
```

If you wish to install a copy of the build with profiling, don't forget to use `conf=CONF` when issuing `make install`:

```
make conf=prof install
```

See also

Section 4.6.1 [Installing LilyPond from a local build], page 46

4.5.4 Useful `make` variables

If a less verbose build output if desired, the variable `QUIET_BUILD` may be set to `1` on `make` command line, or in '`local.make`' at top of the build tree.

4.6 Post-compilation options

4.6.1 Installing LilyPond from a local build

If you configured `make` to install your local build in a directory where you normally have write permission (such as your home directory), and you have compiled LilyPond by running `make`, you can install the program in your target directory by running:

```
make install
```

If instead, your installation directory is not one that you can normally write to (such as the default '`/usr/local/`', which typically is only writeable by the superuser), you will need to temporarily become the superuser when running `make install`:

```
sudo make install
```

or...

```
su -c 'make install'
```

If you don't have superuser privileges, then you need to configure the installation directory to one that you can write to, and then re-install. See [Configuring target directories], page 44.

4.6.2 Generating documentation

Documentation editor's edit/compile cycle

- Initial documentation build:

```
make [-jX]
make [-jX CPU_COUNT=X] doc          ## can take an hour or more
make [-jX CPU_COUNT=X] doc-stage-1  ## to build only PDF documentation
```

- Edit/compile cycle:

```
## edit source files, then...

make [-jX]                  ## needed if editing outside
                            ##   Documentation/, but useful anyway
                            ##   for finding Texinfo errors.
make [-jX CPU_COUNT=X] doc  ## usually faster than initial build.
```

- Reset:

  It is generally possible to remove the compiled documentation from your system with '`make doc-clean`', but this method is not 100% guaranteed. Instead, if you want to be sure you have a clean system, we recommend that you delete your '`build/`' directory, and begin compiling from scratch. Since the documentation compile takes much longer than the non-documentation compile, this does not increase the overall time by a great deal.

Building documentation

After a successful compile (using `make`), the documentation can be built by issuing:

```
make doc
```

or, to build only the PDF documentation and not the HTML,

```
make doc-stage-1
```

> **Note:** The first time you run `make doc`, the process can easily take an hour or more with not much output on the command line.

After this initial build, `make doc` only makes changes to the documentation where needed, so it may only take a minute or two to test changes if the documentation is already built.

If `make doc` succeeds, the HTML documentation tree is available in '`out-www/offline-root/`', and can be browsed locally. Various portions of the documentation can be found by looking in '`out/`' and '`out-www`' subdirectories in other places in the source tree, but these are only *portions* of the docs. Please do not complain about anything which is broken in those places; the only complete set of documentation is in '`out-www/offline-root/`' from the top of the source tree.

`make doc` sends the output from most of the compilation to logfiles. If the build fails for any reason, it should prompt you with the name of a logfile which will provide information to help you work out why the build failed. These logfiles are not deleted with `make doc-clean`. To remove all the logfiles generated by the compilation process, use:

```
make log-clean
```

`make doc` compiles the documents for all languages. To save some compile time, the English language documents can be compiled on their own with:

```
make LANGS='' doc
```

Similarly, it is possible to compile a subset of the translated documentation by specifying their language codes on the command line. For example, the French and German translations are compiled with:

```
make LANGS='de fr' doc
```

Note that this will also compile the English version.

Compilation of documentation in Info format with images can be done separately by issuing:

```
make info
```

An issue when switching branches between master and translation is the appearance/disappearance of translated versions of some manuals. If you see such a warning from make:

```
No rule to make target `X', needed by `Y'
```

Your best bet is to delete the file Y.dep and to try again.

Building a single document

It's possible to build a single document. For example, to rebuild only '`contributor.pdf`', do the following:

```
cd build/
cd Documentation/
touch ../../Documentation/contributor.texi
make out=www out-www/contributor.pdf
```

If you are only working on a single document, test-building it in this way can give substantial time savings - recreating '`contributor.pdf`', for example, takes a matter of seconds.

Saving time with `CPU_COUNT`

The most time consuming task for building the documentation is running LilyPond to build images of music, and there cannot be several simultaneously running `lilypond-book` instances, so the '`-j`' `make` option does not significantly speed up the build process. To help speed it up, the makefile variable '`CPU_COUNT`' may be set in '`local.make`' or on the command line to the number of `.ly` files that LilyPond should process simultaneously, e.g. on a bi-processor or dual core machine:

```
make -j3 CPU_COUNT=3 doc
```

The recommended value of '`CPU_COUNT`' is one plus the number of cores or processors, but it is advisable to set it to a smaller value unless your system has enough RAM to run that many simultaneous LilyPond instances. Also, values for the '`-j`' option that pose problems with '`make`' are less likely to pose problems with '`make doc`' (this applies to both '`-j`' and '`CPU_COUNT`'). For example, with a quad-core processor, it is possible for '`make -j5 CPU_COUNT=5 doc`' to work consistently even if '`make -j5`' rarely succeeds.

AJAX search

To build the documentation with interactive searching, use:

```
make doc AJAX_SEARCH=1
```

This requires PHP, and you must view the docs via a http connection (you cannot view them on your local filesystem).

> **Note:** Due to potential security or load issues, this option is not enabled in the official documentation builds. Enable at your own risk.

Installing documentation

The HTML, PDF and if available Info files can be installed into the standard documentation path by issuing

```
make install-doc
```

This also installs Info documentation with images if the installation prefix is properly set; otherwise, instructions to complete proper installation of Info documentation are printed on standard output.

To install the Info documentation separately, run:

```
make install-info
```

Note that to get the images in Info documentation, `install-doc` target creates symbolic links to HTML and PDF installed documentation tree in '*prefix*`/share/info`', in order to save disk space, whereas `install-info` copies images in '*prefix*`/share/info`' subdirectories.

It is possible to build a documentation tree in '`out-www/online-root/`', with special processing, so it can be used on a website with content negotiation for automatic language selection; this can be achieved by issuing

```
make WEB_TARGETS=online doc
```

and both 'offline' and 'online' targets can be generated by issuing

```
make WEB_TARGETS="offline online" doc
```

Several targets are available to clean the documentation build and help with maintaining documentation; an overview of these targets is available with

```
make help
```

from every directory in the build tree. Most targets for documentation maintenance are available from '`Documentation/`'; for more information, see Section "Documentation work" in *Contributor's Guide*.

The makefile variable `QUIET_BUILD` may be set to `1` for a less verbose build output, just like for building the programs.

Building documentation without compiling

The documentation can be built locally without compiling LilyPond binary, if LilyPond is already installed on your system.

From a fresh Git checkout, do

```
./autogen.sh   # ignore any warning messages
cp GNUmakefile.in GNUmakefile
make -C scripts && make -C python
nice make LILYPOND_EXTERNAL_BINARY=/path/to/bin/lilypond doc
```

Please note that this may break sometimes – for example, if a new feature is added with a test file in input/regression, even the latest development release of LilyPond will fail to build the docs.

You may build the manual without building all the '`input/*`' stuff (i.e. mostly regression tests): change directory, for example to '`Documentation/`', issue `make doc`, which will build documentation in a subdirectory '`out-www`' from the source files in current directory. In this case, if you also want to browse the documentation in its post-processed form, change back to top directory and issue

```
make out=www WWW-post
```

Known issues and warnings

You may also need to create a script for `pngtopnm` and `pnmtopng`. On GNU/Linux, I use this:

```
export LD_LIBRARY_PATH=/usr/lib
exec /usr/bin/pngtopnm "$@"
```

On MacOS X with fink, I use this:

```
export DYLD_LIBRARY_PATH=/sw/lib
exec /sw/bin/pngtopnm "$@"
```

On MacOS X with macports, you should use this:

```
export DYLD_FALLBACK_LIBRARY_PATH=/opt/local/lib
exec /opt/local/bin/pngtopnm "$@"
```

4.6.3 Testing LilyPond binary

LilyPond comes with an extensive suite that exercises the entire program. This suite can be used to test that the binary has been built correctly.

The test suite can be executed with:

```
make test
```

If the test suite completes successfully, the LilyPond binary has been verified.

More information on the regression test suite is found at Section "Regression tests" in *Contributor's Guide*.

4.7 Problems

For help and questions use `lilypond-user@gnu.org`. Send bug reports to `bug-lilypond@gnu.org`.

Bugs that are not fault of LilyPond are documented here.

Bison 1.875

There is a bug in bison-1.875: compilation fails with "parse error before 'goto'" in line 4922 due to a bug in bison. To fix, please recompile bison 1.875 with the following fix

```
$ cd lily; make out/parser.cc
$ vi +4919 out/parser.cc
# append a semicolon to the line containing "__attribute__ ((__unused__))
# save
$ make
```

Compiling on MacOS X

Here are special instructions for compiling under MacOS X. These instructions assume that dependencies are installed using MacPorts. The instructions have been tested using OS X 10.5 (Leopard).

First, install the relevant dependencies using MacPorts.

Next, add the following to your relevant shell initialization files. This is `~/.profile` by default. You should create this file if it does not exist.

```
export PATH=/opt/local/bin:/opt/local/sbin:$PATH
export DYLD_FALLBACK_LIBRARY_PATH=/opt/local/lib:$DYLD_FALLBACK_LIBRARY_PATH
```

Now you must edit the generated '`config.make`' file. Change

```
FLEXLEXER_FILE = /usr/include/FlexLexer.h
```

to:

```
FLEXLEXER_FILE = /opt/local/include/FlexLexer.h
```

At this point, you should verify that you have the appropriate fonts installed with your ghostscript installation. Check `ls /opt/local/share/ghostscript/fonts` for: 'c0590*' files (.pfb, .pfb and .afm). If you don't have them, run the following commands to grab them from the ghostscript SVN server and install them in the appropriate location:

```
svn export http://svn.ghostscript.com/ghostscript/tags/urw-fonts-1.0.7pre44/
sudo mv urw-fonts-1.0.7pre44/* /opt/local/share/ghostscript/fonts/
rm -rf urw-fonts-1.07pre44
```

Now run the `./configure` script. To avoid complications with automatic font detection, add

```
--with-ncsb-dir=/opt/local/share/ghostscript/fonts
```

Solaris

Solaris7, ./configure

'`./configure`' needs a POSIX compliant shell. On Solaris7, '`/bin/sh`' is not yet POSIX compliant, but '`/bin/ksh`' or bash is. Run configure like

```
CONFIG_SHELL=/bin/ksh ksh -c ./configure
```

or

```
CONFIG_SHELL=/bin/bash bash -c ./configure
```

FreeBSD

To use system fonts, dejaview must be installed. With the default port, the fonts are installed in '`usr/X11R6/lib/X11/fonts/dejavu`'.

Open the file '`$LILYPONDBASE/usr/etc/fonts/local.conf`' and add the following line just after the `<fontconfig>` line. (Adjust as necessary for your hierarchy.)

```
<dir>/usr/X11R6/lib/X11/fonts</dir>
```

International fonts

On Mac OS X, all fonts are installed by default. However, finding all system fonts requires a bit of configuration; see this post on the `lilypond-user` mailing list.

On Linux, international fonts are installed by different means on every distribution. We cannot list the exact commands or packages that are necessary, as each distribution is different, and the exact package names within each distribution changes. Here are some hints, though:

`Red Hat Fedora`

```
taipeifonts fonts-xorg-truetype ttfonts-ja fonts-arabic \
     ttfonts-zh_CN fonts-ja fonts-hebrew
```

`Debian GNU/Linux`

```
apt-get install emacs-intl-fonts xfonts-intl-.* \
     ttf-kochi-gothic ttf-kochi-mincho \
     xfonts-bolkhov-75dpi xfonts-cronyx-100dpi xfonts-cronyx-75dpi
```

Using lilypond python libraries

If you want to use lilypond's python libraries (either running certain build scripts manually, or using them in other programs), set `PYTHONPATH` to '`python/out`' in your build directory, or '`.../usr/lib/lilypond/current/python`' in the installation directory structure.

4.8 Concurrent stable and development versions

It can be useful to have both the stable and the development versions of Lilypond available at once. One way to do this on GNU/Linux is to install the stable version using the precompiled binary, and run the development version from the source tree. After running `make all` from the top directory of the Lilypond source files, there will be a binary called `lilypond` in the `out` directory:

```
<path to>/lilypond/out/bin/lilypond
```

This binary can be run without actually doing the `make install` command. The advantage to this is that you can have all of the latest changes available after pulling from git and running `make all`, without having to uninstall the old version and reinstall the new.

So, to use the stable version, install it as usual and use the normal commands:

```
lilypond foobar.ly
```

To use the development version, create a link to the binary in the source tree by saving the following line in a file somewhere in your `$PATH`:

```
exec <path to>/lilypond/out/bin/lilypond "$@"
```

Save it as `Lilypond` (with a capital L to distinguish it from the stable `lilypond`), and make it executable:

```
chmod +x Lilypond
```

Then you can invoke the development version this way:

```
Lilypond foobar.ly
```

TODO: ADD

- other compilation tricks for developers

4.9 Build system

We currently use make and stepmake, which is complicated and only used by us. Hopefully this will change in the future.

Version-specific texinfo macros

- made with `scripts/build/create-version-itexi.py` and `scripts/build/create-weblinks-itexi.py`
- used extensively in the `WEBSITE_ONLY_BUILD` version of the website (made with '`website.make`', used on lilypond.org)
- not (?) used in the main docs?
- the numbers in VERSION file: MINOR_VERSION should be 1 more than the last release, VERSION_DEVEL should be the last **online** release. Yes, VERSION_DEVEL is less than VERSION.

5 Documentation work

There are currently 11 manuals for LilyPond, not including the translations. Each book is available in HTML, PDF, and info. The documentation is written in a language called `texinfo` – this allows us to generate different output formats from a single set of source files.

To organize multiple authors working on the documentation, we use a Version Control System (VCS) called git, previously discussed in Section 3.2 [Starting with Git], page 12.

5.1 Introduction to documentation work

Our documentation tries to adhere to our Section 5.4 [Documentation policy], page 63. This policy contains a few items which may seem odd. One policy in particular is often questioned by potential contributors: we do not repeat material in the Notation Reference, and instead provide links to the "definitive" presentation of that information. Some people point out, with good reason, that this makes the documentation harder to read. If we repeated certain information in relevant places, readers would be less likely to miss that information.

That reasoning is sound, but we have two counter-arguments. First, the Notation Reference – one of *five* manuals for users to read – is already over 500 pages long. If we repeated material, we could easily exceed 1000 pages! Second, and much more importantly, LilyPond is an evolving project. New features are added, bugs are fixed, and bugs are discovered and documented. If features are discussed in multiple places, the documentation team must find every instance. Since the manual is so large, it is impossible for one person to have the location of every piece of information memorized, so any attempt to update the documentation will invariably omit a few places. This second concern is not at all theoretical; the documentation used to be plagued with inconsistent information.

If the documentation were targeted for a specific version – say, LilyPond 2.10.5 – and we had unlimited resources to spend on documentation, then we could avoid this second problem. But since LilyPond evolves (and that is a very good thing!), and since we have quite limited resources, this policy remains in place.

A few other policies (such as not permitting the use of tweaks in the main portion of NR 1+2) may also seem counter-intuitive, but they also stem from attempting to find the most effective use of limited documentation help.

Before undertaking any large documentation work, contributors are encouraged to contact the Section 14.3 [Meisters], page 164.

5.2 Documentation suggestions

Small additions

For additions to the documentation,

1. Tell us where the addition should be placed. Please include both the section number and title (i.e. "LM 2.13 Printing lyrics").
2. Please write exact changes to the text.
3. A formal patch to the source code is *not* required; we can take care of the technical details.
4. Send the suggestions to the `bug-lilypond` mailing list as discussed in Section "Contact" in *General Information*.
5. Here is an example of a perfect documentation report:

```
To: bug-lilypond@gnu.org
From: helpful-user@example.net
Subject: doc addition
```

```
In LM 2.13 (printing lyrics), above the last line ("More options,
like..."), please add:

----
To add lyrics to a divided part, use blah blah blah.  For example,

\score {
  \notes {blah <<blah>> }
  \lyrics {blah <<blah>> }
  blah blah blah
}
----

In addition, the second sentence of the first paragraph is
confusing.  Please delete that sentence (it begins "Users
often...") and replace it with this:
----
To align lyrics with something, do this thing.
----

Have a nice day,
Helpful User
```

Larger contributions

To replace large sections of the documentation, the guidelines are stricter. We cannot remove parts of the current documentation unless we are certain that the new version is an improvement.

1. Ask on the lilypond-devel mailing list if such a rewrite is necessary; somebody else might already be working on this issue!
2. Split your work into small sections; this makes it much easier to compare the new and old documentation.
3. Please prepare a formal git patch.

Contributions that contain examples using overrides

Examples that use overrides, tweaks, customer Scheme functions etc. are (with very few exceptions) not included in the main text of the manuals; as there would be far too many, equally useful, candidates.

The correct way is to submit your example, with appropriate explanatory text and tags, to the LilyPond Snippet Repository (LSR). Snippets that have the "docs" tag can then be easily added as a *selected snippet* in the documentation. It will also appear automatically in the Snippets lists. See Section 7.1 [Introduction to LSR], page 84.

Snippets that *don't* have the "docs" tage will still be searchable and viewable within the LSR, but will be not be included in the Snippets list or be able to be included as part of the main documentation.

Generally, any new snippets that have the "docs" tag are more carefully checked for syntax and formatting.

Announcing your snippet

Once you have followed these guidelines, please send a message to lilypond-devel with your documentation submissions. Unfortunately there is a strict 'no top-posting' check on the mailing list; to avoid this, add:

```
> I'm not top posting
```

(you must include the `>`) to the top of your documentation addition.

We may edit your suggestion for spelling, grammar, or style, and we may not place the material exactly where you suggested, but if you give us some material to work with, we can improve the manual much faster.

Thanks for your interest!

5.3 Texinfo introduction and usage policy

5.3.1 Texinfo introduction

The language is called Texinfo; you can see its manual here:

http://www.gnu.org/software/texinfo/manual/texinfo/

However, you don't need to read those docs. The most important thing to notice is that text is text. If you see a mistake in the text, you can fix it. If you want to change the order of something, you can cut-and-paste that stuff into a new location.

> **Note:** Rule of thumb: follow the examples in the existing docs. You can learn most of what you need to know from this; if you want to do anything fancy, discuss it on `lilypond-devel` first.

5.3.2 Documentation files

All manuals live in '`Documentation/`'.

In particular, there are four user manuals, their respective master source files are '`learning.tely`' (LM, Learning Manual), '`notation.tely`' (NR, Notation Reference), '`music-glossary.tely`' (MG, Music Glossary), and '`lilypond-program`' (AU). Each chapter is written in a separate file, ending in '`.itely`' for files containing lilypond code, and '`.itexi`' for files without lilypond code, located in a subdirectory associated to the manual ('`learning/`' for '`learning.tely`', and so on); list the subdirectory of each manual to determine the filename of the specific chapter you wish to modify.

Developer manuals live in '`Documentation/`' too. Currently there is only one: the Contributor's Guide '`contrib-guide.texi`' you are reading.

Snippet files are part of documentation, and the Snippet List (SL) lives in '`Documentation/`' just like the manuals. For information about how to modify the snippet files and SL, see Chapter 7 [LSR work], page 84.

5.3.3 Sectioning commands

The Notation Reference uses section headings at four, occasionally five, levels.

- Level 1: @chapter
- Level 2: @section
- Level 3: @subsection
- Level 4: @unnumberedsubsubsec
- Level 5: @subsubsubheading

The first three levels are numbered in html, the last two are not. Numbered sections correspond to a single html page in the split html documents.

The first four levels always have accompanying nodes so they can be referenced and are also included in the ToC in html.

Most of the manual is written at level 4 under headings created with

```
@node Foo
@unnumberedsubsubsec Foo
```

Level 3 subsections are created with

```
@node Foo
@subsection Foo
```

Level 4 headings and menus must be preceded by level 3 headings and menus, and so on for level 3 and level 2. If this is not what is wanted, please use:

```
@subsubsubheading Foo
```

Please leave two blank lines above a `@node`; this makes it easier to find sections in texinfo.

Do not use any `@` commands for a `@node`. They may be used for any `@sub...` sections or headings however.

```
not:
@node @code{Foo} Bar
@subsection @code{Foo} Bar

but instead:
@node Foo Bar
@subsection @code{Foo} Bar
```

No punctuation may be used in the node names. If the heading text uses punctuation (in particular, colons and commas) simply leave this out of the node name and menu.

```
@menu
* Foo Bar::
@end menu

@node Foo Bar
@subsection Foo: Bar
```

Backslashes must not be used in node names or section headings. If the heading text should include a backslash simply leave this out of the node name and menu and replace it with `@bs{}` in the heading text.

```
@menu
* The set command
@end menu

@node The set command
@subsection The @code{@bs{}set} command
```

References to such a node may use the third argument of the `@ref` command to display the texually correct heading.

```
@ref{The set command,,The @code{@bs{}set command}
```

With the exception of `@` commands, `\` commands and punctuation, the section name should match the node name exactly.

Sectioning commands (`@node` and `@section`) must not appear inside an `@ignore`. Separate those commands with a space, ie `@n ode`.

Nodes must be included inside a

```
@menu
* foo::
* bar::
@end menu
```

construct. These can be constructed with scripts: see [Stripping whitespace and generating menus], page 68.

5.3.4 LilyPond formatting

- Most LilyPond examples throughout the documentation can be produced with:

  ```
  @lilypond[verbatim,quote,relative=1]
  ```

  or

  ```
  @lilypond[verbatim,quote,relative=2]
  ```

  If using any combination of `\header{}`, `\score{}` or `\layout{}` in your example, then you must omit the `relative` variable and either use absolute entry mode or an explicit `\relative{}` construction.

  If using `\book{}` in your example then you must also omit the `relative` variable and either use absolute entry mode or an explicit `\relative{}` construction. However, you must also include the `papersize=X` variable, where `X` is a defined paper size from within '`scm/paper.scm`'. This is to avoid the default `a4` paper size being used and leaving too much unnecessary whitespace and potentially awkward page breaks in the PDFs.

  The preferred `papersize`s are `a5`, `a6` or `a8landscape`.

  `a8landscape` works best for a single measure with a single title and/or single `tagline`:

  ```
  @lilypond[papersize=a8landscape,verbatim]
  \book {
    \header {
      title = "A scale in LilyPond"
    }
    \relative {
      c d e f
    }
  }
  @end lilypond
  ```

  and can also be used to easily show features that require page breaks (i.e. page numbers) without taking large amounts of space within the documentation. Do not use the `quote` option with this paper size.

  `a5` or `a6` paper sizes are best used for examples that have more than two measures of music or require multiple staves (i.e. to illustrate cross-staff features, RH and LH parts etc.) and where `\book{}` constructions are required or where `a8landscape` produces an example that is too cramped. Depending on the example the `quote` option may need to be omitted.

  In rare cases, other options may be used (or omitted), but ask first.

- Please avoid using extra spacing either after or within the `@lilypond` parameters.

  ```
  not:          @lilypond [verbatim, quote, relative=1]
  but instead:  @lilypond[verbatim,quote,relative=1]
  ```

- Inspirational headwords are produced with:

  ```
  @lilypondfile[quote,ragged-right,line-width=16\cm,staffsize=16]
  {pitches-headword.ly}
  ```

- LSR snippets are linked with:

  ```
  @lilypondfile[verbatim,quote,ragged-right,texidoc,doctitle]
  {filename.ly}
  ```

- Use two spaces for indentation in lilypond examples (no tabs).

- All engravers should have double-quotes around them:

  ```
  \consists "Spans_arpeggio_engraver"
  ```

  LilyPond does not strictly require this, but it is a useful convention to follow.

- All context or layout object strings should be prefaced with `#`. Again, LilyPond does not strictly require this, but it is helpful to get users accustomed to this scheme construct, i.e. `\set Staff.instrumentName = #"cello"`
- Try to avoid using `#'` or `#`` within when describing context or layout properties outside of an `@example` or `@lilypond`, unless the description explicitly requires it.

  i.e. "...setting the `transparent` property leaves the object where it is, but makes it invisible."
- If possible, only write one bar per line.
- If you only have one bar per line, omit bar checks. If you must put more than one bar per line (not recommended), then include bar checks.
- Tweaks should, if possible, also occur on their own line.

```
not:          \override TextScript #'padding = #3 c1^"hi"
but instead:  \override TextScript #'padding = #3
              c1^"hi"
```

  excepted in Templates, where 'doctitle' may be omitted.
- Avoid long stretches of input code. Nobody is going to read them in print. Create small examples. However, this does not mean it has be minimal.
- Specify durations for at least the first note of every bar.
- If possible, end with a complete bar.
- Comments should go on their own line, and be placed before the line(s) to which they refer.
- For clarity, always use { } marks even if they are not technically required; i.e.

```
not:

\context Voice \repeat unfold 2 \relative c' {
  c2 d
}

but instead:

\context Voice {
  \repeat unfold 2 {
    \relative c' {
      c2 d
    }
  }
}
```

- Add a space around { } marks; i.e.

```
not:          \chordmode{c e g}
but instead:  \chordmode { c e g }
```

- Use { } marks for additional `\markup` format commands; i.e.

```
not:          c^\markup \tiny\sharp
but instead:  c^\markup { \tiny \sharp }
```

- Remove any space around < > marks; i.e.

```
not:           < c e g > 4
but instead:   <c e g>4
```

- Beam, slur and tie marks should begin immediately after the first note with beam and phrase marks ending immediately after the last.

```
a8\( ais16[ b cis( d] b) cis4~ b' cis,\)
```

- If you want to work on an example outside of the manual (for easier/faster processing), use this header:

```
\paper {
  indent = 0\mm
  line-width = 160\mm - 2.0 * 0.4\in
  line-width = #(- line-width (* mm  3.000000))
}

\layout {
}
```

  You may not change any of these values. If you are making an example demonstrating special `\paper{}` values, contact the Documentation Editor.

5.3.5 Text formatting

- Lines should be less than 72 characters long. (We personally recommend writing with 66-char lines, but do not bother modifying existing material). Also see the recommendations for fixed-width fonts in the Section 5.3.6 [Syntax survey], page 59.
- Do not use tabs.
- Do not use spaces at the beginning of a line (except in `@example` or `@verbatim` environments), and do not use more than a single space between words. 'makeinfo' copies the input lines verbatim without removing those spaces.
- Use two spaces after a period.
- In examples of syntax, use `@var{`*`musicexpr`*`}` for a music expression.
- Don't use `@rinternals{}` in the main text. If you're tempted to do so, you're probably getting too close to "talking through the code". If you really want to refer to a context, use `@code{}` in the main text and `@rinternals{}` in the `@seealso`.

5.3.6 Syntax survey

Comments

- `@c ...` — single line comment. '`@c NOTE:`' is a comment which should remain in the final version. (gp only command ;)
- `@ignore` — multi-line comment:

```
@ignore
...
@end ignore
```

Cross references

Enter the exact `@node` name of the target reference between the brackets (eg. '`@ref{Syntax survey}`'). Do not split a cross-reference across two lines – this causes the cross-reference to be rendered incorrectly in html documents.

- `@ref{...}` — link within current manual.
- `@rchanges{...}` — link to Changes.
- `@rcontrib{...}` — link to Contributor's Guide.
- `@ressay{...}` — link to Engraving Essay.
- `@rextend{...}` — link to Extending LilyPond.
- `@rglos{...}` — link to the Music Glossary.

- `@rinternals{...}` — link to the Internals Reference.
- `@rlearning{...}` — link to Learning Manual.
- `@rlsr{...}` — link to a Snippet section.
- `@rprogram{...}` — link to Application Usage.
- `@ruser{...}` — link to Notation Reference.
- `@rweb{...}` — link to General Information.

External links

- `@email{...}` — create a `mailto:` E-mail link.
- `@uref{`*`URL`*`[, `*`link text`*`]}` — link to an external url. Use within an `@example ... @end example`.

```
@example
@uref{URL [, link text ]}
@end example
```

Fixed-width font

- `@code{...}`, `@samp{...}` —

  Use the `@code{...}` command when referring to individual language-specific tokens (keywords, commands, engravers, scheme symbols, etc.) in the text. Ideally, a single `@code{...}` block should fit within one line in the PDF output.

  Use the `@samp{...}` command when you have a short example of user input, unless it constitutes an entire `@item` by itself, in which case `@code{...}` is preferable. Otherwise, both should only be used when part of a larger sentence within a paragraph or `@item`. Do not use `@code{...}` or `@samp{...}` inside an `@example` block, and do not use either as a free-standing paragraph; use `@example` instead.

  A single unindented line in the PDF has space for about 79 fixed-width characters (76 if indented). Within an `@item` there is space for about 75 fixed-width characters. Each additional level of `@itemize` or `@enumerate` shortens the line by about 4 columns.

  However, even short blocks of `@code{...}` and `@samp{...}` can run into the margin if the Texinfo line-breaking algorithm gets confused. Additionally, blocks that are longer than this may in fact print nicely; it all depends where the line breaks end up. If you compile the docs yourself, check the PDF output to make sure the line breaks are satisfactory.

  The Texinfo setting `@allowcodebreaks` is set to `false` in the manuals, so lines within `@code{...}` or `@samp{...}` blocks will only break at spaces, not at hyphens or underscores. If the block contains spaces, use `@w{@code{...}}` or `@w{@samp{...}}` to prevent unexpected line breaks.

  The Texinfo settings `txicodequoteundirected` and `txicodequotebacktick` are both set in the manuals, so backticks (`` ` ``) and apostrophes (`'`) placed within blocks of `@code`, `@example`, or `@verbatim` are not converted to left- and right-angled quotes (‘ ’) as they normally are within the text, so the apostrophes in ‘`@w{@code{\relative c''}}`’ will display correctly. However, these settings do not affect the PDF output for anything within a `@samp` block (even if it includes a nested `@code` block), so entering ‘`@w{@samp{\relative c''}}`’ wrongly produces ‘`\relative c’’`’ in PDF. Consequently, if you want to use a `@samp{...}` block which contains backticks or apostrophes, you should instead use ‘`@q{@code{...}}`’ (or ‘`@q{@w{@code{...}}}`’ if the block also contains spaces). Note that backslashes within `@q{...}` blocks must be entered as ‘`@bs{}`’, so the example above would be coded as ‘`@q{@w{@code{@bs{}relative c''}}}`’.

- `@command{...}` — Use when referring to command-line commands within the text (eg. ‘`@command{convert-ly}`’). Do not use inside an `@example` block.

- `@example` — Use for examples of program code. Do not add extraneous indentation (i.e. don't start every line with whitespace). Use the following layout (notice the use of blank lines). Omit the `@noindent` if the text following the example starts a new paragraph:

```
...text leading into the example...

@example
...
@end example

@noindent
continuation of the text...
```

  Individual lines within an `@example` block should not exceed 74 characters; otherwise they will run into the margin in the PDF output, and may get clipped. If an `@example` block is part of an `@item`, individual lines in the `@example` block should not exceed 70 columns. Each additional level of `@itemize` or `@enumerate` shortens the line by about 4 columns.

  For long command line examples, if possible, use a trailing backslash to break up a single line, indenting the next line with 2 spaces. If this isn't feasible, use '`@smallexample ... @end smallexample`' instead, which uses a smaller fontsize. Use `@example` whenever possible, but if needed, `@smallexample` can fit up to 90 characters per line before running into the PDF margin. Each additional level of `@itemize` or `@enumerate` shortens a `@smallexample` line by about 5 columns.
- `@file{...}` — Use when referring to filenames and directories in the text. Do not use inside an `@example` block.
- `@option{...}` — Use when referring to command-line options in the text (eg. '`@option{--format}`'). Do not use inside an `@example` block.
- `@verbatim` — Prints the block exactly as it appears in the source file (including whitespace, etc.). For program code examples, use `@example` instead. `@verbatim` uses the same format as `@example`.

  Individual lines within an `@verbatim` block should not exceed 74 characters; otherwise they will run into the margin in the PDF output, and may get clipped. If an `@verbatim` block is part of an `@item`, individual lines in the `@verbatim` block should not exceed 70 columns. Each additional level of `@itemize` or `@enumerate` shortens the line by about 4 columns.

Indexing

- `@cindex ...` — General index. Please add as many as you can. Don't capitalize the first word.
- `@funindex ...` — is for a \lilycommand.

Lists

- `@enumerate` — Create an ordered list (with numbers). Always put '`@item`' on its own line. As an exception, if all the items in the list are short enough to fit on single lines, placing them on the '`@item`' lines is also permissible. '`@item`' and '`@end enumerate`' should always be preceded by a blank line.

```
@enumerate

@item
A long multi-line item like this one must begin
on a line of its own and all the other items in
the list must do so too.
```

```
@item
Even short ones

@end enumerate
@enumerate

@item Short item

@item Short item

@end enumerate
```

- `@itemize` — Create an unordered list (with bullets). Use the same format as `@enumerate`. Do not use '`@itemize @bullet`'.

Special characters

- `--`, `---` — Create an en dash (–) or an em dash (—) in the text. To print two or three literal hyphens in a row, wrap one of them in a `@w{...}` (eg. '`-@w{-}-`').
- `@@`, `@{`, `@}` — Create an at-sign (@), a left curly bracket ({), or a right curly bracket (}).
- `@bs{}` — Create a backslash within a `@q{...}`, `@qq{...}`, or `@warning{...}` block. This is a custom LilyPond macro, not a builtin @-command in Texinfo. Texinfo would also allow '\\', but this breaks the PDF output.
- `@tie{}` — Create a *variable-width* non-breaking space in the text (use '`@w{ }`' for a single *fixed-width* non-breaking space). Variables or numbers which consist of a single character (probably followed by a punctuation mark) should be tied properly, either to the previous or the next word. Example: '`The letter@tie{}@q{I} is skipped`'

Miscellany

- `@notation{...}` — refers to pieces of notation, e.g. '`@notation{clef}`'. Also use for specific lyrics ('`the @notation{A - men} is centered`'). Only use once per subsection per term.
- `@q{...}` — Single quotes. Used for 'vague' terms. To get a backslash (\), you must use '`@bs{}`'.
- `@qq{...}` — Double quotes. Used for actual quotes ("he said") or for introducing special input modes. To get a backslash (\), you must use '`@bs{}`'.
- `@var{...}` — Use for metasyntactic variables (such as *`foo`*, *`bar`*, *`arg1`*, etc.). In most cases, when the `@var{...}` command appears in the text (and not in an `@example` block) it should be wrapped with an appropriate texinfo code-highlighting command (such as `@code`, `@samp`, `@file`, `@command`, etc.). For example: '`@code{@var{foo}}`', '`@file{@var{myfile.ly}}`', '`@samp{git checkout @var{branch}}`', etc. This improves readability in the PDF and HTML output.
- `@version{}` — Return the current LilyPond version string. Use '`@w{@version{}}`' if it's at the end of a line (to prevent an ugly line break in PDF); use '`@w{"@version{}"}`' if you need it in quotes.
- `@w{...}` — Do not allow any line breaks.
- `@warning{...}` — produces a "Note: " box. Use for important messages. To get a backslash (\), you must use '`@bs{}`'.

5.3.7 Other text concerns

- References must occur at the end of a sentence, for more information see the texinfo manual.

Ideally this should also be the final sentence of a paragraph, but this is not required. Any link in a doc section must be duplicated in the `@seealso` section at the bottom.

- Introducing examples must be done with

```
. (i.e. finish the previous sentence/paragraph)
: (i.e. `in this example:')
, (i.e. `may add foo with the blah construct,')
```

  The old "sentence runs directly into the example" method is not allowed any more.

- Abbrevs in caps, e.g., HTML, DVI, MIDI, etc.
- Colon usage
  1. To introduce lists
  2. When beginning a quote: "So, he said,...".

     This usage is rarer. Americans often just use a comma.
  3. When adding a defining example at the end of a sentence.
- Non-ASCII characters which are in utf-8 should be directly used; this is, don't say '`Ba@ss{}tuba`' but '`Baßtuba`'. This ensures that all such characters appear in all output formats.

5.4 Documentation policy

5.4.1 Books

There are four parts to the documentation: the Learning Manual, the Notation Reference, the Program Reference, and the Music Glossary.

- Learning Manual:

  The LM is written in a tutorial style which introduces the most important concepts, structure and syntax of the elements of a LilyPond score in a carefully graded sequence of steps. Explanations of all musical concepts used in the Manual can be found in the Music Glossary, and readers are assumed to have no prior knowledge of LilyPond. The objective is to take readers to a level where the Notation Reference can be understood and employed to both adapt the templates in the Appendix to their needs and to begin to construct their own scores. Commonly used tweaks are introduced and explained. Examples are provided throughout which, while being focussed on the topic being introduced, are long enough to seem real in order to retain the readers' interest. Each example builds on the previous material, and comments are used liberally. Every new aspect is thoroughly explained before it is used.

  Users are encouraged to read the complete Learning Manual from start-to-finish.

- Notation Reference: a (hopefully complete) description of LilyPond input notation. Some material from here may be duplicated in the Learning Manual (for teaching), but consider the NR to be the "definitive" description of each notation element, with the LM being an "extra". The goal is _not_ to provide a step-by-step learning environment – do not avoid using notation that has not be introduced previously in the NR (for example, use \break if appropriate). This section is written in formal technical writing style.

  Avoid duplication. Although users are not expected to read this manual from start to finish, they should be familiar with the material in the Learning Manual (particularly "Fundamental Concepts"), so do not repeat that material in each section of this book. Also watch out for common constructs, like ^ - _ for directions – those are explained in NR 3. In NR 1, you can write: DYNAMICS may be manually placed above or below the staff, see @ref{Controlling direction and placement}.

Most tweaks should be added to LSR and not placed directly in the '`.itely`' file. In some cases, tweaks may be placed in the main text, but ask about this first.

Finally, you should assume that users know what the notation means; explaining musical concepts happens in the Music Glossary.

- Application Usage: information about using the program lilypond with other programs (lilypond-book, operating systems, GUIs, convert-ly, etc). This section is written in formal technical writing style.

  Users are not expected to read this manual from start to finish.
- Music Glossary: information about the music notation itself. Explanations and translations about notation terms go here.

  Users are not expected to read this manual from start to finish.
- Internals Reference: not really a documentation book, since it is automagically generated from the source, but this is its name.

5.4.2 Section organization

- The order of headings inside documentation sections should be:

```
main docs
@predefined
@endpredefined
@snippets
@seealso
@knownissues
```

- You *must* include a @seealso.
  - The order of items inside the @seealso section is

```
Music Glossary:
@rglos{foo},
@rglos{bar}.

Learning Manual:
@rlearning{baz},
@rlearning{foozle}.

Notation Reference:
@ruser{faazle},
@ruser{boo}.

Application Usage:
@rprogram{blah}.

Essay on automated music engraving:
@ressay{yadda}.

Extending LilyPond:
@rextend{frob}.

Installed Files:
@file{path/to/dir/blahz}.

Snippets: @rlsr{section}.
```

```
Internals Reference:
@rinternals{fazzle},
@rinternals{booar}.
```

- If there are multiple entries, separate them by commas but do not include an 'and'.
- Always end with a period.
- Place each link on a new line as above; this makes it much easier to add or remove links. In the output, they appear on a single line.

  ("Snippets" is REQUIRED; the others are optional)
- Any new concepts or links which require an explanation should go as a full sentence(s) in the main text.
- Don't insert an empty line between @seealso and the first entry! Otherwise there is excessive vertical space in the PDF output.

- To create links, use @ref{} if the link is within the same manual.
- @predefined ... @endpredefined is for commands in '`ly/*-init.ly`'
- Do not include any real info in second-level sections (i.e. 1.1 Pitches). A first-level section may have introductory material, but other than that all material goes into third-level sections (i.e. 1.1.1 Writing Pitches).
- The @knownissues should not discuss any issues that are in the tracker, unless the issue is Priority-Postponed. The goal is to discuss any overall architecture or syntax decisions which may be interpreted as bugs. Normal bugs should not be discussed here, because we have so many bugs that it would be a huge task to keep the @knownissues current and accurate all the time.

5.4.3 Checking cross-references

Cross-references between different manuals are heavily used in the documentation, but they are not checked during compilation. However, if you compile the documentation, a script called check_texi_refs can help you with checking and fixing these cross-references; for information on usage, cd into a source tree where documentation has been built, cd into Documentation and run:

```
make check-xrefs
make fix-xrefs
```

Note that you have to find yourself the source files to fix cross-references in the generated documentation such as the Internals Reference; e.g. you can grep scm/ and lily/.

Also of interest may be the linkdoc checks on kainhofer.com. Be warned that these docs are not completely rebuilt every day, so it might not accurately reflect the current state of the docs.

http://kainhofer.com/~lilypond/linkdoc/

5.4.4 General writing

- Do not forget to create @cindex entries for new sections of text. Enter commands with @funindex, i.e.

  ```
  @cindex pitches, writing in different octaves
  @funindex \relative
  ```

  Do not bother with the @code{} (they are added automatically). These items are added to both the command index and the unified index. Both index commands should go in front of the actual material.
- @cindex entries should not be capitalized, i.e.

  ```
  @cindex time signature
  ```

is preferred instead of "Time signature". Only use capital letters for musical terms which demand them, e.g. "D.S. al Fine".

- For scheme function index entries, only include the final part, i.e.

```
@funindex modern-voice-cautionary
     and NOT
@funindex #(set-accidental-style modern-voice-cautionary)
```

- Use American spelling. LilyPond's internal property names use this convention.
- Here is a list of preferred terms to be used:
  - *Simultaneous* NOT concurrent.
  - *Measure*: the unit of music.
  - *Bar line*: the symbol delimiting a measure NOT barline.
  - *Note head* NOT notehead.
  - *Chord construct* NOT just chord (when referring to < ... >)
  - *Staff* NOT stave.
  - *Staves* NOT Staffs: Phrases such as 'multiple @internalsref{Staff}s' should be rephrased to 'multiple @internalsref{Staff} contexts'.

5.4.5 Technical writing style

These refer to the NR. The LM uses a more gentle, colloquial style.

- Do not refer to LilyPond in the text. The reader knows what the manual is about. If you do, capitalization is LilyPond.
- If you explicitly refer to 'lilypond' the program (or any other command to be executed), write `@command{lilypond}`.
- Do not explicitly refer to the reader/user. There is no one else besides the reader and the writer.
- Avoid contractions (don't, won't, etc.). Spell the words out completely.
- Avoid abbreviations, except for commonly used abbreviations of foreign language terms such as etc. and i.e.
- Avoid fluff ("Notice that," "as you can see," "Currently,").
- The use of the word 'illegal' is inappropriate in most cases. Say 'invalid' instead.

5.5 Tips for writing docs

In the NR, I highly recommend focusing on one subsection at a time. For each subsection,

- check the mundane formatting. Are the headings (@predefined, @seealso, etc.) in the right order?
- add any appropriate index entries.
- check the links in the @seealso section – links to music glossary, internal references, and other NR sections are the main concern. Check for potential additions.
- move LSR-worthy material into LSR. Add the snippet, delete the material from the '`.itely`' file, and add a @lilypondfile command.
- check the examples and descriptions. Do they still work? **Do not** assume that the existing text is accurate/complete; some of the manual is highly out of date.
- is the material in the @knownissues still accurate?
- can the examples be improved (made more explanatory), or is there any missing info? (feel free to ask specific questions on -user; a couple of people claimed to be interesting in being "consultants" who would help with such questions)

In general, I favor short text explanations with good examples – "an example is worth a thousand words". When I worked on the docs, I spent about half my time just working on those tiny lilypond examples. Making easily-understandable examples is much harder than it looks.

Tweaks

In general, any \set or \override commands should go in the "select snippets" section, which means that they should go in LSR and not the '`.itely`' file. For some cases, the command obviously belongs in the "main text" (i.e. not inside @predefined or @seealso or whatever) – instrument names are a good example of this.

```
\set Staff.instrumentName = #"foo"
```

On the other side of this,

```
\override Score.Hairpin #'after-line-breaking = ##t
```

clearly belongs in LSR.

I'm quite willing to discuss specific cases if you think that a tweaks needs to be in the main text. But items that can go into LSR are easier to maintain, so I'd like to move as much as possible into there.

It would be "nice" if you spent a lot of time crafting nice tweaks for users... but my recommendation is **not** to do this. There's a lot of doc work to do without adding examples of tweaks. Tweak examples can easily be added by normal users by adding them to the LSR.

One place where a documentation writer can profitably spend time writing or upgrading tweaks is creating tweaks to deal with known issues. It would be ideal if every significant known issue had a workaround to avoid the difficulty.

See also

Section 7.2 [Adding and editing snippets], page 84.

5.6 Scripts to ease doc work

5.6.1 Scripts to test the documentation

Building only one section of the documentation

In order to save build time, a script is available to build only one section of the documentation in English with a default html appearance.

You can build a section of the documentation with:

```
scripts/auxiliar/doc-section.sh MANUAL SECTION
```

where `SECTION` is the name of the file containing the section to be built, and `MANUAL` is replaced by the name of the directory containing the section. So, for example, to build section 1.1 of the Notation Reference, use the command:

```
scripts/auxiliar/doc-section.sh notation pitches
```

You can then see the generated document for the section at

```
tempdocs/pitches/out/pitches.html
```

According to Lilypond issue 1236, the location of the lilypond git tree is taken from `$LILYPOND_GIT` if specified, otherwise it is auto-detected.

It is assumed that compilation takes place in the '`build/`' subdirectory, but this can be overridden by setting the environment variable `LILYPOND_BUILD_DIR`.

Similarly, output defaults to '`build/tempdocs/`' but this can be overridden by setting the environment variable `LILYPOND_TEMPDOCS`.

This script will not work for building sections of the Contributors' guide. For building sections of the Contributors' Guide, use:

```
scripts/auxiliar/cg-section.sh SECTION
```

where `SECTION` is the name of the file containing the sections to be built. For example, to build section 4 of the Contributors' guide, use:

```
scripts/auxiliar/cg-section.sh doc-work
```

`cg-section.sh` uses the same environment variables and corresponding default values as `doc-section.sh`.

5.6.2 Scripts to create documentation

Stripping whitespace and generating menus

> **Note:** This script assumes that the file conforms to our doc policy, in particular with regard to Section 5.3.3 [Sectioning commands], page 55; a few files still need work in this regard.

To automatically regenerate `@menu` portions and strip whitespace, use:

```
scripts/auxiliar/node-menuify.py FILENAME
```

If you are adding documentation that requires new menus, you will need to add a blank `@menu` section:

```
@menu
@end menu
```

Stripping whitespace only

To remove extra whitespace from the ends of lines, run

```
scripts/auxiliar/strip-whitespace.py FILENAME
```

Updating doc with `convert-ly`

Don't. This should be done by programmers when they add new features. If you notice that it hasn't been done, complain to `lilypond-devel`.

5.7 Docstrings in scheme

Material in the Internals reference is generated automatically from our source code. Any doc work on Internals therefore requires modifying files in '`scm/*.scm`'. Texinfo is allowed in these docstrings.

Most documentation writers never touch these, though. If you want to work on them, please ask for help.

5.8 Translating the documentation

The mailing list `translations@lilynet.net` is dedicated to LilyPond web site and documentation translation; on this list, you will get support from the Translations Meister and experienced translators, and we regularly discuss translation issues common to all languages. All people interested in LilyPond translations are invited to subscribe to this list regardless of the amount of their contribution, by sending an email to `translations-request@lilynet.net` with subject `subscribe` and an empty message body. Unless mentioned explicitly, or except if a translations coordinator contacts you privately, you should send questions, remarks and patches to the list `translations@lilynet.net`. Please note that traffic is high on the English-speaking

list `lilypond-user@gnu.org`, so it may take some time before your request or contribution is handled.

5.8.1 Getting started with documentation translation

First, get the sources of branch `translation` from the Git repository, see Section 3.2 [Starting with Git], page 12.

Translation requirements

Working on LilyPond documentation translations requires the following pieces of software, in order to make use of dedicated helper tools:

- Python 2.4 or higher,
- GNU Make,
- Gettext,
- Git.

It is not required to build LilyPond and the documentation to translate the documentation. However, if you have enough time and motivation and a suitable system, it can be very useful to build at least the documentation so that you can check the output yourself and more quickly; if you are interested, see Chapter 4 [Compiling], page 41.

Before undertaking any large translation work, contributors are encouraged to contact the Section 14.3 [Meisters], page 164.

Which documentation can be translated

The makefiles and scripts infrastructure currently supports translation of the following documentation:

- the web site, the Learning Manual, the Notation Reference and Application Usage – Texinfo source, PDF and HTML output; Info output might be added if there is enough demand for it;
- the Changes document.

Support for translating the following pieces of documentation should be added soon, by decreasing order of priority:

- automatically generated documentation: markup commands, predefined music functions;
- the Snippets List;
- the Internals Reference.

Starting translation in a new language

At top of the source directory, do

```
./autogen.sh
```

or (if you want to install your self-compiled LilyPond locally)

```
./autogen.sh --prefix=$HOME
```

If you want to compile LilyPond – which is almost required to build the documentation, but is not required to do translation only – fix all dependencies and rerun `./configure` (with the same options as for `autogen.sh`).

Then `cd` into '`Documentation/`' and run

```
make ISOLANG=MY-LANGUAGE new-lang
```

where *MY-LANGUAGE* is the ISO 639 language code.

Finally, add a language definition for your language in '`python/langdefs.py`'.

5.8.2 Documentation translation details

Please follow all the instructions with care to ensure quality work.

All files should be encoded in UTF-8.

Files to be translated

Translation of '`Documentation/foo/bar`' should be '`Documentation/`*`LANG`*`/foo/bar`'. Unmentioned files should not be translated.

Priorities:

- 1. delivery,
- 2. 3. 4. 5. 6. later,
- 7. optional.

Files of priority 1 should be submitted along all files generated by starting a new language in the same commit and thus a unique patch, and the translation of files marked with priority 2 should be committed to Git at the same time and thus sent in a single patch. Files marked with priority 3 or more may be submitted individually. Word counts (excluding LilyPond snippets) are given for each file. For knowing how to commit your work to Git, then make patches of your new translations as well as corrections and updates, see Section 3.3 [Basic Git procedures], page 20.

```
-1- Web site
616   web.texi
4937  web/introduction.itexi
1201  web/download.itexi
1139  macros.itexi
7977  po/lilypond-doc.pot (translate to po/MY_LANGUAGE.po)
0     search-box.ihtml
---   lilypond-texi2html.init (section TRANSLATIONS)
15870 total

-2- Tutorial
1284  web/manuals.itexi
124   learning.tely
2578  learning/tutorial.itely
4396  learning/common-notation.itely
8382  total

-3- Fundamental Concepts, starting of Usage and Community
11144 learning/fundamental.itely -- Fundamental concepts
135   usage.tely
4537  usage/running.itely
1484  usage/updating.itely
3073  web/community.itexi
20373 total

-4- Rest of Learning manual and Suggestions on writing LilyPond files
16191 learning/tweaks.itely -- Tweaking output
372   learning/templates.itely -- Templates
2692  usage/suggestions.itely -- Suggestions on writing LilyPond files
19255 total

-5- Notation reference
```

```
326   notation.tely
91    notation/notation.itely -- Musical notation
4990  notation/pitches.itely
6890  notation/rhythms.itely
1793  notation/expressive.itely
1050  notation/repeats.itely
2821  notation/simultaneous.itely
2476  notation/staff.itely
954   notation/editorial.itely
2816  notation/text.itely
81    notation/specialist.itely -- Specialist notation
5190  notation/vocal.itely
1972  notation/chords.itely
702   notation/piano.itely
811   notation/percussion.itely
826   notation/guitar.itely
66    notation/strings.itely
242   notation/bagpipes.itely
5375  notation/ancient.itely
10392 notation/input.itely -- Input syntax
2164  notation/non-music.itely -- Non-musical notation
12256 notation/spacing.itely -- Spacing issues
15289 notation/changing-defaults.itely -- Changing defaults
5187  notation/programming-interface.itely -- Interfaces for programmers
2176  notation/notation-appendices.itely -- Notation manual tables
252   notation/cheatsheet.itely -- Cheat sheet
87188 total

-6- Rest of Application Usage
4137  usage/lilypond-book.itely -- LilyPond-book
1122  usage/converters.itely -- Converting from other formats
5259  total

-7- Appendices whose translation is optional
326   essay/literature.itely
1222  learning/scheme-tutorial.itely (should be revised first)
1548  total
```

In addition, not listed above, Snippets' titles and descriptions should be translated; they are a part of the Notation Reference and therefore their priority is 5.

Translating the Web site and other Texinfo documentation

Every piece of text should be translated in the source file, except Texinfo comments, text in `@lilypond` blocks and a few cases mentioned below.

Node names are translated, but the original node name in English should be kept as the argument of `@translationof` put after the section title; that is, every piece in the original file like

```
@node Foo bar
@section_command Bar baz
```

should be translated as

```
@node translation of Foo bar
@section_command translation of Bar baz
```

```
@translationof Foo bar
```

The argument of `@rglos` commands and the first argument of `@rglosnamed` commands must not be translated, as it is the node name of an entry in Music Glossary.

Every time you translate a node name in a cross-reference, i.e. the argument of commands `@ref, @rprogram, @rlearning, @rlsr, @ruser` or the first argument of their `*named` variants, you should make sure the target node is defined in the correct source file; if you do not intend to translate the target node right now, you should at least write the node definition (that is, the `@node @section_commmand @translationof` trio mentioned above) in the expected source file and define all its parent nodes; for each node you have defined this way but have not translated, insert a line that contains `@untranslated`. That is, you should end up for each untranslated node with something like

```
@node translation of Foo bar
@section_command translation of Bar baz
@translationof Foo bar

@untranslated
```

> **Note:** you do not have to translate the node name of a cross-reference to a node that you do not have translated. If you do, you must define an "empty" node like explained just above; this will produce a cross-reference with the translated node name in output, although the target node will still be in English. On the opposite, if all cross-references that refer to an untranslated node use the node name in English, then you do not have to define such an "empty" node, and the cross-reference text will appear in English in the output. The choice between these two strategies implies its particular maintenance requirements and is left to the translators, although the opinion of the Translation meister leans towards not translating these cross-references.

Please think of the fact that it may not make sense translating everything in some Texinfo files, and you may take distance from the original text; for instance, in the translation of the web site section Community, you may take this into account depending on what you know the community in your language is willing to support, which is possible only if you personally assume this support, or there exists a public forum or mailing list listed in Community for LilyPond in your language:

- Section "Bug reports" in *General Information*: this page should be translated only if you know that every bug report sent on your language's mailing list or forum will be handled by someone who will translate it to English and send it on bug-lilypond or add an issue in the tracker, then translate back the reply from developers.
- Section "Help us" in *General Information*: this page should be translated very freely, and possibly not at all: ask help for contributing to LilyPond for tasks that LilyPond community in your language is able and going to handle.

In any case, please mark in your work the sections which do not result from the direct translation of a piece of English translation, using comments i.e. lines starting with '`@c`'.

Finally, press in Emacs `C-c C-u C-a` to update or generate menus. This process should be made easier in the future, when the helper script `texi-langutils.py` and the makefile target are updated.

Some pieces of text manipulated by build scripts that appear in the output are translated in a '`.po`' file – just like LilyPond output messages – in '`Documentation/po`'. The Gettext

domain is named `lilypond-doc`, and unlike `lilypond` domain it is not managed through the Free Translation Project.

Take care of using typographic rules for your language, especially in '`macros.itexi`'.

If you wonder whether a word, phrase or larger piece of text should be translated, whether it is an argument of a Texinfo command or a small piece sandwiched between two Texinfo commands, try to track whether and where it appears in PDF and/or HTML output as visible text. This piece of advice is especially useful for translating '`macros.itexi`'.

Please keep verbatim copies of music snippets (in `@lilypond` blocs). However, some music snippets containing text that shows in the rendered music, and sometimes translating this text really helps the user to understand the documentation; in this case, and only in this case, you may as an exception translate text in the music snippet, and then you must add a line immediately before the `@lilypond` block, starting with

```
@c KEEP LY
```

Otherwise the music snippet would be reset to the same content as the English version at next `make snippet-update` run – see [Updating documentation translation], page 74.

When you encounter

```
@lilypondfile[<number of fragment options>,texidoc]{filename.ly}
```

in the source, open '`Documentation/snippets/`*`filename`*`.ly`', translate the `texidoc` header field it contains, enclose it with `texidoc`*`MY-LANGUAGE`*` = "` and `"`, and write it into '`Documentation/`*`MY-LANGUAGE`*`/texidocs/`*`filename`*`.texidoc`'. Additionally, you may translate the snippet's title in `doctitle` header field, in case `doctitle` is a fragment option used in `@lilypondfile`; you can do this exactly the same way as `texidoc`. For instance, '`Documentation/`*`MY-LANGUAGE`*`/texidocs/`*`filename`*`.texidoc`' may contain

```
doctitlees = "Spanish title baz"
texidoces = "
Spanish translation blah
"
```

`@example` blocks need not be verbatim copies, e.g. variable names, file names and comments should be translated.

Finally, please carefully apply every rule exposed in Section 5.3 [Texinfo introduction and usage policy], page 55, and Section 5.4 [Documentation policy], page 63. If one of these rules conflicts with a rule specific to your language, please ask the Translation meister on `translations@lilynet.net` list and/or the Documentation Editors on `lilypond-devel@gnu.org` list.

Adding a Texinfo manual

In order to start translating a new manual whose basename is *FOO*, do

```
cd Documentation/MY-LANGUAGE
cp ../FOO.tely .
mkdir FOO
cp web/GNUmakefile FOO
```

then append *FOO* to variable `SUBDIRS` in Documentation/*MY-LANGUAGE*/GNUmakefile, then translate file *MY-LANGUAGE*/*FOO*.tely and run `skeleton-update`:

```
cd Documentation/
make ISOLANG=MY-LANGUAGE TEXI_LANGUTIL_FLAGS=--head-only skeleton-update
```

Your are now ready to translate the new manual exactly like the web site or the Learning Manual.

5.8.3 Documentation translation maintenance

Several tools have been developed to make translations maintenance easier. These helper scripts make use of the power of Git, the version control system used for LilyPond development.

You should use them whenever you would like to update the translation in your language, which you may do at the frequency that fits your and your cotranslators' respective available times. In the case your translation is up-do-date (which you can discover in the first subsection below), it is enough to check its state every one or two weeks. If you feel overwhelmed by the quantity of documentation to be updated, see [Maintaining without updating translations], page 76.

Check state of translation

First pull from Git – see Section 3.3.2 [Pulling and rebasing], page 20, but DO NOT rebase unless you are sure to master the translation state checking and updating system – then cd into '`Documentation/`' (or at top of the source tree, replace `make` with `make -C Documentation`) and run

```
make ISOLANG=MY_LANGUAGE check-translation
```

This presents a diff of the original files since the most recent revision of the translation. To check a single file, cd into '`Documentation/`' and run

```
make CHECKED_FILES=MY_LANGUAGE/manual/foo.itely check-translation
```

In case this file has been renamed since you last updated the translation, you should specify both old and new file names, e.g. `CHECKED_FILES=MY_LANGUAGE/{manual,user}/foo.itely`.

To see only which files need to be updated, do

```
make ISOLANG=MY_LANGUAGE check-translation | grep 'diff --git'
```

To avoid printing terminal colors control characters, which is often desirable when you redirect output to a file, run

```
make ISOLANG=MY_LANGUAGE NO_COLOR=1 check-translation
```

You can see the diffs generated by the commands above as changes that you should make in your language to the existing translation, in order to make your translation up to date.

> **Note:** do not forget to update the committish in each file you have completely updated, see [Updating translation committishes], page 75.

Global state of the translation is recorded in '`Documentation/translations.itexi`', which is used to generate Translations status page. To update that page, do from '`Documentation/`'

```
make translation-status
```

This will also leave '`out/translations-status.txt`', which contains up-to-dateness percentages for each translated file, and update word counts of documentation files in this Guide.

See also

[Maintaining without updating translations], page 76.

Updating documentation translation

Instead of running `check-translation`, you may want to run `update-translation`, which will run your favorite text editor to update files. First, make sure environment variable `EDITOR` is set to a text editor command, then run from '`Documentation/`'

```
make ISOLANG=MY_LANGUAGE update-translation
```

or to update a single file

```
make CHECKED_FILES=MY_LANGUAGE/manual/foo.itely update-translation
```

For each file to be updated, `update-translation` will open your text editor with this file and a diff of the file in English; if the diff cannot be generated or is bigger than the file in English itself, the full file in English will be opened instead.

> **Note:** do not forget to update the committish in each file you have completely updated, see [Updating translation committishes], page 75.

Texinfo skeleton files, i.e. '`.itely`' files not yet translated, containing only the first node of the original file in English can be updated automatically: whenever `make check-translation` shows that such files should be updated, run from '`Documentation/`'

```
make ISOLANG=MY_LANGUAGE skeleton-update
```

'`.po`' message catalogs in '`Documentation/po/`' may be updated by issuing from '`Documentation/`' or '`Documentation/po/`'

```
make po-update
```

> **Note:** if you run po-update and somebody else does the same and pushes before you push or send a patch to be applied, there will be a conflict when you pull. Therefore, it is better that only the Translation meister runs this command.

Updating music snippets can quickly become cumbersome, as most snippets should be identical in all languages. Fortunately, there is a script that can do this odd job for you (run from '`Documentation/`'):

```
make ISOLANG=MY_LANGUAGE snippet-update
```

This script overwrites music snippets in '*`MY_LANGUAGE/foo/every.itely`*' with music snippets from '*`foo/every.itely`*'. It ignores skeleton files, and keeps intact music snippets preceded with a line starting with `@c KEEP LY`; it reports an error for each '`.itely`' that has not the same music snippet count in both languages. Always use this script with a lot of care, i.e. run it on a clean Git working tree, and check the changes it made with `git diff` before committing; if you don't do so, some `@lilypond` snippets might be broken or make no sense in their context.

Finally, a command runs the three update processes above for all enabled languages (from '`Documentation/`'):

```
make all-translations-update
```

Use this command with caution, and keep in mind it will not be really useful until translations are stabilized after the end of GDP and GOP.

See also

[Maintaining without updating translations], page 76, Section 7.2 [Adding and editing snippets], page 84.

Updating translation committishes

At the beginning of each translated file except PO files, there is a committish which represents the revision of the sources which you have used to translate this file from the file in English.

When you have pulled and updated a translation, it is very important to update this committish in the files you have completely updated (and only these); to do this, first commit possible changes to any documentation in English which you are sure to have done in your translation as well, then replace in the up-to-date translated files the old committish by the committish of latest commit, which can be obtained by doing

```
git rev-list HEAD |head -1
```

Most of the changes in the LSR snippets included in the documentation concern the syntax, not the description inside `texidoc=""`. This implies that quite often you will have to update only the committish of the matching .texidoc file. This can be a tedious work if there are many snippets to be marked as up do date. You can use the following command to update the committishes at once:

```
cd Documentation/LANG/texidocs
sed -i -r 's/[0-9a-z]{40}/NEW-COMMITTISH/' *.texidoc
```

See also

Chapter 7 [LSR work], page 84.

5.8.4 Translations management policies

These policies show the general intent of how the translations should be managed, they aim at helping translators, developers and coordinators work efficiently.

Maintaining without updating translations

Keeping translations up to date under heavy changes in the documentation in English may be almost impossible, especially as during the former Grand Documentation Project (GDP) or the Grand Organization Project (GOP) when a lot of contributors brings changes. In addition, translators may be — and that is a very good thing — involved in these projects too.

it is possible — and even recommended — to perform some maintenance that keeps translated documentation usable and eases future translation updating. The rationale below the tasks list motivates this plan.

The following tasks are listed in decreasing priority order.

1. Update macros.itexi. For each obsolete macro definition, if it is possible to update macro usage in documentation with an automatic text or regexp substitution, do it and delete the macro definition from '`macros.itexi`'; otherwise, mark this macro definition as obsolete with a comment, and keep it in '`macros.itexi`' until the documentation translation has been updated and no longer uses this macro.
2. Update '`*.tely`' files completely with `make check-translation` – you may want to redirect output to a file because of overwhelming output, or call check-translation.py on individual files, see [Check state of translation], page 74.
3. In '`.itelys`', match sections and .itely file names with those from English docs, which possibly involves moving nodes contents in block between files, without updating contents itself. In other words, the game is catching where has gone each section. In Learning manual, and in Notation Reference sections which have been revised in GDP, there may be completely new sections: in this case, copy `@node` and `@section`-command from English docs, and add the marker for untranslated status `@untranslated` on a single line. Note that it is not possible to exactly match subsections or subsubsections of documentation in English, when contents has been deeply revised; in this case, keep obsolete (sub)subsections in the translation, marking them with a line `@c obsolete` just before the node.

   Emacs with Texinfo mode makes this step easier:

   - without Emacs AucTeX installed, `C-c C-s` shows structure of current Texinfo file in a new buffer `*Occur*`; to show structure of two files simultaneously, first split Emacs window in 4 tiles (with `C-x 1` and `C-x 2`), press `C-c C-s` to show structure of one file (e.g. the translated file), copy `*Occur*` contents into `*Scratch*`, then press `C-c C-s` for the other file.

If you happen to have installed AucTeX, you can either call the macro by doing `M-x texinfo-show-structure` or create a key binding in your '`~/.emacs`', by adding the four following lines:

```
(add-hook 'Texinfo-mode-hook
          '(lambda ()
             (define-key Texinfo-mode-map "\C-cs"
              'texinfo-show-structure)))
```

and then obtain the structure in the `*Occur*` buffer with `C-c s`.

- Do not bother updating `@menu`s when all menu entries are in the same file, just do `C-c C-u C-a` ("update all menus") when you have updated all the rest of the file.
- Moving to next or previous node using incremental search: press `C-s` and type `node` (or `C-s @node` if the text contains the word 'node') then press `C-s` to move to next node or `C-r` to move to previous node. Similar operation can be used to move to the next/previous section. Note that every cursor move exits incremental search, and hitting `C-s` twice starts incremental search with the text entered in previous incremental search.
- Moving a whole node (or even a sequence of nodes): jump to beginning of the node (quit incremental search by pressing an arrow), press `C-SPACE`, press `C-s node` and repeat `C-s` until you have selected enough text, cut it with `C-w` or `C-x`, jump to the right place (moving between nodes with the previous hint is often useful) and paste with `C-y` or `C-v`.

4. Update sections finished in the English documentation; check sections status at
   http://lilypondwiki.tuxfamily.org/index.php?title=Documentation_coordination.
5. Update documentation PO. It is recommended not to update strings which come from documentation that is currently deeply revised in English, to avoid doing the work more than once.
6. Fix broken cross-references by running (from '`Documentation/`')

   ```
   make ISOLANG=YOUR-LANGUAGE fix-xrefs
   ```

   This step requires a successful documentation build (with `make doc`). Some cross-references are broken because they point to a node that exists in the documentation in English, which has not been added to the translation; in this case, do not fix the cross-reference but keep it `"broken"`, so that the resulting HTML link will point to an existing page of documentation in English.

Rationale

You may wonder if it would not be better to leave translations as-is until you can really start updating translations. There are several reasons to do these maintenance tasks right now.

- This will have to be done sooner or later anyway, before updating translation of documentation contents, and this can already be done without needing to be redone later, as sections of documentation in English are mostly revised once. However, note that not all documentation sectioning has been revised in one go, so all this maintenance plan has to be repeated whenever a big reorganization is made.
- This just makes translated documentation take advantage of the new organization, which is better than the old one.
- Moving and renaming sections to match sectioning of documentation in English simplify future updating work: it allows updating the translation by side-by-side comparison, without bothering whether cross-reference names already exist in the translation.
- Each maintenance task except 'Updating PO files' can be done by the same person for all languages, which saves overall time spent by translators to achieve this task: the node

names and section titles are in English, so you can do. It is important to take advantage of this now, as it will be more complicated (but still possible) to do step 3 in all languages when documentation is compiled with `texi2html` and node names are directly translated in source files.

Managing documentation translation with Git

This policy explains how to manage Git branches and commit translations to Git.

- Translation work is made on `translation` branch. This branch is merged on `staging` once a week, approximately. Then, `master` branch is merged on `translation`, where the check-translation script (see [Check state of translation], page 74) shows changes in English docs which should be translated, and the cycle starts again.
- Translations may be pushed directly to `staging` only if they do not break compilation of LilyPond and its documentation. Those changes could be pushed to `translation` too, or alternatively translators could wait until they come from `master` the next time it is merged on `translation`. Similarly, changes matching `stable/X.Y` are preferably made on `X.Ytranslation`.
- `translation` Git branch may be merged into `staging` branch only if LilyPond (`make all`) and documentation (`make doc`) compile successfully.
- `make` and `make doc` are usually successful in `master` Git branch because those tests should have already succeeded in `staging` branch before merging. `master` branch may be merged into `translation` when significant changes had been made in documentation in English in `master` branch.
- General maintenance may be done by anybody who knows what he does in documentation in all languages, without informing translators first. General maintenance include simple text substitutions (e.g. automated by sed), compilation fixes, updating Texinfo or lilypond-book commands, updating macros, updating ly code, fixing cross-references, and operations described in [Maintaining without updating translations], page 76.

5.8.5 Technical background

A number of Python scripts handle a part of the documentation translation process. All scripts used to maintain the translations are located in '`scripts/auxiliar/`'.

- '`check_translation.py`' – show diff to update a translation,
- '`texi-langutils.py`' – quickly and dirtily parse Texinfo files to make message catalogs and Texinfo skeleton files,
- '`texi-skeleton-update.py`' – update Texinfo skeleton files,
- '`update-snippets.py`' – synchronize ly snippets with those from English docs,
- '`translations-status.py`' – update translations status pages and word counts in the file you are reading,
- '`tely-gettext.py`' – gettext node names, section titles and references in the sources; WARNING only use this script once for each file, when support for "makeinfo –html" has been dropped.

Other scripts are used in the build process, in '`scripts/build/`':

- '`mass-link.py`' – link or symlink files between English documentation and documentation in other languages.

Python modules used by scripts in '`scripts/auxiliar/`' or '`scripts/build/`' (but not by installed Python scripts) are located in '`python/auxiliar/`':

- '`manuals_definitions.py`' – define manual names and name of cross-reference Texinfo macros,

- '`buildlib.py`' – common functions (read piped output of a shell command, use Git),
- '`postprocess_html.py`' (module imported by '`www_post.py`') – add footer and tweak links in HTML pages.

And finally

- '`python/langdefs.py`' – language definitions module

6 Website work

6.1 Introduction to website work

The website is *not* written directly in HTML; instead, the source is Texinfo, which is then generated into HTML, PDF, and Info formats. The sources are

```
Documentation/web.texi
Documentation/web/*.texi
```

Unless otherwise specified, follow the instructions and policies given in Chapter 5 [Documentation work], page 53. That chapter also contains a quick introduction to Texinfo; consulting an external Texinfo manual should be not necessary.

Exceptions to the documentation policies

- Sectioning: the website only uses chapters and sections; no subsections or subsubsections.
- @ref{}s to other manuals (@ruser, @rlearning, etc): you can't link to any pieces of automatically generated documentation, like the IR or certain NR appendices.
- The bibliography in Community->Publications is generated automatically from '`.bib`' files; formatting is done automatically by '`texi-web.bst`'.
- ...
- For anything not listed here, just follow the same style as the existing website texinfo files.

6.2 Uploading and security

Overall idea

To reduce the CPU burden on the shared host (as well as some security concerns), we do not compile all of LilyPond. The website build process runs `texi2html`, but all media files (be they graphical `lilypond` output, photos of people, or pdfs) are copied from the `$LILYPOND_WEB_MEDIA_GIT` repository.

All scripts and makefiles used for the website build are run from a "trusted" copy. Any modification to those files in git needs a human to review the changes (after they have been made in git) before they are used on the server.

Building the website (quick local)

Initial setup: make sure that you have the environment variables `$LILYPOND_GIT`, `$LILYPOND_BUILD_DIR` and `$LILYPOND_WEB_MEDIA_GIT` set up correctly. For more information, see Section 14.2 [Environment variables], page 164.

Once that is done,

```
cd $LILYPOND_BUILD_DIR
make website
```

The website is in '`out-website/website/index.html`'.

Building the website (exactly as on the server)

Setting up (exactly as on the server)

Initial setup: you still need `$LILYPOND_GIT` and `$LILYPOND_WEB_MEDIA_GIT`.

Once that's done, create:

```
mkdir -p $HOME/lilypond/
mkdir -p $HOME/lilypond/bin/
```

```
mkdir -p $HOME/lilypond/cron/
mkdir -p $HOME/lilypond/trusted-scripts/
```

The add these files to '`$HOME/lilypond/bin/`':

Update git repositories:

```
### update-git.sh
#!/bin/sh
cd $LILYPOND_GIT
git fetch origin
git merge origin/master
cd $LILYPOND_WEB_MEDIA_GIT
git fetch origin
git merge origin/master
```

Check for any updates to trusted scripts / files:

```
### check-git.sh
#!/bin/sh
DEST=$HOME/lilypond/trusted-scripts
diff -u $DEST/website.make \
  $LILYPOND_GIT/make/website.make
diff -u $DEST/lilypond-texi2html.init \
  $LILYPOND_GIT/Documentation/lilypond-texi2html.init
diff -u $DEST/extract_texi_filenames.py \
  $LILYPOND_GIT/scripts/build/extract_texi_filenames.py
diff -u $DEST/create-version-itexi.py \
  $LILYPOND_GIT/scripts/build/create-version-itexi.py
diff -u $DEST/create-weblinks-itexi.py \
  $LILYPOND_GIT/scripts/build/create-weblinks-itexi.py
diff -u $DEST/mass-link.py \
  $LILYPOND_GIT/scripts/build/mass-link.py
diff -u $DEST/website_post.py \
  $LILYPOND_GIT/scripts/build/website_post.py
diff -u $DEST/bib2texi.py \
  $LILYPOND_GIT/scripts/build/bib2texi.py
diff -u $DEST/langdefs.py \
  $LILYPOND_GIT/python/langdefs.py
diff -u $DEST/lilypond.org.htaccess \
  $LILYPOND_GIT/Documentation/web/server/lilypond.org.htaccess
diff -u $DEST/website-dir.htaccess \
  $LILYPOND_GIT/Documentation/web/server/website-dir.htaccess
```

If the changes look ok, make them trusted:

```
### copy-from-git.sh
#!/bin/sh
DEST=$HOME/lilypond/trusted-scripts
cp $LILYPOND_GIT/make/website.make \
  $DEST/website.make
cp $LILYPOND_GIT/Documentation/lilypond-texi2html.init \
  $DEST/lilypond-texi2html.init
cp $LILYPOND_GIT/scripts/build/extract_texi_filenames.py \
  $DEST/extract_texi_filenames.py
cp $LILYPOND_GIT/scripts/build/create-version-itexi.py \
  $DEST/create-version-itexi.py
cp $LILYPOND_GIT/scripts/build/create-weblinks-itexi.py \
  $DEST/create-weblinks-itexi.py
cp $LILYPOND_GIT/scripts/build/mass-link.py \
  $DEST/mass-link.py
cp $LILYPOND_GIT/scripts/build/website_post.py \
  $DEST/website_post.py
cp $LILYPOND_GIT/scripts/build/bib2texi.py \
  $DEST/bib2texi.py
cp $LILYPOND_GIT/python/langdefs.py \
  $DEST/langdefs.py
cp $LILYPOND_GIT/Documentation/web/server/lilypond.org.htaccess \
  $DEST/lilypond.org.htaccess
```

```
cp $LILYPOND_GIT/Documentation/web/server/website-dir.htaccess \
  $DEST/website-dir.htaccess
```

Build the website:

```
### make-website.sh
#!/bin/sh
DEST=$HOME/web/
BUILD=$HOME/lilypond/build-website
mkdir -p $BUILD
cd $BUILD
cp $HOME/lilypond/trusted-scripts/website.make .

make -f website.make WEBSITE_ONLY_BUILD=1 website
rsync -raO $BUILD/out-website/website/ $DEST/website/
cp $BUILD/out-website/pictures $DEST
cp $BUILD/out-website/.htaccess $DEST
```

Then in the '`cronjob/`' directory, put the cronjob to automate the trusted portions:

> **Note:** `cron` will not inherit environment variables from your main setup, so you must re-define any variables inside your `crontab`.

```
# website-rebuild.cron
LILYPOND_GIT=   ... fill this in
LILYPOND_WEB_MEDIA_GIT=   ... fill this in

11 * * * * $HOME/lilypond/trusted-scripts/update-git.sh >/dev/null 2>&1
22 * * * * $HOME/lilypond/trusted-scripts/make-website.sh >/dev/null 2>&1
```

As the final stage of the setup, run your `copy-from-git.sh` script, assuming that you trust the current state of scripts in lilypond git.

Normal maintenance

When there is a change to the build scripts and/or website makefile, log in to the server (or your own home machine if you're testing this there), and do

```
update-git.sh
check-git.sh
```

After reviewing the changes carefully, you can update the trusted scripts with `copy-from-git.sh`.

Building the website (exactly as on the server)

Run `make-website.sh`; the final version ends up in '`$HOME/web/`'.

On the actual server, the website is generated hourly by user `graham` the host `lilypond.org`. You can set up the cronjob by doing:

```
crontab $HOME/lilypond/website-rebuild.cron
```

Initial setup for new users on actual serve

You should symlink your own '`~/lilypond/`' to '`~graham/lilypond/`'

If this directory does not exist, make it. Git master should go in '`~/lilypond/lilypond-git/`' but make sure you enable:

```
git config core.filemode false
```

If you have created any files in '`~graham/lilypond/`' then please run:

```
chgrp lilypond ~graham/lilypond/ -R
chmod 775 ~graham/lilypond/ -R
```

Additional information

Some information about the website is stored in '`~graham/lilypond/*.txt`'; this information should not be shared with people without trusted access to the server.

6.3 Debugging website and docs locally

- Install apache2, or any other http server. These instructions assume that you also enable `mod_userdir`, and use `$HOME/public_html` as the location.
- Build the online docs and website:

  ```
  make WEB_TARGETS="offline online" doc
  make website
  ```

  This will make all the language variants of the website. To save a little time, just the English version can be made with the command `make WEB_LANGS='' website` or the English and (for example) the French with `make WEB_LANGS='fr' website`.
- Move the built stuff into those directories. It's highly recommended to have your build dir and www dir on the same partition. (make `$HOME/public_html/` a symlink if necessary)

  ```
  mv out-website/website/ $HOME/public_html
  mv $HOME/public_html/website/pictures $HOME/public_html/
  mkdir -p $HOME/public_html/doc/v2.13/
  mv out-www/online-root/* $HOME/public_html/doc/v2.13/
  ```

6.4 Translating the website

As it has much more audience, the website should be translated before the documentation; see Section 5.8 [Translating the documentation], page 68.

In addition to the normal documentation translation practices, there are a few additional things to note:

- Build the website with:

  ```
  make website
  ```

  however, please note that this command is not designed for being run multiple times. If you see unexpected output (mainly the page footers getting all messed up), then delete your '`out-website`' directory and run `make website` again.
- Some of the translation infrastructure is defined in python files; you must look at the `### translation data` sections in:

  ```
  scripts/build/create-weblinks-itexi.py
  scripts/build/website_post.py
  ```
- Translations are not included by default in `make website`. To test your translation, edit the `WEB_LANGUAGES =` line in '`python/langdefs.py`'. You will need to copy this updated script to `$LILYPOND_BUILD_DIR/python/out`.

  Do not submit a patch to add your language to this file unless `make website` completes with fewer than 5 warnings.
- Links to manuals are done with macros like `@manualDevelLearningSplit`. To get translated links, you must change that to `@manualDevelLearningSplit-es` (for es/Spanish translations, for example).

7 LSR work

7.1 Introduction to LSR

The LilyPond Snippet Repository (LSR) is a collection of lilypond examples. A subset of these examples are automatically imported into the documentation, making it easy for users to contribute to the docs without learning Git and Texinfo.

7.2 Adding and editing snippets

General guidelines

When you create (or find!) a nice snippet, if it is supported by the LilyPond version running on the LSR, please add it to the LSR. Go to LSR and log in – if you haven't already, create an account. Follow the instructions on the website. These instructions also explain how to modify existing snippets.

If you think the snippet is particularly informative and you think it should be included in the documentation, tag it with "docs" and one or more other categories, or ask on the development list for somebody who has editing permissions to do it .

Please make sure that the lilypond code follows the guidelines in Section 5.3.4 [LilyPond formatting], page 57.

If a new snippet created for documentation purposes compiles with LilyPond version currently on LSR, it should be added to LSR, and a reference to the snippet should be added to the documentation. Please ask a documentation editor to add a reference to it in an appropriate place in the docs. (Note – it should appear in the snippets document automatically, once it has been imported into git and built. See Section 7.4 [LSR to Git], page 85.

If the new snippet uses new features that are not available in the current LSR version, the snippet should be added to '`Documentation/snippets/new`' and a reference should be added to the manual.

Snippets created or updated in '`Documentation/snippets/new`' should be copied to '`Documentation/snippets`' by invoking at top of the source tree

```
scripts/auxiliar/makelsr.py
```

Be sure that `make doc` runs successfully before submitting a patch, to prevent breaking compilation.

Formatting snippets in '`Documentation/snippets/new`'

When adding a file to this directory, please start the file with

```
\version "2.x.y"
\header {
% Use existing LSR tags other than 'docs'; see makelsr.py for
% the list of tags used to sort snippets.  E.g.:
  lsrtags = "rhythms,expressive-marks"
% This texidoc string will be formatted by Texinfo
  texidoc = "
This code demonstrates ...
"
% Please put doctitle last so that the '% begin verbatim'
% mark will be added correctly by makelsr.py.
  doctitle = "Snippet title"
}
```

and name the file '`snippet-title.ly`'.

Please ensure that the version number you use at the top of the example is the minimum version that the file will compile with: for example, if the LSR is currently at 2.14.2 and your example requires 2.15.30, but the current development version of `lilypond` is 2.17.5, put `\version "2.15.30"` in the example.

Please also pay particular attention to the lines beginning `lsrtags =` and `doctitle =`. The tags must match tags used in the documentation, and the `doctitle` must match the filename.

7.3 Approving snippets

The main task of LSR editors is approving snippets. To find a list of unapproved snippets, log into LSR and select "No" from the dropdown menu to the right of the word "Approved" at the bottom of the interface, then click "Enable filter".

Check each snippet:

1. Does the snippet make sense and does what the author claims that it does? If you think the snippet is particularly helpful, add the "docs" tag and at least one other tag.
2. If the snippet is tagged with "docs", check to see if it matches our guidelines for Section 5.3.4 [LilyPond formatting], page 57.

   Also, snippets tagged with "docs" should not be explaining (replicating) existing material in the docs. They should not refer to the docs; the docs should refer to them.
3. If the snippet uses scheme, check that everything looks good and there are no security risks.

   > **Note:** Somebody could sneak a `#'(system "rm -rf /")` command into our source tree if you do not do this! Take this step **VERY SERIOUSLY**.

4. If all is well, check the box labelled "approved" and save the snippet.

7.4 LSR to Git

Introduction

Snippets used in the documentation are in '`$LILYPOND_GIT/Documentation/snippets`'. This directory contains a complete set of the snippets in the LSR which are tagged with 'docs'. The exact method for getting them there is described below, but in essence they come from downloading a tarball from the LSR and importing into the directory using the `makelsr` script.

Any snippets which are too bleeding edge to run on the LSR (which uses a stable development version) are put into '`$LILYPOND_GIT/Documentation/snippets/new`'. Once the LSR has been upgraded so that these will run, then they are transferred to the LSR and deleted from '`/snippets/new`'.

'Git' is the shorthand name for the Git repository that contains all the development code. For further information on setting this up see, Chapter 3 [Working with source code], page 12. An alternative to setting up a Git repository for people wanting to do LSR work is to get the source code from `http://lilypond.org/website/development.html`.

Importing the LSR to Git

1. Make sure that `convert-ly` script and the `lilypond` binary are a bleeding edge version – the latest release or even better, a fresh snapshot from Git master, with the environment variable `LILYPOND_BUILD_DIR` correctly set up, see Section 14.2 [Environment variables], page 164.

2. Start by creating a list of updated snippets from your local repository. From the top source directory, run:

   ```
   scripts/auxiliar/makelsr.py
   ```

   Commit the changes and make a patch. Check the patch has nothing other than minor changes. If all is good and you're confident in what you've done, this can be pushed directly to staging.

3. Next, download the updated snippets and run `makelsr.py` against them. From the top source directory, run:

   ```
   wget http://lsr.dsi.unimi.it/download/lsr-snippets-docs-`date +%F`.tar.gz
   tar -xzf lsr-snippets-docs-`date +%F`.tar.gz
   make -C $LILYPOND_BUILD_DIR
   scripts/auxiliar/makelsr.py lsr-snippets-docs-`date +%F`
   ```

   where `date +%F` gives the current date in format *YYYY-MM-DD* (the snippets archive is usually generated around 03:50 CET, you may want to use `date -d yesterday +%F` instead, depending on your time zone and the time you run this commands sequence). `make` is included in this sequence so that `makelsr` can run `lilypond` and `convert-ly` versions that match current source tree; you can select different binaries if desired or needed, to see options for this do

   ```
   scripts/auxiliar/makelsr.py --help
   ```

4. Follow the instructions printed on the console to manually check for unsafe files. These are:

   ```
   Unsafe files printed in lsr-unsafe.txt: CHECK MANUALLY!
     git add Documentation/snippets/*.ly
     xargs git diff HEAD < lsr-unsafe.txt
   ```

   First, it's important to check for any added files and add them to the files git is tracking. Run `git status` and look carefully to see if files have been added. If so, add them with `git add`.

   As the console says, `makelsr` creates a list of possibly unsafe files in '`lsr-unsafe.txt`' by running `lilypond` against each snippet using the `-dsafe` switch. This list can be quite long. However, by using the command `xargs git diff HEAD < lsr-unsafe.txt` git will take that list and check whether any of the snippets are different from the snippet already in master. If any is different it must be checked manually VERY CAREFULLY.

   > **Note:** Somebody could sneak a `#'(system "rm -rf /")` command into our source tree if you do not do this! Take this step **VERY SERIOUSLY**.

   If there is any doubt about any of the files, you are strongly advised to run a review on Rietveld.

5. If a Review is not needed, commit the changes and push to `staging`.

Note that whenever there is a snippet in '`Documentation/snippets/new`' and another from the LSR with the same file name, `makelsr.py` will overwrite the LSR version with the one from '`Documentation/snippets/new`'.

7.5 Fixing snippets in LilyPond sources

If some snippet from '`Documentation/snippets`' causes the documentation compilation to fail, the following steps should be followed to fix it reliably.

1. Look up the snippet filename '*`foo`*`.ly`' in the error output or log, then fix the file '`Documentation/snippets/`*`foo`*`.ly`' to make the documentation build successfully.
2. Determine where it comes from by looking at its first two lines, e.g. run

```
head -2 Documentation/snippets/foo.ly
```

3. **If the snippet comes from the LSR**, also apply the fix to the snippet in the LSR and send a notification email to an LSR editor with CC to the development list – see Section 7.2 [Adding and editing snippets], page 84. The failure may sometimes not be caused by the snippet in LSR but by the syntax conversion made by `convert-ly`; in this case, try to fix `convert-ly` or report the problem on the development list, then run `makelsr.py` again, see Section 7.4 [LSR to Git], page 85. In some cases, when some features has been introduced or vastly changed so it requires (or takes significant advantage of) important changes in the snippet, it is simpler and recommended to write a new version of the snippet in '`Documentation/snippets/new`', then run `makelsr.py`.
4. **If the snippet comes from** '`Documentation/snippets/new`', apply the fix in '`Documentation/snippets/new/foo.ly`', then run `makelsr.py` without argument from top of the source tree:

   ```
   scripts/auxiliar/makelsr.py
   ```

   Then, inspect '`Documentation/snippets/foo.ly`' to check that the fix has been well propagated.

   If the build failure was caused by a translation string, you may have to fix some '`Documentation/lang/texidocs/foo.texidoc`' instead; in case the build failure comes only from translation strings, it is not needed to run `makelsr.py`.
5. When you've done, commit your changes to Git and ensure they're pushed to the correct branch.

7.6 Renaming a snippet

Due to the potential duality of snippets (i.e. they may exist both in the LSR database, and in `Documentation/snippets/new/`), this process is a bit more involved than we might like.

1. Send an email LSR editor, requesting the renaming.
2. The LSR editor does the renaming (or debates the topic with you), then warns the LSR-to-git person (wanted: better title) about the renaming.
3. LSR-to-git person does his normal job, but then also renames any copies of the snippets in `Documentation/snippets/new/`, and any instances of the snippet name in the documentation.

   `git grep` is highly recommended for this task.

7.7 Updating the LSR to a new version

To update the LSR, perform the following steps:

1. Start by emailing the LSR maintainer, Sebastiano, and liaising with him to ensure that updating the snippets is synchronised with updating the binary running the LSR.
2. Download the latest snippet tarball from `http://lsr.dsi.unimi.it/download/` and extract it. The relevant files can be found in the '`all`' subdirectory. Make sure your shell is using an English language version, for example `LANG=en_US`, then run `convert-ly` on all the files. Use the command-line option `--to=version` to ensure the snippets are updated to the correct stable version.
3. Make sure that you are using `convert-ly` from the latest available release to gain best advantage from the latest `converting-rules-updates`.

   For example:

   - LSR-version: 2.12.2
   - intended LSR-update to 2.14.2

- latest release 2.15.30

Use convert-ly from 2.15.30 and the following terminal command for all files:

```
convert-ly -e -t2.14.2 *.ly
```

4. There might be no conversion rule for some old commands. To make an initial check for possible problems you can run the following script on a copy of the '`all`' subdirectory:

```
#!/bin/bash

for LILYFILE in *.ly
do
  STEM=$(basename "$LILYFILE" .ly)
  echo "running $LILYFILE..."
  convert-ly -e -t<version> "$LILYFILE" >& "$STEM".txt
done

grep refer *.txt
grep smart *.txt
TODO: better script
```

5. Copy relevant snippets (i.e. snippets whose version is equal to or less than the new version of LilyPond running on the LSR) from '`Documentation/snippets/new/`' into the set of files to be used to make the tarball. Make sure you only choose snippets which are already present in the LSR, since the LSR software isn't able to create new snippets this way. If you don't have a Git repository for LilyPond, you'll find these snippets in the source-tarball on http://lilypond.org/website/development.html. Don't rename any files at this stage.
6. Verify that all files compile with the new version of LilyPond, ideally without any warnings or errors. To ease the process, you may use the shell script that appears after this list.

   Due to the workload involved, we *do not* require that you verify that all snippets produce the expected output. If you happen to notice any such snippets and can fix them, great; but as long as all snippets compile, don't delay this step due to some weird output. If a snippet is not compiling, update it manually. If it's not possible, delete it for now.
7. Remove all headers and version-statements from the files. Phil Holmes has a `python` script that will do this and which needs testing. Please ask him for a copy if you wish to do this.
8. Create a tarball and send it back to Sebastiano. Don't forget to tell him about any deletions.
9. Use the LSR web interface to change any descriptions you want to. Changing the titles of snippets is a bit fraught, since this also changes the filenames. Only do this as a last resort.
10. Use the LSR web interface to add the other snippets from '`Documentation/snippets/new/`' which compile with the new LilyPond version of the LSR. Ensure that they are correctly tagged, including the tag `docs` and that they are approved.
11. When LSR has been updated, wait a day for the tarball to update, then download another snippet tarball. Verify that the relevant snippets from '`Documentation/snippets/new/`' are now included, then delete those snippets from '`Documentation/snippets/new/`'.
12. Commit all the changes. *Don't forget to add new files to the git repository with* `git add`. Run `make`, `make doc` and `make test` to ensure the changes don't break the build. Any snippets that have had their file name changed or have been deleted could break the build, and these will need correcting step by step.

Below is a shell script to run all '`.ly`' files in a directory and redirect terminal output to text files, which are then searched for the word "failed" to see which snippets do not compile.

```
#!/bin/bash

for LILYFILE in *.ly
```

```
do
  STEM=$(basename "$LILYFILE" .ly)
  echo "running $LILYFILE..."
  lilypond --format=png -ddelete-intermediate-files "$LILYFILE" >& "$STEM".txt
done

grep failed *.txt
TODO: better script
```

Sometimes `grep failed *.txt` will not discover all problematic files. In addition you may want to use:

```
grep ERROR *.txt
grep error *.txt
grep warning *.txt
```

8 Issues

This chapter deals with defects, feature requests, and miscellaneous development tasks.

8.1 Introduction to issues

> **Note:** Unless otherwise specified, all the tasks in this chapter are "simple" tasks: they can be done by a normal user with nothing more than a web browser, email, and lilypond.

"Issues" isn't just a politically-correct term for "bug". We use the same tracker for feature requests, code TODOs and patches, so the term "bug" wouldn't be accurate. Despite the difference between "issue" and "bug", we call our team of contributors who organize issues the *Bug Squad*.

The Bug Squad is mainly composed of non-programmers – their job is to *organize* issues, not solve them. Their duties include removing false bug reports, ensuring that any real bug report contains enough information for developers, and checking that a developer's fix actually resolves the problem.

New volunteers for the Bug Squad should contact the Section 14.3 [Meisters], page 164.

8.2 Bug Squad overview

The Bug Squad are volunteers who progress issue tracking using the Google Issue tracker at

http://code.google.com/p/lilypond/issues/list

Bug Squad members have 2 primary responsiblities:

1. Monitoring the LilyPond Bugs mailing list and adding to the tracker any new issues reported there.
2. Verifying issues that are claimed fixed by a developer, to ensure that the fix works, and is actually in the code base.

It's also part of the Bug Squad's responsibility to check that the Regression Tests don't show up any problems in the latest release. The Bug Meister currently does this.

All of this is explained in more detail in the following sections.

8.3 Bug Squad setup

We highly recommend that you configure your email to use effective sorting; this can reduce your workload *immensely*. The email folders names were chosen specifically to make them work if you sort your folders alphabetically.

1. Read every section of this chapter, Chapter 8 [Issues], page 90.
2. If you do not have one already, create a gmail account and send the email address to the Section 14.3 [Meisters], page 164.
3. Subscribe your gmail account to `bug-lilypond`.
4. Configure your google code account:
   1. Wait until your gmail account is listed in:
      http://code.google.com/p/lilypond/people/list
   2. Sign in to google code by clicking in the top-right corner of:
      http://code.google.com/p/lilypond/issues/list
      You cannot log on if you have Google Sharing enabled http://www.googlesharing.net/.

3. Go to your "Profile", and select "Settings".
4. Scroll down to "Issue change notification", and make sure that you have *selected* "If I starred the issue".

5. Configure your email client:
   1. Any email sent with your gmail address in the `To:` or `CC:` fields should go to a `bug-answers` folder.

      When setting up your filtering rules, be aware that Google Code might use different versions of your email address, such as ones ending in `@googlemail.com` or `@gmail.com`.
   2. Any other email either from, or CC'd to,

      ```
      lilypond@googlecode.com
      ```

      should go into a separate `bug-ignore` folder. Alternately, you may automatically delete these emails.

      You will **not read** these emails as part of your Bug Squad duties. If you are curious, go ahead and read them later, but it does **not** count as Bug Squad work.
   3. Any other email sent to (or CC'd to):

      ```
      bug-lilypond
      ```

      should go into a separate `bug-current` folder.

8.4 Bug Squad checklists

When you do Bug Squad work, start at the top of this page and work your way down. Stop when you've done 20 minutes.

Please use the email sorting described in Section 8.3 [Bug Squad setup], page 90. This means that (as Bug Squad members) you will only ever respond to emails sent or CC'd to the `bug-lilypond` mailing list.

Emails to you personally

You are not expected to work on Bug Squad matters outside of your 20 minutes, but sometimes a confused user will send a bug report (or an update to a report) to you personally. If that happens, please forward such emails to the `bug-lilypond` list so that the currently-active Bug Squad member(s) can handle the message.

Daily schedule

```
Monday:    Eluze
Tuesday:   Ralph
Wednesday: Marek
Thursday:  Joe Wakeling (soon)
Friday:    Colin H
Saturday:  Colin H
Sunday:    Federico
```

Emails to `bug-answers`

Some of these emails will be comments on issues that you added to the tracker.

If they are asking for more information, give the additional information.

- If the email says that the issue was classified in some other manner, read the rationale given and take that into account for the next issue you add.
- Otherwise, move them to your `bug-ignore` folder.

Some of these emails will be discussions about Bug Squad work; read those.

Emails to `bug-current`

Dealing with these emails is your main task. Your job is to get rid of these emails in the first method which is applicable:

1. If the email has already been handled by a Bug Squad member (i.e. check to see who else has replied to it), delete it.
2. If the email is a question about how to use LilyPond, reply with this response:

   ```
   For questions about how to use LilyPond, please read our
   documentation available from:
     http://lilypond.org/website/manuals.html
   or ask the lilypond-user mailing list.
   ```

3. If the email mentions "the latest git", or any version number that has not yet been officially released, forward it to `lilypond-devel`.
4. If a bug report is not in the form of a Tiny example, direct the user to resubmit the report with this response:

   ```
   I'm sorry, but due to our limited resources for handling bugs, we
   can only accept reports in the form of Tiny examples.  Please see
   step 2 in our bug reporting guidelines:
     http://lilypond.org/website/bug-reports.html
   ```

5. If anything is unclear, ask the user for more information.

   How does the graphical output differ from what the user expected? What version of lilypond was used (if not given) and operating system (if this is a suspected cause of the problem)? In short, if you cannot understand what the problem is, ask the user to explain more. It is the user's responsibility to explain the problem, not your responsibility to understand it.

6. If the behavior is expected, the user should be told to read the documentation:

   ```
   I believe that this is the expected behaviour -- please read our
   documentation about this topic.  If you think that it really is a
   mistake, please explain in more detail.  If you think that the
   docs are unclear, please suggest an improvement as described by
   \Simple tasks -- Documentation"
    on:
     http://lilypond.org/website/help-us.html
   ```

7. If the issue already exists in the tracker, send an email to that effect:

   ```
   This issue has already been reported; you can follow the
   discussion and be notified about fixes here:
   ```

   (copy+paste the google code issue URL)

8. Accept the report as described in Section 8.6 [Adding issues to the tracker], page 95.

All emails should be CC'd to the `bug-lilypond` list so that other Bug Squad members know that you have processed the email.

> **Note:** There is no option for "ignore the bug report" – if you cannot find a reason to reject the report, you must accept it.

Regular maintenance

After **every release** (both stable and unstable):

- Issues to verify: go to

  `http://code.google.com/p/lilypond/issues/list?can=7`

(You can also generate this list by selecting "Issues to verify" from the drop-down list next to the search box.)

You should see a list of Issues that have been claimed fixed by a developer. If the developer has done their job properly, the Issue should have a tag "Fixed_mm_MM_ss", where mm is the major version, MM the minor version and ss the current release. This will help you work out which you can verify - do not verify any Issues where the claimed fixed build is not yet released. Work your way through these as follows:

If the Issue refers to a bug, try to reproduce the bug with the latest officially released version (not one you've built yourself from source); if the bug is no longer there, mark the issue "Verified" (i.e. "the fix has been verified to work").

Quite a few of these will be issues tracking patches. **You do not have to prove these patches work - simply that they have been pushed into the code base.** The developer should have put information similar to "Pushed as as d8fce1e1ea2aca1a82e25e47805aef0f70f511b9" in the tracker. The long list of letters and numbers is called the "committish". Providing you can find this at the git tracker:

http://git.savannah.gnu.org/gitweb/?p=lilypond.git

then you should mark the issue as verified. A quick way of finding these is to enter the committish at the following address:

http://philholmes.net/lilypond/git/

The Issue tracker also requires that any issues labelled as "Duplicate" are also verified. Check that the linked issue is a duplicate and verify the issue.

A few (approximately 10%) of the fixed issues relate to the build system or fundamental architecture changes; there is no way for you to verify these. Leave those issues alone; somebody else will handle them.

- The official regression test comparison is online at:

  http://lilypond.org/test/

  If anything has changed suspiciously, ask if it was deliberate. If the text output from LilyPond (the logfile) changes, the differences will be displayed with a `+` before text added to the logfile and `-` before any text removed from the logfile. This may or may not be suspicious.

  There is one test designed to produce output every time the regtests are created. `test-output-distance.ly` creates randomly spaced notes and will always have different output if the regtest checker is working.

  More information is available from in Section 9.2 [Precompiled regression tests], page 99.

- Check for any incorrectly-classified items in the tracker. This generally just means looking at the grid to see any items without a Type.

8.5 Issue classification

The Bug Squad should classify issues according to the guidelines given by developers. Every issue should have a Status and Type; the other fields are optional.

Status (mandatory)

Open issues:

- New: the item was added by a non-member, despite numerous warnings not to do this. Should be reviewed by a member of the Bug Squad.
- Accepted: the Bug Squad added it, or reviewed the item.
- Started: a contributor is working on a fix. Owner should change to be this contributor.

Closed issues:

- Invalid: issue should not have been added in the current state.
- Duplicate: issue already exists in the tracker.
- Fixed: a contributor claims to have fixed the bug. The Bug Squad should check the fix with the next official binary release (not by compiling the source from git). Owner should be set to that contributor.
- Verified: Bug Squad has confirmed that the issue is closed. This means that nobody should ever need look at the report again – if there is any information in the issue that should be kept, open a new issue for that info.

Owner (optional)

Newly-added issues should have *no owner*. When a contributor indicates that he has Started or Fixed an item, he should become the owner.

Type (mandatory)

The issue's Type should be the first relevant item in this list.

- Type-Critical: normally a regression against the current stable version or the previous stable version. Alternatively, a regression against a fix developed for the current version. This does not apply where the "regression" occurred because a feature was removed deliberately - this is not a bug.

  Currently, only Critical items will block a stable release.
- Type-Maintainability: hinders future development.
- Type-Crash: any input which produces a crash.
- Type-Ugly: overlapping or other ugly notation in graphical output.
- Type-Defect: a problem in the core program. (the `lilypond` binary, scm files, fonts, etc).
- Type-Documentation: inaccurate, missing, confusing, or desired additional info. Must be fixable by editing a texinfo, ly, or scm file.
- Type-Build: problem or desired features in the build system. This includes the makefiles, stepmake, python scripts, and GUB.
- Type-Scripts: problem or desired feature in the non-build-system scripts. Mostly used for convert-ly, lilypond-book, etc.
- Type-Enhancement: a feature request for the core program. The distinction between enhancement and defect isn't extremely clear; when in doubt, mark it as enhancement.
- Type-Patch: tracking a patch on Rietveld. Bug squad should not need to use this label.
- Type-Other: anything else.

Opsys (optional)

Issues that only affect specific operating systems.

Patch label (optional)

Normal Bug Squad members should not add or modify Patch issues except to verify them; for all other Patch work, leave them to the Patch Meister.

- Patch-new: the patch has not been checked for "obvious" mistakes. When in doubt, use this tag.
- Patch-review: the patch has no "obvious" mistakes (as checked by the Patch Meister), and is ready for review from main developers.

  Developers with git push ability can use this category, skipping over `patch-new`.

- Patch-needs_work: a developer has some concerns about the patch. This does not necessarily mean that the patch must be changed; in some cases, the developer's concerns can be resolved simply by discussion the situation or providing notation examples.

  If the patch is updated, the category should be changed to `patch-new` (for normal contributors) or `patch-review` (for developers who are very confident about their patch).
- Patch-countdown: final call for any patch problems
- Patch-push: patch has passed the countdown and should be pushed.
- Patch-abandoned: the author has not responded to review comments for a few months.

Other items (optional)

Other labels:

- Regression: it used to work intentionally in the current stable release or the previous stable release. If the earlier output was accidental (i.e. we didn't try to stop a collision, but it just so happened that two grobs didn't collide), then breaking it does not count as a regression.

  To help decide whether the change is a regression, please adopt the following process:

  1. Are you certain the change is OK? If so, do nothing.
  2. Are you certain that the change is bad? Add it to the tracker as a regression.
  3. If you're not certain either way, add it to the tracker as a regression but be aware that it may be recategorised or marked invalid.

  In particular, anything that breaks a regression test is a regression.
- Frog: the fix is believed to be suitable for a new contributor (does not require a great deal of knowledge about LilyPond). The issue should also have an estimated time in a comment.
- Bounty: somebody is willing to pay for the fix. Only add this tag if somebody has offered an exact figure in US dollars or euros.
- Warning: graphical output is fine, but lilypond prints a false/misleading warning message. Alternately, a warning should be printed (such as a bar line error), but was not. Also applies to warnings when compiling the source code or generating documentation.
- Security: security risk.
- Performance: performance issue.

If you particularly want to add a label not in the list, go ahead, but this is not recommended, except when an issue is marked as fixed. In this case it should be labeled Fixed_mm_MM_ss, where mm is major version, MM minor version and ss current release.

8.6 Adding issues to the tracker

> **Note:** This should only be done by the Bug Squad or experienced developers. Normal users should not do this; instead, they should follow the guidelines for Section "Bug reports" in *General Information*.

In order to assign labels to issues, Bug Squad members should log in to their google account before adding an item.

1. Check if the issue falls into any previous category given on the relevant checklists in Section 8.4 [Bug Squad checklists], page 91. If in doubt, add a new issue for a report. We would prefer to have some incorrectly-added issues rather than lose information that should have been added.

2. Add the issue and classify it according to the guidelines in Section 8.5 [Issue classification], page 93. In particular, the item should have `Status` and `Type-` labels.

   Include output with the first applicable method:

   - If the issue has a notation example which fits in one system, generate a small '`bug.preview.png`' file with:

     ```
     lilypond -dpreview bug.ly
     ```

   - If the issue has an example which requires more than one system (i.e. a spacing bug), generate a '`bug.png`' file with:

     ```
     lilypond --png bug.ly
     ```

   - If the issue requires one or two pages of output, then generate a '`bug.png`' file with the normal:

     ```
     lilypond --png bug.ly
     ```

   - Images created as '`bug.png`' may be trimmed to a minimum size by using the `trimtagline.sh` script, which can be found at

     ```
     https://raw.github.com/gperciva/lilypond-extra/master/bug-squad/trimtagline.sh
     ```

     ```
     trimtagline.sh bug.ly
     ```

   - If the issue cannot be shown with less than three pages, then generate a '`bug.pdf`' file with:

     ```
     lilypond --pdf bug.ly
     ```

     Note that this is likely to be extremely rare; most bugs should fit into the first two categories above.

3. After adding the issue, please send a response email to the same group(s) that the initial patch was sent to. If the initial email was sent to multiple mailing lists (such as both `user` and `bugs`), then reply to all those mailing lists as well. The email should contain a link to the issue you just added.

8.7 Patch handling

> **Note:** This is not a Bug Squad responsibility; we have a separate person handling this task.

For contributors/developers: follow the steps in Section 3.3.4 [Commits and patches], page 22, and Section 3.4.11 [Pushing to staging], page 33.

Patch cycle

- Patches get added to the tracker and to Rietveld by the "git-cl" tool, with a status of "patch-new".
- The automated tester, Patchy, verifies that the patch can be applied to current master. By default, it checks that the patch allows `make` and `make test` to complete successfully. It can also be configured to check that `make doc` is successful. If it passes, Patchy changes the status to "patch-review" and emails the developer list. If the patch fails, Patchy sets it to "patch-needs_work" and notifies the developer list.
- The Patch Meister reviews the tracker periodically, to list patches which have been on review for at least 24 hours. The list is found at

  ```
  http://code.google.com/p/lilypond/issues/list?can=2&q=label:patch%20patch=review&
  sort=modified+patch&colspec=ID%20Type%20Status%20Priority%20Owner%20Patch%20Summary%20Modified
  ```

- For each patch, the Handler reviews any discussion on the tracker and on Rietveld, to determine whether the patch can go forward. If there is any indication that a developer thinks

the patch is not ready, the Handler marks it "patch-needs_work" and makes a comment regarding the reason, referring to the Rietveld item if needed.

- Patches with explicit approval, or at least no negative comment, can be updated to "patch-countdown". When saving the tracker item, clear the "send email" box to prevent sending notification for each patch.
- The Patch Meister sends an email to the developer list, with a fixed subject line, to enable filtering by email clients:

  ```
  PATCH: Countdown to 20130113
  ```

  The text of the email sets the deadline for this countdown batch. At present, batches are done on Tuesday, Thursday and Sunday evenings.

  The body of the email lists the patches grouped by patch type, and for each patch, shows the tracker issue number and title, with a link to the Rietveld item. Copying the information from the website and pasting into the email gives a hyperlinked version of the information.

  ```
  For 20:00 MST Tuesday January 8:

  Crash:
      Issue 2990: \RemoveEmptyStaves in StaffGroup context crashes - R 7069044

  Defect:
      Issue 677: \score markup confuses paper settings - R 7028045
      Issue 3050: displayLilyMusic produced erroneous code for rightHandFinger arguments -
  R 7032045

  Documentation:
      Issue 2952: Upgrade documentation of \once - R 7031053
      Issue 3044: Dual license the files under mf/ using OFL. - R 6970046
      Issue 3084: [DOC]Add "Known issue" in NR 1.2.1 about Scaling durations with ratio-
  nal numbers - R 7071044

  Enhancement:
      Issue 3061: make \articulate handle colon-type tremolos - R 7033045
      Issue 3082: Patch: Let ChordNameVoice use the same performers as Voice - R 7054043
      Issue 3083: Patch: Chord change detection in fretboards should depend on placements, not notes -
  R 7062043
      Issue 2983: assertion failed with \glissando - R 6625078


  Cheers,
  Colin
  ```

- On the scheduled countdown day, the Patch Meister reviews the previous list of patches on countdown, with the same procedure and criteria as before. Patches with no controversy can be set to "patch-push" with a courtesy message added to the comment block.
- Roughly at six month intervals, the Patch Meister can list the patches which have been set to "patch-needs-work" and send the results to the developer list for review. In most cases, these patches should be marked "patch-abandoned" but this should come from the developer if possible.
- As in most organisations of unpaid volunteers, fixed procedures are useful in as much as they get the job done. In our community, there is room for senior developers to bypass normal patch handling flows, particularly now that the testing of patches is largely automated. Similarly, the minimum age of 24 hours can reasonably be waived if the patch is minor and from an experienced developer.

8.8 Summary of project status

Project overview

Grid view provides the best overview:

http://code.google.com/p/lilypond/issues/list?mode=grid&y=Priority&x=Type&cells=ids

Hindering development

These issues stop or slow development work:

http://code.google.com/p/lilypond/issues/list?can=2&q=label:Maintainability

Easy tasks

Issues tagged with `Frog` indicates a task suitable for a relatively new contributor. The time given is a quick (inaccurate) estimate of the time required for somebody who is familiar with material in this manual, but does not know anything else about LilyPond development.

http://code.google.com/p/lilypond/issues/list?can=2&q=label:Frog

Patches to review

Patches which have no “obvious” problems:

http://code.google.com/p/lilypond/issues/list?can=2&q=label:patch-review

9 Regression tests

9.1 Introduction to regression tests

LilyPond has a complete suite of regression tests that are used to ensure that changes to the code do not break existing behavior. These regression tests comprise small LilyPond snippets that test the functionality of each part of LilyPond.

Regression tests are added when new functionality is added to LilyPond. We do not yet have a policy on when it is appropriate to add or modify a regtest when bugs are fixed. Individual developers should use their best judgement until this is clarified during the Section 14.6 [Grand Organization Project (GOP)], page 167.

The regression tests are compiled using special `make` targets. There are three primary uses for the regression tests. First, successful completion of the regression tests means that LilyPond has been properly built. Second, the output of the regression tests can be manually checked to ensure that the graphical output matches the description of the intended output. Third, the regression test output from two different versions of LilyPond can be automatically compared to identify any differences. These differences should then be manually checked to ensure that the differences are intended.

Regression tests ("regtests") are available in precompiled form as part of the documentation. Regtests can also be compiled on any machine that has a properly configured LilyPond build system.

9.2 Precompiled regression tests

Regression test output

As part of the release process, the regression tests are run for every LilyPond release. Full regression test output is available for every stable version and the most recent development version.

Regression test output is available in HTML and PDF format. Links to the regression test output are available at the developer's resources page for the version of interest.

The latest stable version of the regtests is found at:

`http://lilypond.org/doc/stable/input/regression/collated-files.html`

The latest development version of the regtests is found at:

`http://lilypond.org/doc/latest/input/regression/collated-files.html`

Regression test comparison

Each time a new version is released, the regtests are compiled and the output is automatically compared with the output of the previous release. The result of these comparisons is archived online:

`http://lilypond.org/test/`

Checking these pages is a very important task for the LilyPond project. You are invited to report anything that looks broken, or any case where the output quality is not on par with the previous release, as described in Section "Bug reports" in *General Information*.

> **Note:** The special regression test '`test-output-distance.ly`' will always show up as a regression. This test changes each time it is run, and serves to verify that the regression tests have, in fact, run.

What to look for

The test comparison shows all of the changes that occurred between the current release and the prior release. Each test that has a significant (noticeable) difference in output is displayed, with the old version on the left and the new version on the right.

Some of the small changes can be ignored (slightly different slur shapes, small variations in note spacing), but this is not always the case: sometimes even the smallest change means that something is wrong. To help in distinguishing these cases, we use bigger staff size when small differences matter.

Staff size 30 generally means "pay extra attention to details". Staff size 40 (two times bigger than default size) or more means that the regtest **is** about the details.

Staff size smaller than default doesn't mean anything.

Regression tests whose output is the same for both versions are not shown in the test comparison.

- Images: green blurs in the new version show the approximate location of elements in the old version.

  There are often minor adjustments in spacing which do not indicate any problem.

- Log files: show the difference in command-line output.

  The main thing to examine are any changes in page counts – if a file used to fit on 1 page but now requires 4 or 5 pages, something is suspicious!

- Profile files: give information about TODO? I don't know what they're for. Apparently they give some information about CPU usage. If you got tons of changes in cell counts, this probably means that you compiled `make test-baseline` with a different amount of CPU threads than `make check`. Try redoing tests from scratch with the same number of threads each time – see Section 4.5.2 [Saving time with the -j option], page 45.

> **Note:** The automatic comparison of the regtests checks the LilyPond bounding boxes. This means that Ghostscript changes and changes in lyrics or text are not found.

9.3 Compiling regression tests

Developers may wish to see the output of the complete regression test suite for the current version of the source repository between releases. Current source code is available; see Chapter 3 [Working with source code], page 12.

For regression testing `../configure` should be run with the `--disable-optimising` option. Then you will need to build the LilyPond binary; see Section 4.5 [Compiling LilyPond], page 45.

Uninstalling the previous LilyPond version is not necessary, nor is running `make install`, since the tests will automatically be compiled with the LilyPond binary you have just built in your source directory.

From this point, the regtests are compiled with:

```
make test
```

If you have a multi-core machine you may want to use the '`-j`' option and *CPU_COUNT* variable, as described in [Saving time with CPU_COUNT], page 48. For a quad-core processor the complete command would be:

```
make -j5 CPU_COUNT=5 test
```

The regtest output will then be available in '`input/regression/out-test`'. '`input/regression/out-test/collated-examples.html`' contains a listing of all the

regression tests that were run, but none of the images are included. Individual images are also available in this directory.

The primary use of '`make test`' is to verify that the regression tests all run without error. The regression test page that is part of the documentation is created only when the documentation is built, as described in Section 4.6.2 [Generating documentation], page 46. Note that building the documentation requires more installed components than building the source code, as described in Section 4.2.3 [Requirements for building documentation], page 42.

9.4 Regtest comparison

Before modified code is committed to `master` (via `staging`), a regression test comparison must be completed to ensure that the changes have not caused problems with previously working code. The comparison is made automatically upon compiling the regression test suite twice.

1. Run `make` with current git master without any of your changes.
2. Before making changes to the code, establish a baseline for the comparison by going to the '`$LILYPOND_GIT/build/`' directory and running:

   ```
   make test-baseline
   ```
3. Make your changes, or apply the patch(es) to consider.
4. Compile the source with '`make`' as usual.
5. Check for unintentional changes to the regtests:

   ```
   make check
   ```

   After this has finished, a regression test comparison will be available (relative to the current '`build/`' directory) at:

   ```
   out/test-results/index.html
   ```

   For each regression test that differs between the baseline and the changed code, a regression test entry will be displayed. Ideally, the only changes would be the changes that you were working on. If regressions are introduced, they must be fixed before committing the code.

   > **Note:** The special regression test '`test-output-distance.ly`' will always show up as a regression. This test changes each time it is run, and serves to verify that the regression tests have, in fact, run.

6. If you are happy with the results, then stop now.

   If you want to continue programming, then make any additional code changes, and continue.
7. Compile the source with '`make`' as usual.
8. To re-check files that differed between the initial '`make test-baseline`' and your post-changes '`make check`', run:

   ```
   make test-redo
   ```

   This updates the regression list at '`out/test-results/index.html`'. It does *not* redo '`test-output-distance.ly`'.
9. When all regressions have been resolved, the output list will be empty.
10. Once all regressions have been resolved, a final check should be completed by running:

    ```
    make test-clean
    make check
    ```

    This cleans the results of the previous '`make check`', then does the automatic regression comparison again.

    Advanced note: Once a test baseline has been established, there is no need to run it again unless git master changed. In other words, if you work with several branches

and want to do regtests comparison for all of them, you can `make test-baseline` with git master, checkout some branch, `make` and `make check` it, then switch to another branch, `make test-clean`, `make` and `make check` it without doing `make test-baseline` again.

9.5 Pixel-based regtest comparison

As an alternative to the `make test` method for regtest checking (which relies upon `.signature` files created by a LilyPond run and which describe the placing of grobs) there is a script which compares the output of two LilyPond versions pixel-by-pixel. To use this, start by checking out the version of LilyPond you want to use as a baseline, and run `make`. Then, do the following:

```
cd $LILYPOND_GIT/scripts/auxiliar/
./make-regtest-pngs.sh -j9 -o
```

The `-j9` option tells the script to use 9 CPUs to create the images - change this to your own CPU count+1. `-o` means this is the "old" version. This will create images of all the regtests in

```
$LILYPOND_BUILD_DIR/out-png-check/old-regtest-results/
```

Now checkout the version you want to compare with the baseline. Run `make` again to recreate the LilyPond binary. Then, do the following:

```
cd $LILYPOND_GIT/scripts/auxiliar/
./make-regtest-pngs.sh -j9 -n
```

The `-n` option tells the script to make a "new" version of the images. They are created in

```
$LILYPOND_BUILD_DIR/out-png-check/new-regtest-results/
```

Once the new images have been created, the script compares the old images with the new ones pixel-by-pixel and prints a list of the different images to the terminal, together with a count of how many differences were found. The results of the checks are in

```
$LILYPOND_BUILD_DIR/out-png-check/regtest-diffs/
```

To check for differences, browse that directory with an image viewer. Differences are shown in red. Be aware that some images with complex fonts or spacing annotations always display a few minor differences. These can safely be ignored.

9.6 Finding the cause of a regression

Git has special functionality to help tracking down the exact commit which causes a problem. See the git manual page for `git bisect`. This is a job that non-programmers can do, although it requires familiarity with git, ability to compile LilyPond, and generally a fair amount of technical knowledge. A brief summary is given below, but you may need to consult other documentation for in-depth explanations.

Even if you are not familiar with git or are not able to compile LilyPond you can still help to narrow down the cause of a regression simply by downloading the binary releases of different LilyPond versions and testing them for the regression. Knowing which version of LilyPond first exhibited the regression is helpful to a developer as it shortens the `git bisect` procedure.

Once a problematic commit is identified, the programmers' job is much easier. In fact, for most regression bugs, the majority of the time is spent simply finding the problematic commit.

More information is in Chapter 9 [Regression tests], page 99.

git bisect setup

We need to set up the bisect for each problem we want to investigate.

Suppose we have an input file which compiled in version 2.13.32, but fails in version 2.13.38 and above.

1. Begin the process:

   ```
   git bisect start
   ```

2. Give it the earliest known bad tag:

   ```
   git bisect bad release/2.13.38-1
   ```

   (you can see tags with: `git tag`)

3. Give it the latest known good tag:

   ```
   git bisect good release/2.13.32-1
   ```

   You should now see something like:

   ```
   Bisecting: 195 revisions left to test after this (roughly 8 steps)
   [b17e2f3d7a5853a30f7d5a3cdc6b5079e77a3d2a] Web: Announcement
   update for the new \LilyPond Report"
   .
   ```

git bisect actual

1. Compile the source:

   ```
   make
   ```

2. Test your input file:

   ```
   out/bin/lilypond test.ly
   ```

3. Test results?
   - Does it crash, or is the output bad? If so:

     ```
     git bisect bad
     ```

   - Does your input file produce good output? If so:

     ```
     git bisect good
     ```

4. Once the exact problem commit has been identified, git will inform you with a message like:

   ```
   6d28aebbaaab1be9961a00bf15a1ef93acb91e30 is the first bad commit
   %%% ... blah blah blah ...
   ```

   If there is still a range of commits, then git will automatically select a new version for you to test. Go to step #1.

Recommendation: use two terminal windows

- One window is open to the `build/` directory, and alternates between these commands:

  ```
  make
  out/bin/lilypond test.ly
  ```

- One window is open to the top source directory, and alternates between these commands:

  ```
  git bisect good
  git bisect bad
  ```

9.7 Memory and coverage tests

In addition to the graphical output of the regression tests, it is possible to test memory usage and to determine how much of the source code has been exercised by the tests.

Memory usage

For tracking memory usage as part of this test, you will need GUILE CVS; especially the following patch:

http://www.lilypond.org/vc/old/gub.darcs/patches/guile-1.9-gcstats.patch.

Code coverage

For checking the coverage of the test suite, do the following

```
./scripts/auxiliar/build-coverage.sh
# uncovered files, least covered first
./scripts/auxiliar/coverage.py  --summary out-cov/*.cc
# consecutive uncovered lines, longest first
./scripts/auxiliar/coverage.py  --uncovered out-cov/*.cc
```

9.8 MusicXML tests

LilyPond comes with a complete set of regtests for the MusicXML language. Originally developed to test '`musicxml2ly`', these regression tests can be used to test any MusicXML implementation.

The MusicXML regression tests are found at '`input/regression/musicxml/`'.

The output resulting from running these tests through '`musicxml2ly`' followed by '`lilypond`' is available in the LilyPond documentation:

http://lilypond.org/doc/latest/input/regression/musicxml/collated-files

9.9 Grand Regression Test Checking

What is this all about?

Regression tests (usually abbreviated "regtests") is a collection of '`.ly`' files used to check whether LilyPond is working correctly. Example: before version 2.15.12 breve noteheads had incorrect width, which resulted in collisions with other objects. After the issue was fixed, a small '`.ly`' file demonstrating the problem was added to the regression tests as a proof that the fix works. If someone will accidentally break breve width again, we will notice this in the output of that regression test.

How can I help?

We ask you to help us by checking one or two regtests from time to time. You don't need programming skills to do this, not even LilyPond skills - just basic music notation knowledge; checking one regtest takes less than a minute. Simply go here:

http://www.philholmes.net/lilypond/regtests/

Some tips on checking regtests

Description text

The description should be clear even for a music beginner. If there are any special terms used in the description, they all should be explained in our Section "Music Glossary" in *Music Glossary* or Section "Internals Reference" in *Internals Reference*. Vague descriptions (like "behaves well", "looks reasonable") shouldn't be used.

10 Programming work

10.1 Overview of LilyPond architecture

LilyPond processes the input file into graphical and musical output in a number of stages. This process, along with the types of routines that accomplish the various stages of the process, is described in this section. A more complete description of the LilyPond architecture and internal program execution is found in Erik Sandberg's master's thesis.

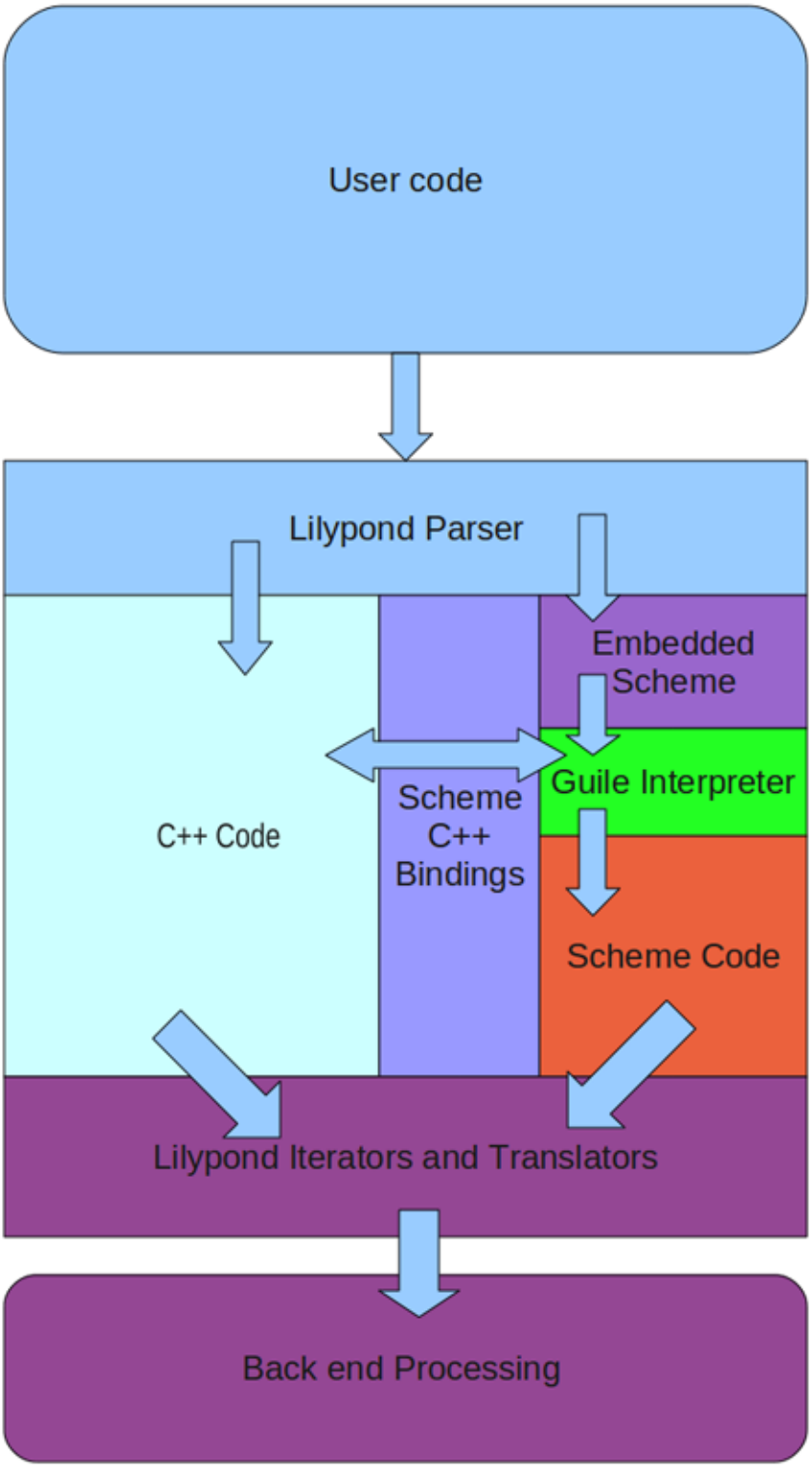
The first stage of LilyPond processing is *parsing*. In the parsing process, music expressions in LilyPond input format are converted to music expressions in Scheme format. In Scheme format, a music expression is a list in tree form, with nodes that indicate the relationships between various music events. The LilyPond parser is written in Bison.

The second stage of LilyPond processing is *iterating*. Iterating assigns each music event to a context, which is the environment in which the music will be finally engraved. The context is responsible for all further processing of the music. It is during the iteration stage that contexts are created as necessary to ensure that every note has a Voice type context (e.g. Voice, TabVoice, DrumVoice, CueVoice, MensuralVoice, VaticanaVoice, GregorianTranscriptionVoice), that the Voice type contexts exist in appropriate Staff type contexts, and that parallel Staff type contexts exist in StaffGroup type contexts. In addition, during the iteration stage each music event is assigned a moment, or a time in the music when the event begins.

Each type of music event has an associated iterator. Iterators are defined in '`*-iterator.cc`'. During iteration, an event's iterator is called to deliver that music event to the appropriate context(s).

The final stage of LilyPond processing is *translation*. During translation, music events are prepared for graphical or midi output. The translation step is accomplished by the polymorphic base class Translator through its two derived classes: Engraver (for graphical output) and Performer (for midi output).

Translators are defined in C++ files named '`*-engraver.cc`' and '`*-performer.cc`'. Much of the work of translating is handled by Scheme functions, which is one of the keys to LilyPond's exceptional flexibility.



10.2 LilyPond programming languages

Programming in LilyPond is done in a variety of programming languages. Each language is used for a specific purpose or purposes. This section describes the languages used and provides links to reference manuals and tutorials for the relevant language.

10.2.1 C++

The core functionality of LilyPond is implemented in C++.

C++ is so ubiquitous that it is difficult to identify either a reference manual or a tutorial. Programmers unfamiliar with C++ will need to spend some time to learn the language before attempting to modify the C++ code.

The C++ code calls Scheme/GUILE through the GUILE interface, which is documented in the GUILE Reference Manual.

10.2.2 Flex

The LilyPond lexer is implemented in Flex, an implementation of the Unix lex lexical analyser generator. Resources for Flex can be found here.

10.2.3 GNU Bison

The LilyPond parser is implemented in Bison, a GNU parser generator. The Bison homepage is found at gnu.org. The manual (which includes both a reference and tutorial) is available in a variety of formats.

10.2.4 GNU Make

GNU Make is used to control the compiling process and to build the documentation and the website. GNU Make documentation is available at the GNU website.

10.2.5 GUILE or Scheme

GUILE is the dialect of Scheme that is used as LilyPond's extension language. Many extensions to LilyPond are written entirely in GUILE. The GUILE Reference Manual is available online.

Structure and Interpretation of Computer Programs, a popular textbook used to teach programming in Scheme is available in its entirety online.

An introduction to Guile/Scheme as used in LilyPond can be found in the Section "Scheme tutorial" in *Extending*.

10.2.6 MetaFont

MetaFont is used to create the music fonts used by LilyPond. A MetaFont tutorial is available at the METAFONT tutorial page.

10.2.7 PostScript

PostScript is used to generate graphical output. A brief PostScript tutorial is available online. The PostScript Language Reference is available online in PDF format.

10.2.8 Python

Python is used for XML2ly and is used for building the documentation and the website.

Python documentation is available at python.org.

10.3 Programming without compiling

Much of the development work in LilyPond takes place by changing '`*.ly`' or '`*.scm`' files. These changes can be made without compiling LilyPond. Such changes are described in this section.

10.3.1 Modifying distribution files

Much of LilyPond is written in Scheme or LilyPond input files. These files are interpreted when the program is run, rather than being compiled when the program is built, and are present in all LilyPond distributions. You will find '`.ly`' files in the '`ly/`' directory and the Scheme files in the '`scm/`' directory. Both Scheme files and '`.ly`' files can be modified and saved with any text editor. It's probably wise to make a backup copy of your files before you modify them, although you can reinstall if the files become corrupted.

Once you've modified the files, you can test the changes just by running LilyPond on some input file. It's a good idea to create a file that demonstrates the feature you're trying to add. This file will eventually become a regression test and will be part of the LilyPond distribution.

10.3.2 Desired file formatting

Files that are part of the LilyPond distribution have Unix-style line endings (LF), rather than DOS (CR+LF) or MacOS 9 and earlier (CR). Make sure you use the necessary tools to ensure that Unix-style line endings are preserved in the patches you create.

Tab characters should not be included in files for distribution. All indentation should be done with spaces. Most editors have settings to allow the setting of tab stops and ensuring that no tab characters are included in the file.

Scheme files and LilyPond files should be written according to standard style guidelines. Scheme file guidelines can be found at `http://community.schemewiki.org/?scheme-style`. Following these guidelines will make your code easier to read. Both you and others that work on your code will be glad you followed these guidelines.

For LilyPond files, you should follow the guidelines for LilyPond snippets in the documentation. You can find these guidelines at Section 5.3 [Texinfo introduction and usage policy], page 55.

10.4 Finding functions

When making changes or fixing bugs in LilyPond, one of the initial challenges is finding out where in the code tree the functions to be modified live. With nearly 3000 files in the source tree, trial-and-error searching is generally ineffective. This section describes a process for finding interesting code.

10.4.1 Using the ROADMAP

The file ROADMAP is located in the main directory of the lilypond source. ROADMAP lists all of the directories in the LilyPond source tree, along with a brief description of the kind of files found in each directory. This can be a very helpful tool for deciding which directories to search when looking for a function.

10.4.2 Using grep to search

Having identified a likely subdirectory to search, the grep utility can be used to search for a function name. The format of the grep command is

```
grep -i functionName subdirectory/*
```

This command will search all the contents of the directory subdirectory/ and display every line in any of the files that contains functionName. The '`-i`' option makes `grep` ignore case – this can be very useful if you are not yet familiar with our capitalization conventions.

The most likely directories to grep for function names are '`scm/`' for scheme files, ly/ for lilypond input ('`*.ly`') files, and '`lily/`' for C++ files.

10.4.3 Using git grep to search

If you have used git to obtain the source, you have access to a powerful tool to search for functions. The command:

```
git grep functionName
```

will search through all of the files that are present in the git repository looking for functionName. It also presents the results of the search using `less`, so the results are displayed one page at a time.

10.4.4 Searching on the git repository at Savannah

You can also use the equivalent of git grep on the Savannah server.

- Go to http://git.sv.gnu.org/gitweb/?p=lilypond.git
- In the pulldown box that says commit, select grep.
- Type functionName in the search box, and hit enter/return

This will initiate a search of the remote git repository.

10.5 Code style

This section describes style guidelines for LilyPond source code.

10.5.1 Languages

C++ and Python are preferred. Python code should use PEP 8.

10.5.2 Filenames

Definitions of classes that are only accessed via pointers (*) or references (&) shall not be included as include files.

```
filenames

     ".hh"   Include files
          ".cc"      Implementation files
          ".icc"     Inline definition files
          ".tcc"     non inline Template defs

in emacs:

          (setq auto-mode-alist
                (append '(("\\.make$" . makefile-mode)
                     ("\\.cc$" . c++-mode)
                     ("\\.icc$" . c++-mode)
                     ("\\.tcc$" . c++-mode)
                     ("\\.hh$" . c++-mode)
                     ("\\.pod$" . text-mode)
                     )
                   auto-mode-alist))
```

The class Class_name is coded in ‘class-name.*’

10.5.3 Indentation

Standard GNU coding style is used.

Indenting files with `fixcc.py` (recommended)

LilyPond provides a python script that will adjust the indentation and spacing on a `.cc` or `.hh` file to very near the GNU standard:

```
scripts/auxiliar/fixcc.py FILENAME
```

This can be run on all files at once, but this is not recommended for normal contributors or developers.

```
scripts/auxiliar/fixcc.py \
  $(find flower lily -name '*cc' -o -name '*hh' | grep -v /out)
```

Indenting with emacs

The following hooks will produce indentation which is similar to our official indentation as produced with `fixcc.py`.

```
(add-hook 'c++-mode-hook
     '(lambda ()
        (c-set-style "gnu")
        (setq indent-tabs-mode nil))
```

If you like using font-lock, you can also add this to your '`.emacs`':

```
(setq font-lock-maximum-decoration t)
(setq c++-font-lock-keywords-3
      (append
       c++-font-lock-keywords-3
       '(("\\b\\(a-zA-Z_?+_\\)\\b" 1 font-lock-variable-name-face) ("\\b\\(A-Z?+a-z_?+\
       ))
```

Indenting with vim

Although emacs indentation is the GNU standard, acceptable indentation can usually be accomplished with vim. Some hints for vim are as follows:

A workable .vimrc:

```
set cindent
set smartindent
set autoindent
set expandtab
set softtabstop=2
set shiftwidth=2
filetype plugin indent on
set incsearch
set ignorecase smartcase
set hlsearch
set confirm
set statusline=%F%m%r%h%w\ %{&ff}\ %Y\ [ASCII=\%03.3b]\ [HEX=\%02.2B]\ %04l,%04v\ %p%%\
set laststatus=2
set number
" Remove trailing whitespace on write
autocmd BufWritePre * :%s/\s\+$//e
```

With this '`.vimrc`', files can be reindented automatically by highlighting the lines to be indented in visual mode (use V to enter visual mode) and pressing `=`.

A '`scheme.vim`' file will help improve the indentation. This one was suggested by Patrick McCarty. It should be saved in '`~/.vim/after/syntax/scheme.vim`'.

```
" Additional Guile-specific 'forms'
```

```
syn keyword schemeSyntax define-public define*-public
syn keyword schemeSyntax define* lambda* let-keywords*
syn keyword schemeSyntax defmacro defmacro* define-macro
syn keyword schemeSyntax defmacro-public defmacro*-public
syn keyword schemeSyntax use-modules define-module
syn keyword schemeSyntax define-method define-class

" Additional LilyPond-specific 'forms'
syn keyword schemeSyntax define-markup-command define-markup-list-command
syn keyword schemeSyntax define-safe-public define-music-function
syn keyword schemeSyntax def-grace-function

" All of the above should influence indenting too
set lw+=define-public,define*-public
set lw+=define*,lambda*,let-keywords*
set lw+=defmacro,defmacro*,define-macro
set lw+=defmacro-public,defmacro*-public
set lw+=use-modules,define-module
set lw+=define-method,define-class
set lw+=define-markup-command,define-markup-list-command
set lw+=define-safe-public,define-music-function
set lw+=def-grace-function

" These forms should not influence indenting
set lw-=if
set lw-=set!

" Try to highlight all ly: procedures
syn match schemeFunc "ly:[^) ]\+"
```

10.5.4 Naming Conventions

Naming conventions have been established for LilyPond source code.

Classes and Types

Classes begin with an uppercase letter, and words in class names are separated with `_`:

```
This_is_a_class
```

Members

Member variable names end with an underscore:

```
Type Class::member_
```

Macros

Macro names should be written in uppercase completely, with words separated by `_`:

```
THIS_IS_A_MACRO
```

Variables

Variable names should be complete words, rather than abbreviations. For example, it is preferred to use `thickness` rather than `th` or `t`.

Multi-word variable names in C++ should have the words separated by the underscore character ('_'):

`cxx_multiword_variable`

Multi-word variable names in Scheme should have the words separated by a hyphen ('-'):

`scheme-multiword-variable`

10.5.5 Broken code

Do not write broken code. This includes hardwired dependencies, hardwired constants, slow algorithms and obvious limitations. If you can not avoid it, mark the place clearly, and add a comment explaining shortcomings of the code.

Ideally, the comment marking the shortcoming would include TODO, so that it is marked for future fixing.

We reject broken-in-advance on principle.

10.5.6 Code comments

Comments may not be needed if descriptive variable names are used in the code and the logic is straightforward. However, if the logic is difficult to follow, and particularly if non-obvious code has been included to resolve a bug, a comment describing the logic and/or the need for the non-obvious code should be included.

There are instances where the current code could be commented better. If significant time is required to understand the code as part of preparing a patch, it would be wise to add comments reflecting your understanding to make future work easier.

10.5.7 Handling errors

As a general rule, you should always try to continue computations, even if there is some kind of error. When the program stops, it is often very hard for a user to pinpoint what part of the input causes an error. Finding the culprit is much easier if there is some viewable output.

So functions and methods do not return errorcodes, they never crash, but report a programming_error and try to carry on.

Error and warning messages need to be localized.

10.5.8 Localization

This document provides some guidelines to help programmers write proper user messages. To help translations, user messages must follow uniform conventions. Follow these rules when coding for LilyPond. Hopefully, this can be replaced by general GNU guidelines in the future. Even better would be to have an English (en_BR, en_AM) guide helping programmers writing consistent messages for all GNU programs.

Non-preferred messages are marked with '+'. By convention, ungrammatical examples are marked with '*'. However, such ungrammatical examples may still be preferred.

- Every message to the user should be localized (and thus be marked for localization). This includes warning and error messages.
- Do not localize/gettextify:
  - 'programming_error ()'s
  - 'programming_warning ()'s
  - debug strings
  - output strings (PostScript, TeX, etc.)
- Messages to be localized must be encapsulated in '_ (STRING)' or '_f (FORMAT, ...)'. E.g.:

```
warning (_ ("need music in a score"));
error (_f ("cannot open file: `%s'", file_name));
```

In some rare cases you may need to call 'gettext ()' by hand. This happens when you pre-define (a list of) string constants for later use. In that case, you'll probably also need to mark these string constants for translation, using '_i (STRING)'. The '_i' macro is a no-op, it only serves as a marker for 'xgettext'.

```
char const* messages[] = {
  _i ("enable debugging output"),
  _i ("ignore lilypond version"),
  0
};

void
foo (int i)
{
  puts (gettext (messages i));
}
```

See also '`flower/getopt-long.cc`' and '`lily/main.cc`'.

- Do not use leading or trailing whitespace in messages. If you need whitespace to be printed, prepend or append it to the translated message

```
message ("Calculating line breaks..." + " ");
```

- Error or warning messages displayed with a file name and line number never start with a capital, eg,

```
foo.ly: 12: not a duration: 3
```

Messages containing a final verb, or a gerund ('-ing'-form) always start with a capital. Other (simpler) messages start with a lowercase letter

```
Processing foo.ly...
`foo': not declared.
Not declaring: `foo'.
```

- Avoid abbreviations or short forms, use 'cannot' and 'do not' rather than 'can't' or 'don't' To avoid having a number of different messages for the same situation, well will use quoting like this '"message: '%s'"' for all strings. Numbers are not quoted:

```
_f ("cannot open file: `%s'", name_str)
_f ("cannot find character number: %d", i)
```

- Think about translation issues. In a lot of cases, it is better to translate a whole message. English grammar must not be imposed on the translator. So, instead of

```
stem at  + moment.str () +  does not fit in beam
```

have

```
_f ("stem at %s does not fit in beam", moment.str ())
```

- Split up multi-sentence messages, whenever possible. Instead of

```
warning (_f ("out of tune!  Can't find: `%s'", "Key_engraver"));
warning (_f ("cannot find font `%s', loading default", font_name));
```

rather say:

```
warning (_ ("out of tune:"));
warning (_f ("cannot find: `%s', "Key_engraver"));
warning (_f ("cannot find font: `%s', font_name));
warning (_f ("Loading default font"));
```

- If you must have multiple-sentence messages, use full punctuation. Use two spaces after end of sentence punctuation. No punctuation (esp. period) is used at the end of simple messages.

```
_f ("Non-matching braces in text `%s', adding braces", text)
_ ("Debug output disabled.  Compiled with NPRINT.")
_f ("Huh?  Not a Request: `%s'.  Ignoring.", request)
```

- Do not modularize too much; words frequently cannot be translated without context. It is probably safe to treat most occurrences of words like stem, beam, crescendo as separately translatable words.
- When translating, it is preferable to put interesting information at the end of the message, rather than embedded in the middle. This especially applies to frequently used messages, even if this would mean sacrificing a bit of eloquence. This holds for original messages too, of course.

```
en: cannot open: `foo.ly'
+   nl: kan `foo.ly' niet openen (1)
kan niet openen: `foo.ly'*   (2)
niet te openen: `foo.ly'*    (3)
```

  The first nl message, although grammatically and stylistically correct, is not friendly for parsing by humans (even if they speak dutch). I guess we would prefer something like (2) or (3).
- Do not run make po/po-update with GNU gettext < 0.10.35

10.6 Warnings, Errors, Progress and Debug Output

Available log levels

LilyPond has several loglevels, which specify how verbose the output on the console should be:

- NONE: No output at all, even on failure
- ERROR: Only error messages
- WARN: Only error messages and warnings
- BASIC_PROGRESS: Warnings, errors and basic progress (success, etc.)
- PROGRESS: Warnings, errors and full progress messages
- INFO: Warnings, errors, progress and more detailed information (default)
- DEBUG: All messages, including full debug messages (very verbose!)

The loglevel can either be set with the environment variable `LILYPOND_LOGLEVEL` or on the command line with the '`--loglevel=...`' option.

Functions for debug and log output

LilyPond has two different types of error and log functions:

- If a warning or error is caused by an identified position in the input file, e.g. by a grob or by a music expression, the functions of the `Input` class provide logging functionality that prints the position of the message in addition to the message.
- If a message can not be associated with a particular position in an input file, e.g. the output file cannot be written, then the functions in the `flower/include/warn.hh` file will provide logging functionality that only prints out the message, but no location.

There are also Scheme functions to access all of these logging functions from scheme. In addition, the Grob class contains some convenience wrappers for even easier access to these functions.

The message and debug functions in `warn.hh` also have an optional argument `newline`, which specifies whether the message should always start on a new line or continue a previous message. By default, `progress_indication` does NOT start on a new line, but rather continue

the previous output. They also do not have a particular input position associated, so there are no progress functions in the Input class. All other functions by default start their output on a new line.

The error functions come in three different flavors: fatal error messages, programming error messages and normal error messages. Errors written by the `error ()` function will cause LilyPond to exit immediately, errors by `Input::error ()` will continue the compilation, but return a non-zero return value of the lilypond call (i.e. indicate an unsuccessful program execution). All other errors will be printed on the console, but not exit LilyPond or indicate an unsuccessful return code. Their only differences to a warnings are the displayed text and that they will be shown with loglevel `ERROR`.

If the Scheme option `warning-as-error` is set, any warning will be treated as if `Input::error` was called.

All logging functions at a glance

	C++, no location	**C++ from input location**
ERROR	`error ()`, `programming_error (msg)`, `non_fatal_error (msg)`	`Input::error (msg)`, `Input::programming_error (msg)`
WARN	`warning (msg)`	`Input::warning (msg)`
BASIC	`basic_progress (msg)`	-
PROGRESS	`progress_indication (msg)`	-
INFO	`message (msg)`	`Input::message (msg)`
DEBUG	`debug_output (msg)`	`Input::debug_output (msg)`

	C++ from a Grob	**Scheme, music expression**
ERROR	`Grob::programming_error (msg)`	-
WARN	`Grob::warning (msg)`	`(ly:music-warning music msg)`
BASIC	-	-
PROGRESS	-	-
INFO	-	`(ly:music-message music msg)`
DEBUG	-	-

	Scheme, no location	**Scheme, input location**

ERROR	-	`(ly:error msg args)`, `(ly:programming-error msg args)`
WARN	`(ly:warning msg args)`	`(ly:input-warning input msg args)`
BASIC	`(ly:basic-progress msg args)`	-
PROGRESS	`(ly:progress msg args)`	-
INFO	`(ly:message msg args)`	`(ly:input-message input msg args)`
DEBUG	`(ly:debug msg args)`	-

10.7 Debugging LilyPond

The most commonly used tool for debugging LilyPond is the GNU debugger gdb. The gdb tool is used for investigating and debugging core Lilypond code written in C++. Another tool is available for debugging Scheme code using the Guile debugger. This section describes how to use both gdb and the Guile Debugger.

10.7.1 Debugging overview

Using a debugger simplifies troubleshooting in at least two ways.

First, breakpoints can be set to pause execution at any desired point. Then, when execution has paused, debugger commands can be issued to explore the values of various variables or to execute functions.

Second, the debugger can display a stack trace, which shows the sequence in which functions have been called and the arguments passed to the called functions.

10.7.2 Debugging C++ code

The GNU debugger, gdb, is the principal tool for debugging C++ code.

Compiling LilyPond for use with gdb

In order to use gdb with LilyPond, it is necessary to compile LilyPond with debugging information. This is accomplished by running the following commands in the main LilyPond source directory.

```
./configure  --disable-optimising
make
```

This will create a version of LilyPond containing debugging information that will allow the debugger to tie the source code to the compiled code.

You should not do *make install* if you want to use a debugger with LilyPond. The *make install* command will strip debugging information from the LilyPond binary.

Typical gdb usage

Once you have compiled the Lilypond image with the necessary debugging information it will have been written to a location in a subfolder of your current working directory:

```
out/bin/lilypond
```

This is important as you will need to let gdb know where to find the image containing the symbol tables. You can invoke gdb from the command line using the following:

```
gdb out/bin/lilypond
```

This loads the LilyPond symbol tables into gdb. Then, to run LilyPond on '`test.ly`' under the debugger, enter the following:

```
run test.ly
```

at the gdb prompt.

As an alternative to running gdb at the command line you may try a graphical interface to gdb such as ddd:

```
ddd out/bin/lilypond
```

You can also use sets of standard gdb commands stored in a .gdbinit file (see next section).

Typical .gdbinit files

The behavior of gdb can be readily customized through the use of a *.gdbinit* file. A *.gdbinit* file is a file named *.gdbinit* (notice the "." at the beginning of the file name) that is placed in a user's home directory.

The *.gdbinit* file below is from Han-Wen. It sets breakpoints for all errors and defines functions for displaying scheme objects (ps), grobs (pgrob), and parsed music expressions (pmusic).

```
file $LILYPOND_GIT/build/out/bin/lilypond
b programming_error
b Grob::programming_error

define ps
   print ly_display_scm($arg0)
end
define pgrob
  print ly_display_scm($arg0->self_scm_)
  print ly_display_scm($arg0->mutable_property_alist_)
  print ly_display_scm($arg0->immutable_property_alist_)
  print ly_display_scm($arg0->object_alist_)
end
define pmusic
  print ly_display_scm($arg0->self_scm_)
  print ly_display_scm($arg0->mutable_property_alist_)
  print ly_display_scm($arg0->immutable_property_alist_)
end
```

10.7.3 Debugging Scheme code

Scheme code can be developed using the Guile command line interpreter `top-repl`. You can either investigate interactively using just Guile or you can use the debugging tools available within Guile.

Using Guile interactively with LilyPond

In order to experiment with Scheme programming in the LilyPond environment, it is necessary to have a Guile interpreter that has all the LilyPond modules loaded. This requires the following steps.

First, define a Scheme symbol for the active module in the '`.ly`' file:

```
#(module-define! (resolve-module '(guile-user))
                 'lilypond-module (current-module))
```

Now place a Scheme function in the '`.ly`' file that gives an interactive Guile prompt:

```
#(top-repl)
```

When the '`.ly`' file is compiled, this causes the compilation to be interrupted and an interactive guile prompt to appear. Once the guile prompt appears, the LilyPond active module must be set as the current guile module:

```
guile> (set-current-module lilypond-module)
```

You can demonstrate these commands are operating properly by typing the name of a LilyPond public scheme function to check it has been defined:

```
guile> fret-diagram-verbose-markup
#<procedure fret-diagram-verbose-markup (layout props marking-list)>
```

If the LilyPond module has not been correctly loaded, an error message will be generated:

```
guile> fret-diagram-verbose-markup
ERROR: Unbound variable: fret-diagram-verbose-markup
ABORT: (unbound-variable)
```

Once the module is properly loaded, any valid LilyPond Scheme expression can be entered at the interactive prompt.

After the investigation is complete, the interactive guile interpreter can be exited:

```
guile> (quit)
```

The compilation of the '`.ly`' file will then continue.

Using the Guile debugger

To set breakpoints and/or enable tracing in Scheme functions, put

```
\include "guile-debugger.ly"
```

in your input file after any scheme procedures you have defined in that file. This will invoke the Guile command-line after having set up the environment for the debug command-line. When your input file is processed, a guile prompt will be displayed. You may now enter commands to set up breakpoints and enable tracing by the Guile debugger.

Using breakpoints

At the guile prompt, you can set breakpoints with the `set-break!` procedure:

```
guile> (set-break! my-scheme-procedure)
```

Once you have set the desired breakpoints, you exit the guile repl frame by typing:

```
guile> (quit)
```

Then, when one of the scheme routines for which you have set breakpoints is entered, guile will interrupt execution in a debug frame. At this point you will have access to Guile debugging commands. For a listing of these commands, type:

```
debug> help
```

Alternatively you may code the breakpoints in your Lilypond source file using a command such as:

```
#(set-break! my-scheme-procedure)
```

immediately after the `\include` statement. In this case the breakpoint will be set straight after you enter the `(quit)` command at the guile prompt.

Embedding breakpoint commands like this is particularly useful if you want to look at how the Scheme procedures in the '`.scm`' files supplied with LilyPond work. To do this, edit the file in the relevant directory to add this line near the top:

```
(use-modules (scm guile-debugger))
```

Now you can set a breakpoint after the procedure you are interested in has been declared. For example, if you are working on routines called by *print-book-with* in '`lily-library.scm`':

```
(define (print-book-with parser book process-procedure)
  (let* ((paper (ly:parser-lookup parser '$defaultpaper))
 (layout (ly:parser-lookup parser '$defaultlayout))
 (outfile-name (get-outfile-name parser)))
    (process-procedure book paper layout outfile-name)))

(define-public (print-book-with-defaults parser book)
  (print-book-with parser book ly:book-process))

(define-public (print-book-with-defaults-as-systems parser book)
  (print-book-with parser book ly:book-process-to-systems))
```

At this point in the code you could add this to set a breakpoint at print-book-with:

```
(set-break! print-book-with)
```

Tracing procedure calls and evaluator steps

Two forms of trace are available:

```
(set-trace-call! my-scheme-procedure)
```

and

```
(set-trace-subtree! my-scheme-procedure)
```

`set-trace-call!` causes Scheme to log a line to the standard output to show when the procedure is called and when it exits.

`set-trace-subtree!` traces every step the Scheme evaluator performs in evaluating the procedure.

10.8 Tracing object relationships

Understanding the LilyPond source often boils down to figuring out what is happening to the Grobs. Where (and why) are they being created, modified and destroyed? Tracing Lily through a debugger in order to identify these relationships can be time-consuming and tedious.

In order to simplify this process, a facility has been added to display the grobs that are created and the properties that are set and modified. Although it can be complex to get set up, once set up it easily provides detailed information about the life of grobs in the form of a network graph.

Each of the steps necessary to use the graphviz utility is described below.

1. Installing graphviz

   In order to create the graph of the object relationships, it is first necessary to install Graphviz. Graphviz is available for a number of different platforms:

   `http://www.graphviz.org/Download..php`

2. Modifying config.make

   In order for the Graphviz tool to work, config.make must be modified. It is probably a good idea to first save a copy of config.make under a different name. Then, edit config.make by removing every occurrence of '`-DNDEBUG`'.

3. Rebuilding LilyPond

   The executable code of LilyPond must be rebuilt from scratch:

```
make -C lily clean && make -C lily
```

4. Create a graphviz-compatible '`.ly`' file

   In order to use the graphviz utility, the '`.ly`' file must include '`ly/graphviz-init.ly`', and should then specify the grobs and symbols that should be tracked. An example of this is found in '`input/regression/graphviz.ly`'.

5. Run lilypond with output sent to a log file

   The Graphviz data is sent to stderr by lilypond, so it is necessary to redirect stderr to a logfile:

   ```
   lilypond graphviz.ly 2> graphviz.log
   ```

6. Edit the logfile

   The logfile has standard lilypond output, as well as the Graphviz output data. Delete everything from the beginning of the file up to but not including the first occurrence of `digraph`.

   Also, delete the final lilypond message about success from the end of the file.

7. Process the logfile with `dot`

   The directed graph is created from the log file with the program `dot`:

   ```
   dot -Tpdf graphviz.log > graphviz.pdf
   ```

The pdf file can then be viewed with any pdf viewer.

When compiled without '`-DNDEBUG`', lilypond may run slower than normal. The original configuration can be restored by either renaming the saved copy of `config.make` or rerunning `configure`. Then rebuild lilypond with

```
make -C lily clean && make -C lily
```

10.9 Adding or modifying features

When a new feature is to be added to LilyPond, it is necessary to ensure that the feature is properly integrated to maintain its long-term support. This section describes the steps necessary for feature addition and modification.

10.9.1 Write the code

You should probably create a new git branch for writing the code, as that will separate it from the master branch and allow you to continue to work on small projects related to master.

Please be sure to follow the rules for programming style discussed earlier in this chapter.

10.9.2 Write regression tests

In order to demonstrate that the code works properly, you will need to write one or more regression tests. These tests are typically '`.ly`' files that are found in '`input/regression`'.

Regression tests should be as brief as possible to demonstrate the functionality of the code.

Regression tests should generally cover one issue per test. Several short, single-issue regression tests are preferred to a single, long, multiple-issue regression test.

If the change in the output is small or easy to overlook, use bigger staff size – 40 or more (up to 100 in extreme cases). Size 30 means "pay extra attention to details in general".

Use existing regression tests as templates to demonstrate the type of header information that should be included in a regression test.

10.9.3 Write convert-ly rule

If the modification changes the input syntax, a convert-ly rule should be written to automatically update input files from older versions.

convert-ly rules are found in python/convertrules.py

If possible, the convert-ly rule should allow automatic updating of the file. In some cases, this will not be possible, so the rule will simply point out to the user that the feature needs manual correction.

Updating version numbers

If a development release occurs between you writing your patch and having it approved+pushed, you will need to update the version numbers in your tree. This can be done with:

```
scripts/auxiliar/update-patch-version old.version.number new.version.number
```

It will change all files in git, so use with caution and examine the resulting diff.

10.9.4 Automatically update documentation

`convert-ly` should be used to update the documentation, the snippets, and the regression tests. This not only makes the necessary syntax changes, it also tests the `convert-ly` rules.

The automatic updating is performed by moving to the top-level source directory, then running:

```
scripts/auxiliar/update-with-convert-ly.sh
```

If you did an out-of-tree build, pass in the relative path:

```
BUILD_DIR=../build-lilypond/ scripts/auxiliar/update-with-convert-ly.sh
```

10.9.5 Manually update documentation

Where the convert-ly rule is not able to automatically update the inline lilypond code in the documentation (i.e. if a NOT_SMART rule is used), the documentation must be manually updated. The inline snippets that require changing must be changed in the English version of the docs and all translated versions. If the inline code is not changed in the translated documentation, the old snippets will show up in the English version of the documentation.

Where the convert-ly rule is not able to automatically update snippets in Documentation/snippets/, those snippets must be manually updated. Those snippets should be copied to Documentation/snippets/new. The comments at the top of the snippet describing its automatic generation should be removed. All translated texidoc strings should be removed. The comment "% begin verbatim" should be removed. The syntax of the snippet should then be manually edited.

Where snippets in Documentation/snippets are made obsolete, the snippet should be copied to Documentation/snippets/new. The comments and texidoc strings should be removed as described above. Then the body of the snippet should be changed to:

```
\markup {
  This snippet is deprecated as of version X.Y.Z and
  will be removed from the documentation.
}
```

where X.Y.Z is the version number for which the convert-ly rule was written.

Update the snippet files by running:

```
scripts/auxiliar/makelsr.py
```

Where the convert-ly rule is not able to automatically update regression tests, the regression tests in input/regression should be manually edited.

Although it is not required, it is helpful if the developer can write relevant material for inclusion in the Notation Reference. If the developer does not feel qualified to write the documentation, a documentation editor will be able to write it from the regression tests. In this case the developer should raise a new issue with the Type=Documentation tag containing a reference to the original issue number and/or the committish of the pushed patch so that the need for new documention is not overlooked.

Any text that is added to or removed from the documentation should be changed only in the English version.

10.9.6 Edit changes.tely

An entry should be added to Documentation/changes.tely to describe the feature changes to be implemented. This is especially important for changes that change input file syntax.

Hints for changes.tely entries are given at the top of the file.

New entries in changes.tely go at the top of the file.

The changes.tely entry should be written to show how the new change improves LilyPond, if possible.

10.9.7 Verify successful build

When the changes have been made, successful completion must be verified by doing

```
make all
make doc
```

When these commands complete without error, the patch is considered to function successfully.

Developers on Windows who are unable to build LilyPond should get help from a GNU/Linux or OSX developer to do the make tests.

10.9.8 Verify regression tests

In order to avoid breaking LilyPond, it is important to verify that the regression tests succeed, and that no unwanted changes are introduced into the output. This process is described in Section 9.4 [Regtest comparison], page 101.

Typical developer's edit/compile/test cycle

- Initial test:

```
make [-jX]
make [-jX CPU_COUNT=X] test-baseline
make [-jX CPU_COUNT=X] check
```

- Edit/compile/test cycle:

```
## edit source files, then...

make clean                          ## only if needed (see below)
make [-jX]                          ## only if needed (see below)
make [-jX CPU_COUNT=X] test-redo ## redo files differing from baseline
make [-jX CPU_COUNT=X] check
```

- Reset:

```
make test-clean
```

If you modify any source files that have to be compiled (such as '`.cc`' or '`.hh`' files in '`flower/`' or '`lily/`'), then you must run `make` before `make test-redo`, so `make` can compile the modified files and relink all the object files. If you only modify files which are interpreted, like those in the '`scm/`' and '`ly/`' directories, then `make` is not needed before `make test-redo`.

Also, if you modify any font definitions in the 'mf/' directory then you must run `make clean` and `make` before running `make test-redo`. This will recompile everything, whether modified or not, and takes a lot longer.

Running `make check` will leave an HTML page 'out/test-results/index.html'. This page shows all the important differences that your change introduced, whether in the layout, MIDI, performance or error reporting.

You only need to use `make test-clean` to start from scratch, prior to running `make test-baseline`. To check new modifications, all that is needed is to repeat `make test-redo` and `make test-check` (not forgetting `make` if needed).

10.9.9 Post patch for comments

See [Uploading a patch for review], page 24.

10.9.10 Push patch

Once all the comments have been addressed, the patch can be pushed.

If the author has push privileges, the author will push the patch. Otherwise, a developer with push privileges will push the patch.

10.9.11 Closing the issues

Once the patch has been pushed, all the relevant issues should be closed.

On Rietveld, the author should log in and close the issue either by using the 'Edit Issue' link, or by clicking the circled x icon to the left of the issue name.

If the changes were in response to a feature request on the Google issue tracker for LilyPond, the author should change the status to Fixed and a tag 'fixed_x_y_z' should be added, where the patch was fixed in version x.y.z. If the author does not have privileges to change the status, an email should be sent to bug-lilypond requesting the BugMeister to change the status.

10.10 Iterator tutorial

TODO – this is a placeholder for a tutorial on iterators

Iterators are routines written in C++ that process music expressions and sent the music events to the appropriate engravers and/or performers.

See a short example discussing iterators and their duties in Section 10.16.4 [Articulations on EventChord], page 136.

10.11 Engraver tutorial

Engravers are C++ classes that catch music events and create the appropriate grobs for display on the page. Though the majority of engravers are responsible for the creation of a single grob, in some cases (e.g. `New_fingering_engraver`), several different grobs may be created.

Engravers listen for events and acknowledge grobs. Events are passed to the engraver in time-step order during the iteration phase. Grobs are made available to the engraver when they are created by other engravers during the iteration phase.

10.11.1 Useful methods for information processing

An engraver inherits the following public methods from the Translator base class, which can be used to process listened events and acknowledged grobs:

- `virtual void initialize ()`
- `void start_translation_timestep ()`
- `void process_music ()`

- `void process_acknowledged ()`
- `void stop_translation_timestep ()`
- `virtual void finalize ()`

These methods are listed in order of translation time, with `initialize ()` and `finalize ()` bookending the whole process. `initialize ()` can be used for one-time initialization of context properties before translation starts, whereas `finalize ()` is often used to tie up loose ends at the end of translation: for example, an unterminated spanner might be completed automatically or reported with a warning message.

10.11.2 Translation process

At each timestep in the music, translation proceeds by calling the following methods in turn:

`start_translation_timestep ()` is called before any user information enters the translators, i.e., no property operations (\set, \override, etc.) or events have been processed yet.

`process_music ()` and `process_acknowledged ()` are called after all events in the current time step have been heard, or all grobs in the current time step have been acknowledged. The latter tends to be used exclusively with engravers which only acknowledge grobs, whereas the former is the default method for main processing within engravers.

`stop_translation_timestep ()` is called after all user information has been processed prior to beginning the translation for the next timestep.

10.11.3 Preventing garbage collection for SCM member variables

In certain cases, an engraver might need to ensure private Scheme variables (with type SCM) do not get swept away by Guile's garbage collector: for example, a cache of the previous key signature which must persist between timesteps. The method `virtual derived_mark () const` can be used in such cases:

```
Engraver_name::derived_mark ()
{
  scm_gc_mark (private_scm_member_)
}
```

10.11.4 Listening to music events

External interfaces to the engraver are implemented by protected macros including one or more of the following:

- `DECLARE_TRANSLATOR_LISTENER (event_name)`
- `IMPLEMENT_TRANSLATOR_LISTENER (Engraver_name, event_name)`

where *event_name* is the type of event required to provide the input the engraver needs and *Engraver_name* is the name of the engraver.

Following declaration of a listener, the method is implemented as follows:

```
IMPLEMENT_TRANSLATOR_LISTENER (Engraver_name, event_name)
void
Engraver_name::listen_event_name (Stream event *event)
{
  ...body of listener method...
}
```

10.11.5 Acknowledging grobs

Some engravers also need information from grobs as they are created and as they terminate. The mechanism and methods to obtain this information are set up by the macros:

- `DECLARE_ACKNOWLEDGER (grob_interface)`
- `DECLARE_END_ACKNOWLEDGER (grob_interface)`

where *grob_interface* is an interface supported by the grob(s) which should be acknowledged. For example, the following code would declare acknowledgers for a `NoteHead` grob (via the `note-head-interface`) and any grobs which support the `side-position-interface`:

```
DECLARE_ACKNOWLEDGER (note_head)
DECLARE_ACKNOWLEDGER (side_position)
```

The `DECLARE_END_ACKNOWLEDGER ()` macro sets up a spanner-specific acknowledger which will be called whenever a spanner ends.

Following declaration of an acknowledger, the method is coded as follows:

```
void
Engraver_name::acknowledge_interface_name (Grob_info info)
{
  ...body of acknowledger method...
}
```

Acknowledge functions are called in the order engravers are `\consist`-ed (the only exception is if you set `must-be-last` to `#t`).

If useful things are to be done to the acknowledged grobs, this should be deferred until all the acknowledging has finished, i.e., store the acknowledged grobs and process the information in a `process-acknowledged ()` or `stop-translation-timestep ()` function.

10.11.6 Engraver declaration/documentation

An engraver must have a public macro

- `TRANSLATOR_DECLARATIONS (Engraver_name)`

where `Engraver_name` is the name of the engraver. This defines the common variables and methods used by every engraver.

At the end of the engraver file, one or both of the following macros are generally called to document the engraver in the Internals Reference:

- `ADD_ACKNOWLEDGER (Engraver_name, grob_interface)`
- `ADD_TRANSLATOR (Engraver_name, Engraver_doc, Engraver_creates, Engraver_reads, Engraver_writes)`

where `Engraver_name` is the name of the engraver, `grob_interface` is the name of the interface that will be acknowledged, `Engraver_doc` is a docstring for the engraver, `Engraver_creates` is the set of grobs created by the engraver, `Engraver_reads` is the set of properties read by the engraver, and `Engraver_writes` is the set of properties written by the engraver.

The `ADD_ACKNOWLEDGER` and `ADD_TRANSLATOR` macros use a non-standard indentation system. Each interface, grob, read property, and write property is on its own line, and the closing parenthesis and semicolon for the macro all occupy a separate line beneath the final interface or write property. See existing engraver files for more information.

10.12 Callback tutorial

TODO – This is a placeholder for a tutorial on callback functions.

10.13 Understanding pure properties

Pure properties are some of the most difficult properties to understand in LilyPond but, once understood, it is much easier to work with horizontal spacing. This document provides an overview of what it means for something to be 'pure' in LilyPond, what this purity guarantees, and where pure properties are stored and used. It finishes by discussing a few case studies for the pure programmer to save you some time and to prevent you some major headaches.

10.13.1 Purity in LilyPond

Pure properties in LilyPond that do not have any 'side effects'. That is, looking up a pure property should never result in calls to the following functions:

- `set_property`
- `set_object`
- `suicide`

This means that, if the property is calculated via a callback, this callback must not only avoid the functions above but make sure that any functions it calls also avoid the functions above. Also, to date in LilyPond, a pure function will always return the same value before line breaking (or, more precisely, before any version of `break_into_pieces` is called). This convention makes it possible to cache pure functions and be more flexible about the order in which functions are called. For example; Stem #'length has a pure property that will *never* trigger one of the functions listed above and will *always* return the same value before line breaking, independent of where it is called. Sometimes, this will be the actual length of the Stem. But sometimes it will not. For example; stem that links up with a beam will need its end set to the Y position of the beam at the stem's X position. However, the beam's Y positions can only be known after the score is broken up in to several systems (a beam that has a shallow slope on a compressed line of music, for example, may have a steeper one on an uncompressed line). Thus, we only call the impure version of the properties once we are *absolutely certain* that all of the parameters needed to calculate their final value have been calculated. The pure version provides a useful estimate of what this Stem length (or any property) will be, and the art of creating good pure properties is trying to get the estimation as close to the actual value as possible.

Of course, like Gregory Peck and Tintin, some Grobs will have properties that will always be pure. For example, the height of a note-head in not-crazy music will never depend on line breaking or other parameters decided late in the typesetting process. Inversely, in rare cases, certain properties are difficult to estimate with pure values. For example, the height of a Hairpin at a certain cross-section of its horizontal span is difficult to know without knowing the horizontal distance that the hairpin spans, and LilyPond provides an over-estimation by reporting the pure height as the entire height of the Hairpin.

Purity, like for those living in a convent, is more like a contract than an *a priori*. If you write a pure-function, you are promising the user (and the developer who may have to clean up after you) that your function will not be dependent on factors that change at different stages of the compilation process (compilation of a score, not of LilyPond).

One last oddity is that purity, in LilyPond, is currently limited exclusively to things that have to do with Y-extent and positioning. There is no concept of 'pure X' as, by design, X is always the independent variable (i.e. from column X1 to column X2, what will be the Y height of a given grob). Furthermore, there is no purity for properties like color, text, and other things for which a meaningful notion of estimation is either not necessary or has not yet been found. For example, even if a color were susceptible to change at different points of the compilation process, it is not clear what a pure estimate of this color would be or how this pure color could be used. Thus, in this document and in the source, you will see purity discussed almost interchangeably with Y-axis positioning issues.

10.13.2 Writing a pure function

Pure functions take, at a minimum, three arguments: the *grob*, the starting column at which the function is being evaluated (hereafter referred to as *start*), and the end column at which the grob is being evaluated (hereafter referred to as *end*). For items, *start* and *end* must be provided (meaning they are not optional) but will not have a meaningful impact on the result, as items only occupy one column and will thus yield a value or not (if they are not in the range from *start* to *end*). For spanners however, *start* and *end* are important, as we may can get a better pure estimation of a slice of the spanner than considering it on the whole. This is useful during line breaking, for example, when we want to estimate the Y-extent of a spanner broken at given starting and ending columns.

10.13.3 How purity is defined and stored

Purity can currently be defined two different ways in LilyPond that correspond to two types of scenarios. In one scenario, we know that a callback is pure, but we are not necessarily certain what properties will use this callback. In another, we want a property to be pure, but we don't want to guarantee that its callback function will be pure in all circumstances.

In the first scenario, we register the callback in define-grobs.scm in one of four places depending on what the function does.

- `pure-print-functions`: If finding a print function's vertical extent does not have any 'side effects' we register it here. We then don't have to set the pure Y-extent property, which will be taken from the stencil.
- `pure-print-to-height-conversions`: If a stencil can eventually be used to glean a grob's Y-extent but is not pure (meaning it will have a different height at different stages of the compilation process), we add it to this list along with a function for the pure Y-extent.
- `pure-conversions-alist`: This list contains pairs of functions and their pure equivalents. It is onto but not one-to-one.
- `pure-functions`: Like pure-print-functions in that they work for both pure and impure values, but they do not return a stencil.

At all stages of the compilation process, when LilyPond wants the pure version of a property, it will consult these lists and see if it can get this property for a given Grob. Note that you do *not* need to register the pure property in the grob itself. For example, there is no property 'pure-Y-extent'. Rather, by registering these functions as defined above, every time LilyPond needs a pure property, it will check to see if a Grob contains one of these functions and, if so, will use its value. If LilyPond cannot get a pure function, it will return a value of `##f` for the property.

LilyPond is smart enough to know if a series of chained functions are pure. For example, if a Y-offset property has four chained functions and all of them have pure equivalents, LilyPond will read the four pure equivalents when calculating the pure property. However, if even one is impure, LilyPond will not return a pure property for the offset (instead returning something like `#f` or `'()`) and will likely wreak havoc on your score.

In the second scenario, we create an unpure-pure-container (unpure is not a word, but hey, neither was Lilypond until the 90s). For example:

```
#(define (foo grob)
  '(-1 . 1))

#(define (bar grob start end)
  '(-2 . 2))

\override Stem #'length = #(ly:make-unpure-pure-container foo bar)
```

This is useful if we want to:

- create overrides that have pure alternatives (should not be used in development, but useful for users)
- use return values that are not functions (i.e. pairs or booleans) for either pure or unpure values.
- allow a function to be considered pure in a limited amount of circumstances. This is useful if we are sure that, when associated with one grob a function will be pure but not necessarily with another grob that has different callbacks.

Items can only ever have two pure heights: their actual pure height if they are between 'start' and 'end', or an empty interval if they are not. Thus, their pure property is cached to speed LilyPond up. Pure heights for spanners are generally not cached as they change depending on the start and end values. They are only cached in certain particular cases. Before writing a lot of caching code, make sure that it is a value that will be reused a lot.

10.13.4 Where purity is used

Pure Y values must be used in any functions that are called before line breaking. Examples of this can be seen in `Separation_items::boxes` to construct horizontal skylines and in `Note_spacing::stem_dir_correction` to correct for optical illusions in spacing. Pure properties are also used in the calculation of other pure properties. For example, the `Axis_group_interface` has pure functions that look up other pure functions.

Purity is also implicitly used in any functions that should only ever return pure values. For example, extra-spacing-height is only ever used before line-breaking and thus should never use values that would only be available after line breaking. In this case, there is no need to create callbacks with pure equivalents because these functions, by design, need to be pure.

To know if a property will be called before and/or after line-breaking is sometimes tricky and can, like all things in coding, be found by using a debugger and/or adding *printf* statements to see where they are called in various circumstances.

10.13.5 Case studies

In each of these case studies, we expose a problem in pure properties, a solution, and the pros and cons of this solution.

Time signatures

A time signature needs to prevent accidentals from passing over or under it, but its extent does not necessarily extend to the Y-position of accidentals. LilyPond's horizontal spacing sometimes makes a line of music compact and, when doing so, allows certain columns to pass over each other if they will not collide. This type of passing over is not desirable with time signatures in traditional engraving. But how do we know if this passing over will happen before line breaking, as we are not sure what the X positions will be? We need a pure estimation of how much extra spacing height the time signatures would need to prevent this form of passing over without making this height so large as to overly-distort the Y-extent of an system, which could result in a very 'loose' looking score with lots of horizontal space between columns. So, to approximate this extra spacing height, we use the Y-extent of a time signature's next-door-neighbor grobs via the pure-from-neighbor interface.

- pros: By extending the extra spacing height of a time signature to that of its next-door-neighbors, we make sure that grobs to the right of it that could pass above or below it do not.
- cons: This over-estimation of the vertical height could prevent snug vertical spacing of systems, as the system will be registered as being taller at the point of the time signature than it actually is. This approach can be used for clefs and bar lines as well.

Stems

As described above, Stems need pure height approximations when they are beamed, as we do not know the beam positions before line breaking. To estimate this pure height, we take all the stems in a beam and find their pure heights as if they were not beamed. Then, we find the union of all these pure heights and take the intersection between this interval (which is large) and an interval going from the note-head of a stem to infinity in the direction of the stem so that the interval stops at the note head.

- pros: This is guaranteed to be at least as long as the beamed stem, as a beamed stem will never go over the ideal length of the extremal beam of a stem.
- cons: Certain stems will be estimated as being too long, which leads to the same problem of too-much-vertical-height as described above.

10.13.6 Debugging tips

A few questions to ask yourself when working with pure properties:

- Is the property really pure? Are you sure that its value could not be changed later in the compiling process due to other changes?
- Can the property be made to correspond even more exactly with the eventual impure property?
- For a spanner, is the pure property changing correctly depending on the starting and ending points of the spanner?
- For an Item, will the item's pure height need to act in horizontal spacing but not in vertical spacing? If so, use extra-spacing-height instead of pure height.

10.14 LilyPond scoping

The Lilypond language has a concept of scoping, i.e. you can do:

```
foo = 1

#(begin
   (display (+ foo 2)))
```

with `\paper`, `\midi` and `\header` being nested scope inside the '`.ly`' file-level scope. `foo = 1` is translated in to a scheme variable definition.

This implemented using modules, with each scope being an anonymous module that imports its enclosing scope's module.

Lilypond's core, loaded from '`.scm`' files, is usually placed in the `lily` module, outside the '`.ly`' level. In the case of

```
lilypond a.ly b.ly
```

we want to reuse the built-in definitions, without changes effected in user-level '`a.ly`' leaking into the processing of '`b.ly`'.

The user-accessible definition commands have to take care to avoid memory leaks that could occur when running multiple files. All information belonging to user-defined commands and markups is stored in a manner that allows it to be garbage-collected when the module is dispersed, either by being stored module-locally, or in weak hash tables.

10.15 Scheme->C interface

Most of the C functions interfacing with Guile/Scheme used in LilyPond are described in the API Reference of the GUILE Reference Manual.

The remaining functions are defined in 'lily/lily-guile.cc', 'lily/include/lily-guile.hh' and 'lily/include/lily-guile-macros.hh'. Although their names are meaningful there's a few things you should know about them.

10.15.1 Comparison

This is the trickiest part of the interface.

Mixing Scheme values with C comparison operators won't produce any crash or warning when compiling but must be avoided:

```
scm_string_p (scm_value) == SCM_BOOL_T
```

As we can read in the reference, `scm_string_p` returns a Scheme value: either `#t` or `#f` which are written `SCM_BOOL_T` and `SCM_BOOL_F` in C. This will work, but it is not following to the API guidelines. For further information, read this discussion:

http://lists.gnu.org/archive/html/lilypond-devel/2011-08/msg00646.html

There are functions in the Guile reference that returns C values instead of Scheme values. In our example, a function called `scm_is_string` (described after `string?` and `scm_string_p`) returns the C value 0 or 1.

So the best solution was simply:

```
scm_is_string (scm_value)
```

There a simple solution for almost every common comparison. Another example: we want to know if a Scheme value is a non-empty list. Instead of:

```
(scm_is_true (scm_list_p (scm_value)) && scm_value != SCM_EOL)
```

one can usually use:

```
scm_is_pair (scm_value)
```

since a list of at least one member is a pair. This test is cheap; `scm_list_p` is actually quite more complex since it makes sure that its argument is neither a 'dotted list' where the last pair has a non-null `cdr`, nor a circular list. There are few situations where the complexity of those tests make sense.

Unfortunately, there is not a `scm_is_[something]` function for everything. That's one of the reasons why LilyPond has its own Scheme interface. As a rule of thumb, tests that are cheap enough to be worth inlining tend to have such a C interface. So there is `scm_is_pair` but not `scm_is_list`, and `scm_is_eq` but not `scm_is_equal`.

General definitions

bool to_boolean (SCM b)

Return `true` if *b* is `SCM_BOOL_T`, else return `false`.

This should be used instead of `scm_is_true` and `scm_is_false` for properties since in Lilypond, unset properties are read as an empty list, and by convention unset Boolean properties default to false. Since both `scm_is_true` and `scm_is_false` only compare with `##f` in line with what Scheme's conditionals do, they are not really useful for checking the state of a Boolean property.

bool ly_is_[something] (args)

Behave the same as scm_is_[something] would do if it existed.

bool is_[type] (SCM s)

Test whether the type of *s* is [type]. [type] is a LilyPond-only set of values (direction, axis...). More often than not, the code checks Lilypond specific C++-implemented types using

[type *] unsmob_[type] (SCM s)

This tries converting a Scheme object to a pointer of the desired kind. If the Scheme object is of the wrong type, a pointer value of `0` is returned, making this suitable for a Boolean test.

10.15.2 Conversion

General definitions

bool to_boolean (SCM b)

Return `true` if *b* is `SCM_BOOL_T`, else return `false`.

This should be used instead of `scm_is_true` and `scm_is_false` for properties since empty lists are sometimes used to unset them.

[C type] ly_scm2[C type] (SCM s)

Behave the same as scm_to_[C type] would do if it existed.

[C type] robust_scm2[C type] (SCM s, [C type] d)

Behave the same as scm_to_[C type] would do if it existed. Return *d* if type verification fails.

10.16 LilyPond miscellany

This is a place to dump information that may be of use to developers but doesn't yet have a proper home. Ideally, the length of this section would become zero as items are moved to other homes.

10.16.1 Spacing algorithms

Here is information from an email exchange about spacing algorithms.

On Thu, 2010-02-04 at 15:33 -0500, Boris Shingarov wrote: I am experimenting with some modifications to the line breaking code, and I am stuck trying to understand how some of it works. So far my understanding is that Simple_spacer operates on a vector of Grobs, and it is a well-known Constrained-QP problem (rods = constraints, springs = quadratic function to minimize). What I don't understand is, if the spacer operates at the level of Grobs, which are built at an earlier stage in the pipeline, how are the changes necessitated by differences in line breaking, taken into account? in other words, if I take the last measure of a line and place it on the next line, it is not just a matter of literally moving that graphic to where the start of the next line is, but I also need to draw a clef, key signature, and possibly other fundamental things – but at that stage in the rendering pipeline, is it not too late??

Joe Neeman answered:

We create lots of extra grobs (eg. a BarNumber at every bar line) but most of them are not drawn. See the break-visibility property in item-interface.

Here is another e-mail exchange. Janek Warchoł asked for a starting point to fixing 1301 (change clef colliding with notes). Neil Puttock replied:

The clef is on a loose column (it floats before the head), so the first place I'd look would be lily/spacing-loose-columns.cc (and possibly lily/spacing-determine-loose-columns.cc). I'd guess the problem is the way loose columns are spaced between other columns: in this snippet, the columns for the quaver and tuplet minim are so close together that the clef's column gets dumped on top of the quaver (since it's loose, it doesn't influence the spacing).

10.16.2 Info from Han-Wen email

In 2004, Douglas Linhardt decided to try starting a document that would explain LilyPond architecture and design principles. The material below is extracted from that email, which

can be found at http://thread.gmane.org/gmane.comp.gnu.lilypond.devel/2992. The headings reflect questions from Doug or comments from Han-Wen; the body text are Han-Wen's answers.

Figuring out how things work.

I must admit that when I want to know how a program works, I use grep and emacs and dive into the source code. The comments and the code itself are usually more revealing than technical documents.

What's a grob, and how is one used?

Graphical object - they are created from within engravers, either as Spanners (derived class) -slurs, beams- or Items (also a derived class) -notes, clefs, etc.

There are two other derived classes System (derived from Spanner, containing a "line of music") and Paper_column (derived from Item, it contains all items that happen at the same moment). They are separate classes because they play a special role in the linebreaking process.

What's a smob, and how is one used?

A C(++) object that is encapsulated so it can be used as a Scheme object. See GUILE info, "19.3 Defining New Types (Smobs)"

When is each C++ class constructed and used?

- Music classes

  In the parser.yy see the macro calls MAKE_MUSIC_BY_NAME().
- Contexts

  Constructed during "interpreting" phase.
- Engravers

  Executive branch of Contexts, plugins that create grobs, usually one engraver per grob type. Created together with context.
- Layout Objects

  = grobs
- Grob Interfaces

  These are not C++ classes per se. The idea of a Grob interface hasn't crystallized well. ATM, an interface is a symbol, with a bunch of grob properties. They are not objects that are created or destroyed.
- Iterators

  Objects that walk through different music classes, and deliver events in a synchronized way, so that notes that play together are processed at the same moment and (as a result) end up on the same horizontal position.

  Created during interpreting phase.

  BTW, the entry point for interpreting is ly:run-translator (ly_run_translator on the C++ side)

Can you get to Context properties from a Music object?

You can create music object with a Scheme function that reads context properties (the \apply-context syntax). However, that function is executed during Interpreting, so you can not really get Context properties from Music objects, since music objects are not directly connected to Contexts. That connection is made by the Music_iterators

Can you get to Music properties from a Context object?

Yes, if you are given the music object within a Context object. Normally, the music objects enter Contexts in synchronized fashion, and the synchronization is done by Music_iterators.

What is the relationship between C++ classes and Scheme objects?

Smobs are C++ objects in Scheme. Scheme objects (lists, functions) are manipulated from C++ as well using the GUILE C function interface (prefix: scm_)

How do Scheme procedures get called from C++ functions?

scm_call_*, where * is an integer from 0 to 4. Also scm_c_eval_string (), scm_eval ()

How do C++ functions get called from Scheme procedures?

Export a C++ function to Scheme with LY_DEFINE.

What is the flow of control in the program?

Good question. Things used to be clear-cut, but we have Scheme and SMOBs now, which means that interactions do not follow a very rigid format anymore. See below for an overview, though.

Does the parser make Scheme procedure calls or C++ function calls?

Both. And the Scheme calls can call C++ and vice versa. It's nested, with the SCM datatype as lubrication between the interactions

(I think the word "lubrication" describes the process better than the traditional word "glue")

How do the front-end and back-end get started?

Front-end: a file is parsed, the rest follows from that. Specifically,

Parsing leads to a Music + Music_output_def object (see parser.yy, definition of toplevel_expression)

A Music + Music_output_def object leads to a Global_context object (see ly_run_translator ())

During interpreting, Global_context + Music leads to a bunch of Contexts (see Global_translator::run_iterator_on_me ()).

After interpreting, Global_context contains a Score_context (which contains staves, lyrics etc.) as a child. Score_context::get_output () spews a Music_output object (either a Paper_score object for notation or Performance object for MIDI).

The Music_output object is the entry point for the backend (see ly_render_output ()).

The main steps of the backend itself are in

- '`paper-score.cc`' , Paper_score::process_
- '`system.cc`' , System::get_lines()
- The step, where things go from grobs to output, is in System::get_line(): each grob delivers a Stencil (a Device independent output description), which is interpreted by our outputting backends ('`scm/output-tex.scm`' and '`scm/output-ps.scm`') to produce TeX and PS.

Interactions between grobs and putting things into .tex and .ps files have gotten a little more complex lately. Jan has implemented page-breaking, so now the backend also involves Paper_book, Paper_lines and other things. This area is still heavily in flux, and perhaps not something you should want to look at.

How do the front-end and back-end communicate?

There is no communication from backend to front-end. From front-end to backend is simply the program flow: music + definitions gives contexts, contexts yield output, after processing, output is written to disk.

Where is the functionality associated with KEYWORDs?

See '`my-lily-lexer.cc`' (keywords, there aren't that many) and '`ly/*.ly`' (most of the other backslashed `/\words` are identifiers)

What Contexts/Properties/Music/etc. are available when they are processed?

What do you mean exactly with this question?

See '`ly/engraver-init.ly`' for contexts, see '`scm/define-*.scm`' for other objects.

How do you decide if something is a Music, Context, or Grob property?

Why is part-combine-status a Music property when it seems (IMO) to be related to the Staff context?

The Music_iterators and Context communicate through two channels

Music_iterators can set and read context properties, idem for Engravers and Contexts

Music_iterators can send "synthetic" music events (which aren't in the input) to a context. These are caught by Engravers. This is mostly a one way communication channel.

part-combine-status is part of such a synthetic event, used by Part_combine_iterator to communicate with Part_combine_engraver.

Deciding between context and music properties

I'm adding a property to affect how \autochange works. It seems to me that it should be a context property, but the Scheme autochange procedure has a Music argument. Does this mean I should use a Music property?

\autochange is one of these extra strange beasts: it requires look-ahead to decide when to change staves. This is achieved by running the interpreting step twice (see '`scm/part-combiner.scm`' , at the bottom), and storing the result of the first step (where to switch staves) in a Music property. Since you want to influence that where-to-switch list, your must affect the code in make-autochange-music ('`scm/part-combiner.scm`'). That code is called directly from the parser and there are no official "parsing properties" yet, so there is no generic way to tune \autochange. We would have to invent something new for this, or add a separate argument,

```
\autochange #around-central-C ..music..
```

where around-central-C is some function that is called from make-autochange-music.

More on context and music properties

From Neil Puttock, in response to a question about transposition:

Context properties (using \set & \unset) are tied to engravers: they provide information relevant to the generation of graphical objects.

Since transposition occurs at the music interpretation stage, it has no direct connection with engravers: the pitch of a note is fixed before a notehead is created. Consider the following minimal snippet:

```
{ c' }
```

This generates (simplified) a NoteEvent, with its pitch and duration as event properties,

```
(make-music
  'NoteEvent
  'duration
  (ly:make-duration 2 0 1 1)
  'pitch
  (ly:make-pitch 0 0 0)
```

which the Note_heads_engraver hears. It passes this information on to the NoteHead grob it creates from the event, so the head's correct position and duration-log can be determined once it's ready for printing.

If we transpose the snippet,

```
\transpose c d { c' }
```

the pitch is changed before it reaches the engraver (in fact, it happens just after the parsing stage with the creation of a TransposedMusic music object):

```
(make-music
 'NoteEvent
 'duration
 (ly:make-duration 2 0 1 1)
 'pitch
 (ly:make-pitch 0 1 0)
```

You can see an example of a music property relevant to transposition: untransposable.

```
\transpose c d { c'2 \withMusicProperty #'untransposable ##t c' }
```

-> the second c' remains untransposed.

Take a look at '`lily/music.cc`' to see where the transposition takes place.

How do I tell about the execution environment?

I get lost figuring out what environment the code I'm looking at is in when it executes. I found both the C++ and Scheme autochange code. Then I was trying to figure out where the code got called from. I finally figured out that the Scheme procedure was called before the C++ iterator code, but it took me a while to figure that out, and I still didn't know who did the calling in the first place. I only know a little bit about Flex and Bison, so reading those files helped only a little bit.

Han-Wen: GDB can be of help here. Set a breakpoint in C++, and run. When you hit the breakpoint, do a backtrace. You can inspect Scheme objects along the way by doing

```
p ly_display_scm(obj)
```

this will display OBJ through GUILE.

10.16.3 Music functions and GUILE debugging

Ian Hulin was trying to do some debugging in music functions, and came up with the following question

HI all, I'm working on the Guile Debugger Stuff, and would like to try debugging a music function definition such as:

```
conditionalMark = #(define-music-function (parser location) ()
    #{ \tag #'instrumental-part {\mark \default}  #} )
```

It appears conditionalMark does not get set up as an equivalent of a Scheme

```
(define conditionalMark = define-music-function(parser location () ...
```

although something gets defined because Scheme apparently recognizes

```
#(set-break! conditionalMark)
```

later on in the file without signalling any Guile errors.

However the breakpoint trap is never encountered as define-music-function passed things on to ly:make-music-function, which is really C++ code ly_make_music_function, so Guile never finds out about the breakpoint.

Han-Wen answered as follows:

You can see the definition by doing

```
#(display conditionalMark)
```

noindent inside the '`.ly`' file.

The breakpoint failing may have to do with the call sequence. See '`parser.yy`', run_music_function(). The function is called directly from C++, without going through the GUILE evaluator, so I think that is why there is no debugger trap.

10.16.4 Articulations on EventChord

From David Kastrup's email http://lists.gnu.org/archive/html/lilypond-devel/2012-02/msg00189.html:

LilyPond's typesetting does not act on music expressions and music events. It acts exclusively on stream events. It is the act of iterators to convert a music expression into a sequence of stream events played in time order.

The EventChord iterator is pretty simple: it just takes its "elements" field when its time comes up, turns every member into a StreamEvent and plays that through the typesetting process. The parser currently appends all postevents belonging to a chord at the end of "elements", and thus they get played at the same point of time as the elements of the chord. Due to this design, you can add per-chord articulations or postevents or even assemble chords with a common stem by using parallel music providing additional notes/events: the typesetter does not see a chord structure or postevents belonging to a chord, it just sees a number of events occuring at the same point of time in a Voice context.

So all one needs to do is let the EventChord iterator play articulations after elements, and then adding to articulations in EventChord is equivalent to adding them to elements (except in cases where the order of events matters).

11 Release work

11.1 Development phases

There are 2 states of development on `master`:

1. **Normal development**: Any commits are fine.
2. **Build-frozen**: Do not require any additional or updated libraries or make non-trivial changes to the build process. Any such patch (or branch) may not be merged with master during this period.

   This should occur approximately 1 month before any alpha version of the next stable release, and ends when the next unstable branch begins.

After announcing a beta release, branch `stable/2.x`. There are 2 states of development for this branch:

1. **Normal maintenance**: The following patches **MAY NOT** be merged with this branch:
   - Any change to the input syntax. If a file compiled with a previous `2.x` (beta) version, then it must compile in the new version.

     Exception: any bugfix to a Critical issue.
   - New features with new syntax *may be committed*, although once committed that syntax cannot change during the remainder of the stable phase.
   - Any change to the build dependencies (including programming libraries, documentation process programs, or python modules used in the buildscripts). If a contributor could compile a previous lilypond `2.x`, then he must be able to compile the new version.
2. **Release prep**: Only translation updates and important bugfixes are allowed.

11.2 Minor release checklist

A "minor release" means an update of `y` in `2.x.y`.

Pre-release

1. Using any system with git pull access (not necessarily the GUB build machine), use the commands below to switch to the release branch, get changes and prepare the release announcement. This requires a system which has the release/unstable branch. If you get a warning saying you are in `detached HEAD` state, then you should create a release/unstable branch with `git checkout release/unstable`.

   Check the environment variables are set as in Section 14.2 [Environment variables], page 164.

   You need to ensure you have a clean index and work tree. If the checkout displays modified files, you might want to run `git reset --hard` before continuing.

   ```
   git fetch
   git checkout release/unstable
   git merge origin/master
   make -C $LILYPOND_BUILD_DIR po-replace
   mv $LILYPOND_BUILD_DIR/po/lilypond.pot po/
   gedit Documentation/web/news-front.itexi Documentation/web/news.itexi
   gedit VERSION
   ```

   - VERSION_DEVEL = the current development version (previous VERSION_DEVEL + 0.01)
   - VERSION_STABLE = the current stable version (probably no change here)
2. Commit, push, switch back to master (or wherever else):

```
git commit -m "Release: bump VERSION_DEVEL." VERSION
git commit -m "PO: update template." po/lilypond.pot
git commit -m "Release: update news." Documentation/web/
git push origin HEAD:release/unstable
git checkout master
```

3. If you do not have the previous release test-output tarball, download it and put it in `regtests/`
4. Prepare GUB environment by running:

```
### my-gub.sh
# special terminal, and default PATH environment.
# import these special environment vars:
#   HOME, HTTP_PROXY, TERM
env -i \
  HOME=$HOME \
  HTTP_PROXY=$HTTP_PROXY \
  bash --rcfile my-bashrc
```

```
### my-bashrc
export PS1="\[\e[1;33mGUB-ENV \w\]$ \[\e[0m\]"
export PATH=$PATH
export TERM=xterm
```

5. Build release on GUB by running:

```
make LILYPOND_BRANCH=release/unstable lilypond
```

or something like:

```
make LILYPOND_BRANCH=stable/2.16 lilypond
```

6. Check the regtest comparison in '`uploads/webtest/`' for any unintentional breakage. More info in Section 9.2 [Precompiled regression tests], page 99.
7. If any work was done on GUB since the last release, upload binaries to a temporary location, ask for feedback, and wait a day or two in case there's any major problems.

> **Note:** Always do this for a stable release.

Actual release

1. If you're not the right user on the webserver, remove the `t` from the rsync command in:

```
test-lily/rsync-lily-doc.py
test-lily/rsync-test.py
```

2. Upload GUB by running:

```
make lilypond-upload \
  LILYPOND_REPO_URL=git://git.sv.gnu.org/lilypond.git \
  LILYPOND_BRANCH=release/unstable
```

or something like:

```
make lilypond-upload \
  LILYPOND_REPO_URL=git://git.sv.gnu.org/lilypond.git \
  LILYPOND_BRANCH=stable/2.12
```

Post release

1. Update the current staging branch with the current news:

```
git fetch
```

```
git checkout origin/staging
git merge origin/release/unstable
```

2. Update '`VERSION`' in lilypond git and upload changes:

```
gedit VERSION
```

   - VERSION = what you just did +0.0.1

```
git commit -m "Release: bump VERSION." VERSION
git push origin HEAD:staging
```

   If the push fails with a message like

```
 ! [rejected]        HEAD -> staging (non-fast-forward)
```

   it means that somebody else updated the staging branch while you were preparing your change. In that case, you need to restart the Post Release process. Otherwise, proceed:

3. Wait a few hours for the website to update.
4. Email release notice to `info-lilypond`

11.3 Major release checklist

A "major release" means an update of `x` in `2.x.0`.

Main requirements

These are the current official guidelines.

- 0 Critical issues for two weeks (14 days) after the latest release candidate.

Potential requirements

These might become official guidelines in the future.

- Check reg test
- Check all 2ly scripts
- Check for emergencies the docs:

```
grep FIXME --exclude "misc/*" --exclude "*GNUmakefile" \
  --exclude "snippets/*" ????*/*
```

- Check for altered regtests, and document as necessary:

```
git diff -u -r release/2.FIRST-CURRENT-STABLE \
  -r release/2.LAST-CURRENT-DEVELOPMENT input/regression/
```

Housekeeping requirements

Before the release:

- write release notes. note: stringent size requirements for various websites, so be brief.
- Run convert-ly on all files, bump parser minimum version.
- Update lilypond.pot:

```
make -C $LILYPOND_BUILD_DIR po-replace
mv $LILYPOND_BUILD_DIR/po/lilypond.pot po/
```

- Make directories on lilypond.org:

```
~/download/sources/v2.NEW-STABLE
~/download/sources/v2.NEW-DEVELOPMENT
```

- Shortly after the release, move all current contributors to previous contributors in '`Documentation/included/authors.itexi`'.
- Delete old material in '`Documentation/changes.tely`', but don't forget to check it still compiles! Also update the version numbers:

```
@node Top
@top New features in 2.NEW-STABLE since 2.OLD-STABLE
```

- Website:
  - make a link from the old unstable to the next stable in lilypond.org's '`/doc/`' dir. Keep all previous unstable->stable doc symlinks.

    Also, make the old docs self-contained – if there's a redirect in '`/doc/v2.OLD-STABLE/Documentation/index.html`' , replace it with the '`index.html.old-2.OLD-STABLE`' files.

    The post-2.13 docs will need another way of handling the self-containment. It won't be hard to whip up a python script that changes the link to '`../../../../manuals.html`' to '`../website/manuals.html`', but it's still a 30-minute task that needs to be done before 2.16.
  - doc auto redirects to `v2.NEW-STABLE`
  - add these two lines to '`Documentation/web/server/robots.txt`':

```
Disallow: /doc/v2.OLD-STABLE/
Disallow: /doc/v2.NEW-DEVELOPMENT/
```

Unsorted

- submit po template for translation: send url of tarball to coordinator@translationproject.org, mentioning lilypond-VERSION.pot
- update links to distros providing lilypond packages? link in: '`Documentation/web/download.itexi`'

  This has nothing to do with the release, but it's a "periodic maintenance" task that might make sense to include with releases.
- Send announcements to...

  News:

```
comp.music.research
comp.os.linux.announce

comp.text.tex
rec.music.compose
```

  Mail:

```
info-lilypond@gnu.org

linux-audio-announce@lists.linuxaudio.org
linux-audio-user@lists.linuxaudio.org
linux-audio-dev@lists.linuxaudio.org

tex-music@icking-music-archive.org

--- non-existant?
abcusers@blackmill.net

rosegarden-user@lists.sourceforge.net
info-gnu@gnu.org
noteedit-user@berlios.de

gmane.comp.audio.fomus.devel
gmane.linux.audio.users
```

```
gmane.linux.audio.announce
gmane.comp.audio.rosegarden.devel
```

Web:

```
lilypond.org
freshmeat.net
linuxfr.com
http://www.apple.com/downloads
harmony-central.com (news@harmony-central.com)
versiontracker.com [auto]
hitsquad.com [auto]
http://www.svgx.org
https://savannah.gnu.org/news/submit.php?group_id=1673
```

11.4 Release extra notes

Regenerating regression tests

Regenerating regtests (if the lilypond-book naming has changed):

- git checkout release/lilypond-X.Y.Z-A
- take lilypond-book and any related makefile updates from the latest git.
- configure; make; make test
- tar -cjf lilypond-X.Y.Z-A.test-output.tar.bz2 input/regression/out-test/
- mv lilypond-X.Y.Z-A.test-output.tar.bz2 ../gub/regtests/
- cd ../gub/regtests/
- make lilypond

stable/2.12

If releasing stable/2.12, then:

- apply doc patch: patches/rsync-lily.patch (or something like that)
- change infodir in gub/specs/lilypond-doc.py from "lilypond.info" to "lilypond-web.info"

Updating a release (changing a in x.y.z-a)

Really tentative instructions, almost certainly can be done better.

1. change the VERSION back to release you want. push change. (hopefully you'll have forgotten to update it when you made your last release)
2. make sure that there aren't any lilypond files floating around in target/ (like usr/bin/lilypond).
3. build the specific package(s) you want, i.e.

   ```
   bin/gub mingw::lilypond-installer
   make LILYPOND_BRANCH=stable/2.12 -f lilypond.make doc
   bin/gub --platform=darwin-x86 \
     'git://git.sv.gnu.org/lilypond-doc.git?branch=stable/2.12'
   ```

   or

   build everything with the normal "make lilypond", then (maybe) manually delete stuff you don't want to upload.
4. manually upload them. good luck figuring out the rsync command(s). Hints are in test-lily/

   or

   run the normal lilypond-upload command, and (maybe) manually delete stuff you didn't want to upload from the server.

11.5 Notes on builds with GUB

Building GUB

GUB - the Grand Unified Builder - is used to build the release versions of LilyPond. For background information, see [Grand Unified Builder (GUB)], page 18. The simplest way to set up a GUB build environment is to use a virtual machine with LilyDev (Section 2.1 [LilyDev], page 5). Follow the instructions on that page to set this up. Make sure that your virtual machine has enough disk space - a GUB installation takes over 30 GBytes of disk space, and if you allocate too little, it will fail during the setting up stage and you will have to start again. 64 GBytes should be sufficient.

While GUB is being built, any interruptions are likely to make it almost impossible to restart. If at all possible, leave the build to continue uninterrupted.

Download GUB and start the set up:

```
git clone git://github.com/gperciva/gub/gub.git
cd gub
make bootstrap
```

This will take a very long time, even on a very fast computer. You will need to be patient. It's also liable to fail - it downloads a number of tools, and some will have moved and others won't respond to the network. For example, the perl archive. If this happens, download it from `http://www.cpan.org/src/5.0/perl-5.10.0.tar.gz`, saving the archive to '`gub/downloads/perl/`'. Continue the set up with:

```
make bootstrap
```

Once this has completed successfully, you can build the LilyPond release package. However, this uses an archived version of the regression tests, so it is better to download this first. Download the test output from lilypond.org (you will need to replace `2.15.33-1` with the latest build):

`http://lilypond.org/download/binaries/test-output/lilypond-2.15.33-1.test-output.tar.bz2`

Copy the tarball into '`gub/regtests/`', and tell the build system that you have done this:

```
touch regtests/ignore
```

Now start the GUB build:

```
make lilypond
```

That's it. This will build LilyPond from current master. To build the current unstable release, run:

```
make LILYPOND_BRANCH=release/unstable lilypond
```

The first time you do this, it will take a very long time.

Assuming the build has gone well, it can be uploaded using:

```
make lilypond-upload
  LILYPOND_BRANCH=release/unstable
  LILYPOND_REPO_URL=git://git.sv.gnu.org/lilypond.git
```

Output files

GUB builds the files it needs into the directory `gub/target/`. As a general rule, these don't need to be touched unless there is a problem building GUB (see below). The files to be uploaded are in `gub/uploads/`. Once the build has completed successfully, there should be 8 installation files and 3 archives, totalling about 600MB. There are also 4 directories:

```
gub/signatures
gub/localdoc
gub/webdoc
```

```
gub/webtest
```

`signatures` contains files that are used to track whether some of the archives have already been built. Don't touch these.

`localdoc` probably contains local copies of the documentation.

`webdoc` contains the documentation to be uploaded.

`webtest` contains the regtest comparison, which should be checked before upload, and is also uploaded for subsequent checking.

The total upload is about 700 MB in total, and on an ADSL connection will take about 4 hours to upload.

Subsequent builds

In principle, building the next release of LilyPond requires no action other then following the instructions in Section 11.2 [Minor release checklist], page 137. Because much of the infrastructure has already been built, it will take much less time - about an hour on a fast computer.

Continuing to build LilyPond without any other archiving/deletion of previous builds is likely to be successful, but will take up a fair amount of disk space (around 2GB per build) which may be a problem with a Virtual Machine. It's therefore recommended to move (not copy) `gub/uploads` to another machine/disk after each build, if space is at a premium.

However, if a significant change has been made to the LilyPond source (e.g. added source files) the build may fail if tried on top of a previous build. If this happens, be sure to move/delete `gub/uploads` and all mentions of LilyPond in `gub/target`. The latter can be achieved with this command:

```
rm -rf target/*/*/*lilypond*
```

Be *very* careful with this command. Typing it wrongly could wipe your disk completely.

Updating the web site

The `make lilypond-upload` command updates the documentation on the LilyPond web site. However, it does *not* update any part of the site that is not part of the documentation - for example, the front page (`index.html`). The website is updated by 2 cron jobs running on the web server. One of these pulls git master to the web server, and the other makes the website with the standard `make website` command. They run hourly, 30 minutes apart. So - to update the front page of the website, it's necessary to update `VERSION` and `news-front.itexi` in master and then wait for the cron jobs to run. (N.B. - this is done by pushing the changes to staging and letting patchy do its checks before it pushes to master).

12 Build system notes

> **Note:** This chapter is in high flux, and is being run in a "wiki-like" fashion. Do not trust anything you read in this chapter.

12.1 Build system overview

Build system is currently GNU make, with an extra "stepmake" layer on top. Look at files in '`make/`' and '`stepmake/`' and all '`GNUmakefile`'s.

There is wide-spread dissatisfaction with this system, and we are considering changing. This would be a huge undertaking (estimated 200+ hours). This change will probably involve not using GNU make any more – but a discussion about the precise build system will have to wait. Before we reach that point, we need to figure out (at least approximately) what the current build system does.

Fundamentally, a build system does two things:

1. Constructs command-line commands, for example:

```
lilypond-book \
  --tons --of --options \
  pitches.itely
texi2pdf \
  --more --imperial --and --metric --tons --of --options \
  pitches.texi
```

2. If there was a previous build, it decides which parts of the system need to be rebuilt.

When I try to do anything in the build system, it helps to remind myself of this. The "end result" is just a series of command-line commands. All the black magick is just an attempt to construct those commands.

12.2 Tips for working on the build system

- Add:

```
echo "aaa"


echo "bbb"
```

  to the build system files in various places. This will let you track where the program is, in various points of the build.

  PH note. There are lots of places where Make doesn't let you put echo commands. My top tip for tracing how make runs is to put

```
$(error Some Text to display)
```

  This will stop make running and print the text `Some Text to display`.

  End PH note.

- First task: understand how `make website` works, *without* the translations. Looking at the english-only website is the best introduction to the build system... it only covers about 5% of the whole thing, but even that will likely take 10 hours or more.

12.3 General build system notes

12.3.1 How stepmake works

Typing make website runs the file '`GNUmakefile`' from the build directory. This only contains 3 lines:

```
depth = .
include config$(if $(conf),-$(conf),).make
include $(configure-srcdir)/GNUmakefile.in
```

The variable `depth` is used throughout the make system to track how far down the directory structure the make is. The first include sets lots of variables but doesn't "do" anything. Default values for these variables are automatically detected at the ./configure step, which creates the file '`config.make`'. The second include runs the file '`GNUmakefile.in`' from the top level source directory.

This sets another load of variables, and then includes (i.e. immediately runs) '`stepmake.make`' from the '`make`' subdirectory. This sets a load of other variables, does some testing to see if SCONS (another build tool?) is being used, and then runs '`make/config.make`' - which doesn't seem to exist...

GP: scons is indeed a different build tool; I think that Jan experimented with it 5 years ago or something. It seems like we still have bits and pieces of it floating around.

Next, it runs '`make/toplevel-version.make`', which sets the version variables for major, minor, patch, stable, development and mypatchlevel (which seems to be used for patch numbers for non-stable versions only?).

Next - '`make/local.make`', which doesn't exist.

Then a few more variable and the interesting comment:

```
# Don't try to outsmart us, you puny computer!
# Well, UGH.  This only removes builtin rules from
```

and then tests to see whether BUILTINS_REMOVED is defined. It appears to be when I run make, and so '`stepmake/stepmake/no-builtin-rules.make`' is run. The comment at the head of this file says:

```
# UGH.  GNU make comes with implicit rules.
# We don't want any of them, and can't force users to run
# --no-builtin-rules
```

I've not studied that file at length, but assume it removes all make's build-in rules (e.g. '`*.c`' files are run through the GNU C compiler) - there's a lot of them in here, and a lot of comments, and I'd guess most of it isn't needed.

We return to '`stepmake.make`', where we hit the make rule all: The first line of this is:

```
-include $(addprefix $(depth)/make/,$(addsuffix -inclusions.make, $(LOCALSTEPMAKE_TEMPLATES)))
```

which, when the variables are substituted, gives:

```
./make/generic-inclusions.make
./make/lilypond-inclusions.make.
```

(Note - according to the make documentation, -include is only different from include in that it doesn't produce any kind of error message when the included file doesn't exist).

And the first file doesn't exist. Nor the second. Next:

```
-include $(addprefix $(stepdir)/,$(addsuffix -inclusions.make, $(STEPMAKE_TEMPLATES)))
```

which expands to the following files:

```
/home/phil/lilypond-git/stepmake/stepmake/generic-inclusions.make
/home/phil/lilypond-git/stepmake/stepmake/toplevel-inclusions.make
/home/phil/lilypond-git/stepmake/stepmake/po-inclusions.make
/home/phil/lilypond-git/stepmake/stepmake/install-inclusions.make.
```

One little feature to notice here - these are all absolute file locations - the line prior to this used relative locations. And none of these files exist, either.

(Further note - I'm assuming all these lines of make I'm following are autogenerated, but that'll be something else to discover.)

JM: *"No, these lines are not useful in LilyPond (this is why you think they are autogenerated), but they are part of StepMake, which was meant to be a package to be installed as a build system over autoconf/make in software project source trees."*

Next in '`stepmake.make`':

```
include $(addprefix $(stepdir)/,$(addsuffix -vars.make, $(STEPMAKE_TEMPLATES)))
```

which expands to:

```
/home/phil/lilypond-git/stepmake/stepmake/generic-vars.make
/home/phil/lilypond-git/stepmake/stepmake/toplevel-vars.make
/home/phil/lilypond-git/stepmake/stepmake/po-vars.make
/home/phil/lilypond-git/stepmake/stepmake/install-vars.make.
```

Woo. They all exist (they should as there's no - in front of the include). '`generic-vars.make`' sets loads of variables (funnily enough). '`toplevel-vars.make`' is very short - one line commented as `# override Generic_vars.make:` and 2 as follows:

```
# urg?
include $(stepdir)/documentation-vars.make
```

I assume the urg comment refers to the fact that this should really just create more variables, but it actually sends us off to '`/home/phil/lilypond-git/stepmake/stepmake/documentation-vars.make`'.

That file is a 3 line variable setting one.

'`po-vars.make`' has the one-line comment `# empty`, as does '`install-vars.make`'.

So now we're back to '`stepmake.make`'.

The next lines are :

```
# ugh. need to do this because of PATH :=$(top-src-dir)/..:$(PATH)
include $(addprefix $(depth)/make/,$(addsuffix -vars.make, $(LOCALSTEPMAKE_TEMPLATES)))
```

and the include expands to:

```
include ./make/generic-vars.make ./make/lilypond-vars.make.
```

These again set variables, and in some cases export them to allow child `make` processes to use them.

The final 4 lines of '`stepmake.make`' are:

```
include $(addprefix $(depth)/make/,$(addsuffix -rules.make, $(LOCALSTEPMAKE_TEMPLATES)))
include $(addprefix $(stepdir)/,$(addsuffix -rules.make, $(STEPMAKE_TEMPLATES)))
include $(addprefix $(depth)/make/,$(addsuffix -targets.make, $(LOCALSTEPMAKE_TEMPLATES)))
include $(addprefix $(stepdir)/,$(addsuffix -targets.make, $(STEPMAKE_TEMPLATES)))
```

which expand as follows:

```
include ./make/generic-rules.make ./make/lilypond-rules.make
include
  /home/phil/lilypond-git/stepmake/stepmake/generic-rules.make
  /home/phil/lilypond-git/stepmake/stepmake/toplevel-rules.make
  /home/phil/lilypond-git/stepmake/stepmake/po-rules.make
  /home/phil/lilypond-git/stepmake/stepmake/install-rules.make
include ./make/generic-targets.make ./make/lilypond-targets.make
include
  /home/phil/lilypond-git/stepmake/stepmake/generic-targets.make
  /home/phil/lilypond-git/stepmake/stepmake/toplevel-targets.make
  /home/phil/lilypond-git/stepmake/stepmake/po-targets.make
```

```
/home/phil/lilypond-git/stepmake/stepmake/install-targets.make
```

‘lilypond-rules.make’ is #empty

‘generic-rules.make’ does seem to have 2 rules in it. They are:

```
$(outdir)/%.ly: %.lym4
        $(M4) $< | sed "s/\`/,/g" > $@

$(outdir)/%: %.in
        rm -f $@
        cat $< | sed $(sed-atfiles) | sed $(sed-atvariables) > $@
```

I believe the first rule is for *.ly files, and has a prerequisite that *.lym4 files must be built first. The recipe is `m4 | sed "s/\`/,/g" >`. Perhaps someone with more Unix/make knowledge can comment on exactly what the rules mean/do.

‘toplevel-rules.make’ is #empty

‘po-rules.make’ is #empty

‘install-rules.make’ is #empty

‘generic-targets.make’ contains 2 lines of comments.

‘lilypond-targets.make’ contains only:

```
## TODO: fail dist or web if no \version present.
check-version:
        grep -L version $(LY_FILES)
```

‘stepmake/generic-targets.make’ contains lots of rules - too many to list here - it seems to be the main file for rules. (FWIW I haven’t actually found a rule for website: anywhere, although it clearly exists. I have also found that you can display a rule in the terminal by typing, say `make -n website`. This is probably common knowledge.

‘stepmake/toplevel-targets.make’ adds a load of other (and occasionally the same) rules to the gernric-targets.

‘stepmake/po-targets.make’ is rules for po* makes.

‘stepmake/install-targets.make’ has rules for local-install*.

And that’s the end of stepmake.make. Back to ‘GNUmakefile.in’.

A bit more info from 27 March. I’ve put some error traces into GNUmakefile in the build directory, and it looks like the following lines actually cause the make to run (putting an error call above them - no make; below them - make):

```
ifeq ($(out),www)
# All web targets, except info image symlinks and info docs are
# installed in non-recursing target from TOP-SRC-DIR
install-WWW:
        -$(INSTALL) -m 755 -d $(DESTDIR)$(webdir)
        rsync -rl --exclude='*.signature' $(outdir)/offline-root $(DESTDIR)$(webdir)
        $(MAKE) -C Documentation omf-local-install
```

I don’t currently understand the `ifeq`, since `$(out)` is empty at this point, but the line starting `-$(INSTALL)` translates to:

```
-/usr/bin/python /home/phil/lilypond-git/stepmake/bin/install.py \
  -c -m 755 -d /usr/local/share/doc/lilypond/html
```

End of work for Sunday 27th.

Another alterative approach to understanding the website build would be to redirect `make -n website` and `make website` to a text file and work through a) what it does and b) where the errors are occurring.

GP: wow, all the above is much more complicated than I’ve ever looked at stuff – I tend to do a "back first" approach (where I begin from the command-line that I want to modify, figure out

where it's generated, and then figure out how to change the generated command-line), rather than a "front first" (where you begin from the "make" command).

12.4 Doc build

12.4.1 The function of make doc

The following is a set of notes on how make doc functions.

Preliminary question to be answered some time: where do all the GNUmakefiles come from. They're in the build directory, but this is not part of source. Must be the configure script. And it looks like this comes from autogen.sh. Must at some point kill the whole git directory, repull and see what is created when.

Anyway, here's how make doc progresses:

This is the build dependency tree from '`stepmake/stepmake/generic-targets.make`':

```
doc: doc-stage-1
  doc-stage-1:
        $(MAKE) -C $(depth)/scripts/build out=
        $(MAKE) out=www WWW-1
          WWW-1: local-WWW-1
        $(LOOP)
          $(MAKE) out=www WWW-2
          WWW-2: local-WWW-2
            $(LOOP)
          $(MAKE) out=www WWW-post
MAKE = make --no-builtin-rules
-C = Change to directory before make
```

doc-stage-1 does lots of opening and looking in files, but no processing.

```
Variable LOOP =

+ make PACKAGE=LILYPOND package=lilypond -C python
&& make PACKAGE=LILYPOND package=lilypond -C scripts
&&  make PACKAGE=LILYPOND package=lilypond -C flower
&&  make PACKAGE=LILYPOND package=lilypond -C lily
&&  make PACKAGE=LILYPOND package=lilypond -C mf
&&  make PACKAGE=LILYPOND package=lilypond -C ly
&&  make PACKAGE=LILYPOND package=lilypond -C tex
&&  make PACKAGE=LILYPOND package=lilypond -C ps
&&  make PACKAGE=LILYPOND package=lilypond -C scm
&&  make PACKAGE=LILYPOND package=lilypond -C po
&&  make PACKAGE=LILYPOND package=lilypond -C make
&&  make PACKAGE=LILYPOND package=lilypond -C elisp
&&  make PACKAGE=LILYPOND package=lilypond -C vim
&&  make PACKAGE=LILYPOND package=lilypond -C input
&&  make PACKAGE=LILYPOND package=lilypond -C stepmake
&&  make PACKAGE=LILYPOND package=lilypond -C Documentation
&& true
```

From git grep:

stepmake/stepmake/generic-vars.make has this:

```
LOOP=+$(foreach i, $(SUBDIRS), $(MAKE) PACKAGE=$(PACKAGE) package=$(package) -C $(i) $@ &&) true
```

$@ is the name of the target - WWW-1 in this case.

In GNUmakefile.in we find:

```
SUBDIRS = python scripts \
        flower lily \
        mf ly \
        tex ps scm \
        po make \
        elisp vim \
        input \
        stepmake $(documentation-dir)
```

So that's how we get the main make loop...

That loop expands like this:

```
make PACKAGE=LILYPOND package=lilypond -C python WWW-1 &&
make PACKAGE=LILYPOND package=lilypond -C scripts WWW-1 &&
make PACKAGE=LILYPOND package=lilypond -C flower WWW-1 &&
make PACKAGE=LILYPOND package=lilypond -C lily WWW-1 &&
make PACKAGE=LILYPOND package=lilypond -C mf WWW-1 &&
make PACKAGE=LILYPOND package=lilypond -C ly WWW-1 &&
make PACKAGE=LILYPOND package=lilypond -C tex WWW-1 &&
make PACKAGE=LILYPOND package=lilypond -C ps WWW-1 &&
make PACKAGE=LILYPOND package=lilypond -C scm WWW-1 &&
make PACKAGE=LILYPOND package=lilypond -C po WWW-1 &&
make PACKAGE=LILYPOND package=lilypond -C make WWW-1 &&
make PACKAGE=LILYPOND package=lilypond -C elisp WWW-1 &&
make PACKAGE=LILYPOND package=lilypond -C vim WWW-1 &&
make PACKAGE=LILYPOND package=lilypond -C input WWW-1 &&
make PACKAGE=LILYPOND package=lilypond -C stepmake WWW-1 &&
make PACKAGE=LILYPOND package=lilypond -C Documentation WWW-1 &&
true
```

The directories up to and including vim produce no effect with make in non-debug mode, although debug does show lots of action.

'`git/build/input/GNUmakefile`' is:

```
depth=../
include $(depth)/config$(if $(conf),-$(conf),).make
include $(configure-srcdir)/./input/GNUmakefile
MODULE_INCLUDES += $(src-dir)/$(outbase)
```

The first include is:

```
..//config.make
```

(note the // which is strictly wrong)

which has lots of variables to set, but no action occurs.

The second is:

```
lilypond-git/./input/GNUmakefile
```

which similarly doesn't create any actual action.

An error message at the end of build/input/GNUmakefile stops make processing before it moves on to regression - so where does that come from?

And the answer is - make processes all directories in the directory it's entered (with some exceptions like out and out-www) and so it changes to /regression.

It then seems to consider whether it needs to make/remake loads of makefiles. Don't understand this yet. Possibly these are all the makefiles it's processing, and it always checks they're up to date before processing other files?

Could be correct - some of this output is:

```
Must remake target `../../make/ly-inclusions.make'.
Failed to remake target file `../../make/ly-inclusions.make'.
```

Having decided that, it then leaves the directory and re-executes:

```
make PACKAGE=LILYPOND package=lilypond -C regression WWW-1
```

The top of this make is:

```
This program built for i486-pc-linux-gnu
Reading makefiles...
Reading makefile `GNUmakefile'...
Reading makefile `..//..//config.make' (search path) (no ~ expansion)...
```

which looks like it's re-reading all its known makefiles to check they're up to date.

(From the make manual:

To this end, after reading in all makefiles, make will consider each as a goal target and attempt to update it. If a makefile has a rule which says how to update it (found either in that very makefile or in another one) or if an implicit rule applies to it (see Chapter 10 [Using Implicit Rules], page 103), it will be updated if necessary. After all makefiles have been checked, if any have actually been changed, make starts with a clean slate and reads all the makefiles over again. (It will also attempt to update each of them over again, but normally this will not change them again, since they are already up to date.)

So my assumption seems correct)

There appear to be about 74 of them. After all the makefile checking, we get this:

```
Updating goal targets....
Considering target file `WWW-1'.
File `WWW-1' does not exist.
Considering target file `local-WWW-1'.
File `local-WWW-1' does not exist.
Considering target file `out-www/collated-files.texi'.
File `out-www/collated-files.texi' does not exist.
Looking for an implicit rule for `out-www/collated-files.texi'.
Trying pattern rule with stem `collated-files.texi'.
Trying implicit prerequisite `collated-files.texi.in'.
Trying pattern rule with stem `collated-files.texi'.
Trying implicit prerequisite `collated-files.texi.in'.
Trying pattern rule with stem `collated-files'.
Trying implicit prerequisite `collated-files.tely'.
Trying pattern rule with stem `collated-files'.
Trying implicit prerequisite `out-www/collated-files.tely'.
Trying rule prerequisite `out-www/version.itexi'.
Found prerequisite `out-www/version.itexi' as VPATH `/home/phil/lilypond-git/input/regression/out-
www/version.itexi'
```

grep finds this if searching for local-WWW-1:

```
make/lysdoc-targets.make:
  local-WWW-1: $(outdir)/collated-files.texi $(outdir)/collated-files.pdf
```

which means that local-WWW-1 depends on coll*.texi and coll*.pdf and so these will need to be checked to see if they're up to date. So make needs to find rules for both of those and (as it says) it certainly needs to make coll*.texi, since it doesn't exist.

In ly-rules.make we have:

```
.SUFFIXES: .doc .tely .texi .ly
```

which I'll work out at some point, and also this rule:

```
$(outdir)/%.texi: $(outdir)/%.tely $(outdir)/version.itexi $(DOCUMENTATION_LOCALE_TARGET) $(INIT_LY_SOURC
  LILYPOND_VERSION=$(TOPLEVEL_VERSION) $(PYTHON) $(LILYPOND_BOOK) $(LILYPOND_BOOK_INCLUDES) -
-process='$(LILYPOND_BOOK_PROCESS) $(LILYPOND_BOOK_INCLUDES) $(LILYPOND_BOOK_LILYPOND_FLAGS)' -
-output=$(outdir) --format=$(LILYPOND_BOOK_FORMAT) $(LILYPOND_BOOK_FLAGS) $<
```

Note that the recipe is a very long line - it could probably benefit from splitting. The same makefile also has:

```
$(outdir)/%.texi: $(outdir)/%.tely $(outdir)/version.itexi $(DOCUMENTATION_LOCALE_TARGET) $(INIT_LY_SOURC
  LILYPOND_VERSION=$(TOPLEVEL_VERSION) $(PYTHON) $(LILYPOND_BOOK) $(LILYPOND_BOOK_INCLUDES) -
-process='$(LILYPOND_BOOK_PROCESS) $(LILYPOND_BOOK_INCLUDES) $(LILYPOND_BOOK_LILYPOND_FLAGS)' -
-output=$(outdir) --format=$(LILYPOND_BOOK_FORMAT) $(LILYPOND_BOOK_FLAGS) $<
```

which seems to be an almost exact duplicate. Whatever, the first one is executed first. Have not checked if the second executes.

The first recipe translates as this:

```
LILYPOND_VERSION=2.15.0 /usr/bin/python   --process=' ' \
  --output=./out-www --format= --lily-output-dir \
    /home/phil/lilypond-git/build/out/lybook-db
```

if we stop the build with an $(error), but I think this is because we need to allow it to process the dependencies first. It looks like foo.texi is shown as being dependent on foo.tely, plus a load of other files.

```
DOCUMENTATION_LOCALE_TARGET is blank
INIT_LY_SOURCES = /home/phil/lilypond-git/scm/auto-beam.scm \
  /home/phil/lilypond-git/scm/autochange.scm
```

plus 10s (100s?) of other .scm files.

```
SCHEME_SOURCES = /home/phil/lilypond-git/ly/Welcome-to-LilyPond-MacOS.ly \
  /home/phil/lilypond-git/ly/Welcome_to_LilyPond.ly
```

ditto .ly files. This does seem a teency bit wrong - it looks like the .ly and .scm files have been interchanged. ly-vars.make has these 2 lines:

```
INIT_LY_SOURCES = $(wildcard $(top-src-dir)/scm/*.scm)
SCHEME_SOURCES = $(wildcard $(top-src-dir)/ly/*.ly)
```

Looks like a bug.....

So it now works its way through all these files, checking if they need to be remade. This is 100s of lines of the debug listing, although none in the normal list. Clearly none has to be made since they're source files. It concludes:

```
Must remake target `out-www/collated-files.tely'
```

'`lysdoc-rules.make`' has this:

```
$(outdir)/collated-files.tely: $(COLLATED_FILES)
        $(LYS_TO_TELY) --name=$(outdir)/collated-files.tely --title="$(TITLE)" --author="$(AUTHOR)" $^
```

'`lysdoc-vars.make`' has:

```
COLLATED_FILES = $(sort $(TEXINFO_SOURCES) $(LY_FILES) $(OUT_LY_FILES) )
```

We find that:

```
TEXINFO_SOURCES = AAA-intro-regression.tely
OUT_LY_FILES is empty
```

so LY_FILES has the big long list of all the .ly files in the regression directory.

This kicks off

```
/home/phil/lilypond-git/build/scripts/build/out/lys-to-tely
```

with a list of all the files in the regression test directory. This should (I believe) create the file collated-files.tely.

So the next rule in make is for '`version.itexi`', and make duly checks this. There's a rule in '`doc-i18n-root-rules.make`' that this depends on '`git/VERSION`':

```
$(outdir)/version.%: $(top-src-dir)/VERSION
        $(PYTHON) $(top-src-dir)/scripts/build/create-version-itexi.py > $
```

This causes create-version-itexi.py to run and create version.itexi.

Once that's done, all the other *.scm and *.ly files are checked and since they have no rules associated, they aren't remade (just as well for source files, really). Since version.itexi was remade make concludes that collated-files.texi must be remade. To do this, it runs lilypond-book.py on collated-files.tely, as below:

```
LILYPOND_VERSION=2.15.0
  /usr/bin/python
  /home/phil/lilypond-git/scripts/lilypond-book.py
    -I /home/phil/lilypond-git/input/regression/
    -I ./out-www -I /home/phil/lilypond-git/input
    -I /home/phil/lilypond-git/Documentation
    -I /home/phil/lilypond-git/Documentation/snippets
    -I /home/phil/lilypond-git/input/regression/
    -I /home/phil/lilypond-git/Documentation/included/
    -I /home/phil/lilypond-git/build/mf/out/
    -I /home/phil/lilypond-git/build/mf/out/
    -I /home/phil/lilypond-git/Documentation/pictures
    -I /home/phil/lilypond-git/build/Documentation/pictures/./out-www
    --process='/home/phil/lilypond-git/build/out/bin/lilypond
    -I /home/phil/lilypond-git/input/regression/
    -I ./out-www
    -I /home/phil/lilypond-git/input
    -I /home/phil/lilypond-git/Documentation
    -I /home/phil/lilypond-git/Documentation/snippets
    -I /home/phil/lilypond-git/input/regression/
    -I /home/phil/lilypond-git/Documentation/included/
    -I /home/phil/lilypond-git/build/mf/out/
    -I /home/phil/lilypond-git/build/mf/out/
    -I /home/phil/lilypond-git/Documentation/pictures
    -I /home/phil/lilypond-git/build/Documentation/pictures/./out-www
    -dbackend=eps
    --formats=ps,png,pdf
    -dinclude-eps-fonts
    -dgs-load-fonts
    --header=doctitle
    --header=doctitlecs
    --header=doctitlede
    --header=doctitlees
    --header=doctitlefr
    --header=doctitlehu
    --header=doctitleit
    --header=doctitleja
    --header=doctitlenl
    --header=doctitlezh
    --header=texidoc
    --header=texidoccs
    --header=texidocde
    --header=texidoces
    --header=texidocfr
```

```
    --header=texidochu
    --header=texidocit
    --header=texidocja
    --header=texidocnl
    --header=texidoczh
    -dcheck-internal-types
    -ddump-signatures
    -danti-alias-factor=2'
    --output=./out-www
    --format=texi-html
    --verbose
    --lily-output-dir /home/phil/lilypond-git/build/out/lybook-db
    out-www/collated-files.tely
```

So - lilypond-book runs on:

```
input/regression/out-www/collated-files.tely
```

Note the –verbose flag - this is from the make variable LILYPOND_BOOK_VERBOSE which is added to the make variable LILYPOND_BOOK_FLAGS.

Now found the invocation to write some of the image files. It's like this:

```
/home/phil/lilypond-git/build/out/bin/lilypond
  -I /home/phil/lilypond-git/input/regression/
  -I ./out-www -I /home/phil/lilypond-git/input
  -I /home/phil/lilypond-git/Documentation
  -I /home/phil/lilypond-git/Documentation/snippets
  -I /home/phil/lilypond-git/input/regression/
  -I /home/phil/lilypond-git/Documentation/included/
  -I /home/phil/lilypond-git/build/mf/out/
  -I /home/phil/lilypond-git/build/mf/out/
  -I /home/phil/lilypond-git/Documentation/pictures
  -I /home/phil/lilypond-git/build/Documentation/pictures/./out-www
  -dbackend=eps
  --formats=ps,png,pdf
  -dinclude-eps-fonts
  -dgs-load-fonts
  --header=doctitle
  --header=doctitlecs
  --header=doctitlede
  --header=doctitlees
  --header=doctitlefr
  --header=doctitlehu
  --header=doctitleit
  --header=doctitleja
  --header=doctitlenl
  --header=doctitlezh
  --header=texidoc
  --header=texidoccs
  --header=texidocde
  --header=texidoces
  --header=texidocfr
  --header=texidochu
  --header=texidocit
  --header=texidocja
```

```
--header=texidocnl
--header=texidoczh
-dcheck-internal-types
-ddump-signatures
-danti-alias-factor=2
-I  "/home/phil/lilypond-git/build/out/lybook-db"
-I  "/home/phil/lilypond-git/build/input/regression"
-I  "/home/phil/lilypond-git/input/regression"
-I  "/home/phil/lilypond-git/build/input/regression/out-www"
-I  "/home/phil/lilypond-git/input"
-I  "/home/phil/lilypond-git/Documentation"
-I  "/home/phil/lilypond-git/Documentation/snippets"
-I  "/home/phil/lilypond-git/input/regression"
-I  "/home/phil/lilypond-git/Documentation/included"
-I  "/home/phil/lilypond-git/build/mf/out"
-I  "/home/phil/lilypond-git/build/mf/out"
-I  "/home/phil/lilypond-git/Documentation/pictures"
-I  "/home/phil/lilypond-git/build/Documentation/pictures/out-www"
--formats=eps
--verbose
-deps-box-padding=3.000000
-dread-file-list
-dno-strip-output-dir
"/home/phil/lilypond-git/build/out/lybook-db/snippet-names--415419468.ly"'
```

Note the –verbose. This causes 100s of lines of Lily debug output. But at present I can't work out where the flag comes from. Later.

12.4.2 Building a bibliography

Bibliography files contain a list of citations, like this:

```
@Book{vinci,
  author = {Vinci, Albert C.},
  title = {Fundamentals of Traditional Music Notation},
  publisher = {Kent State University Press},
  year = {1989}
}
```

There are a variety of types of citation (e.g. Book (as above), article, publication). Each cited publication has a list of entries that can be used to identify the publication. Bibliograpies are normally stored as files with a .bib extension. One part of the doc-build process is transforming the bibliography information into `texinfo` files. The commands to do this are in the '`GNUmakefile`' in the '`Documentation`' directory.

A typical line of the makefile to translate a single bibliography is:

```
$(outdir)/colorado.itexi:
        BSTINPUTS=$(src-dir)/essay $(buildscript-dir)/bib2texi \
                -s $(top-src-dir)/Documentation/lily-bib \
                -o $(outdir)/colorado.itexi \
                $(src-dir)/essay/colorado.bib
```

Line by line:

```
$(outdir)/colorado.itexi:
```

We're making the file '`colorado.itexi`' and so this is the make instruction.

```
BSTINPUTS=$(src-dir)/essay $(buildscript-dir)/bib2texi \
```

It's in the 'essay' directory and we want to run the bib2texi.py script against it.

```
-s $(top-src-dir)/Documentation/lily-bib \
```

The style template is 'lily-bib.bst' and is found in the 'Documentation' directory.

```
-o $(outdir)/colorado.itexi \
```

The output file in 'colorado.itexi'.

```
$(src-dir)/essay/colorado.bib
```

The input file is 'colorado.bib' in the 'essay' directory.

The bib2texi Python script used to be used with a variety of options, but now is always called using the same options, as above. Its job is to create the file containing the options for bibtex (the program that actually does the translation), run bibtex, and then clean up some temporary files. Its main "value add" is the creation of the options file, using this code:

```
open (tmpfile + '.aux', 'w').write (r'''
\relax
\citation{*}
\bibstyle{%(style)s}
\bibdata{%(files)s}''' % vars ())
```

The key items are the style file (now always lily-bib for us) and the input file.

The style file is written in its own specialised language, described to some extent at

http://amath.colorado.edu/documentation/LaTeX/reference/faq/bibtex.pdf

The file 'lily-bib.bst' also has fairly extensive commenting.

12.5 Website build

> **Note:** This information applies only to the standard `make website` from the normal build directory. The process is different for `dev/website-build`.

The rule for make website is found in GNUmakefile.in:

```
website:
$(MAKE) config_make=$(config_make) \
        top-src-dir=$(top-src-dir) \
        -f $(top-src-dir)/make/website.make \
        website
```

This translates as:

```
make --no-builtin-rules config_make=./config.make \
                top-src-dir=/home/phil/lilypond-git \
                -f /home/phil/lilypond-git/make/website.make \
                website
```

which has the effect of setting the variables `config_make` and `top-src-dir` and then processing the file `git/make/website.make` with the target of website.

`website.make` starts with the following:

```
ifeq ($(WEBSITE_ONLY_BUILD),1)
```

which checks to see whether the variable `WEBSITE_ONLY_BUILD` was set to one on the command line. This is only done for standalone website builds, not in the normal case. The result of the test determines the value of some variables that are set. A number of other variables are set, in order to establish locations of various files. An example is:

```
CREATE_VERSION=python $(script-dir)/create-version-itexi.py
```

The rule for website is:

```
website: website-texinfo website-css website-pictures website-examples web-post
        cp $(SERVER_FILES)/favicon.ico $(OUT)/website
        cp $(SERVER_FILES)/robots.txt $(OUT)/website
        cp $(top-htaccess) $(OUT)/.htaccess
        cp $(dir-htaccess) $(OUT)/website/.htaccess
```

so we see that this starts by running the rules for 5 other targets, then finishes by copying some files. We'll cover that later - first `website-texinfo`. That rule is:

```
website-texinfo: website-version website-xrefs website-bibs
        for l in '' $(WEB_LANGS); do \
                if test -n "$$l"; then \
                        langopt=--lang="$$l"; \
                        langsuf=.$$l; \
                fi; \
                $(TEXI2HTML) --prefix=index \
                        --split=section \
                        --I=$(top-src-dir)/Documentation/"$$l" \
                        --I=$(top-src-dir)/Documentation \
                        --I=$(OUT) \
                        $$langopt \
                        --init-file=$(texi2html-init-file) \
                        -D web_version \
                        --output=$(OUT)/"$$l" \
                        $(top-src-dir)/Documentation/"$$l"/web.texi ; \
                ls $(OUT)/$$l/*.html | xargs grep -L \
                        'UNTRANSLATED NODE: IGNORE ME' | \
                        sed 's!$(OUT)/'$$l'/!!g' | xargs \
                        $(MASS_LINK) --prepend-suffix="$$langsuf" \
                        hard $(OUT)/$$l/ $(OUT)/website/ ; \
        done
```

which therefore depends on `website-version`, `website-xrefs` and `website-bibs`.

```
website-version:
        mkdir -p $(OUT)
        $(CREATE_VERSION) $(top-src-dir) > $(OUT)/version.itexi
        $(CREATE_WEBLINKS) $(top-src-dir) > $(OUT)/weblinks.itexi
```

which translates as:

```
mkdir -p out-website
python /home/phil/lilypond-git/scripts/build/create-version-itexi.py
        /home/phil/lilypond-git > out-website/version.itexi
python /home/phil/lilypond-git/scripts/build/create-weblinks-itexi.py
        /home/phil/lilypond-git > out-website/weblinks.itexi
```

So, we make out-website then send the output of `create-version-itexi.py` to `out-website/version.itexi` and `create-weblinks-itexi.py` to `out-website/weblinks.itexi`.

`create-version-itexi.py` parses the file `VERSION` in the top source dir. It contains:

```
PACKAGE_NAME=LilyPond
MAJOR_VERSION=2
MINOR_VERSION=15
PATCH_LEVEL=13
```

```
MY_PATCH_LEVEL=
VERSION_STABLE=2.14.2
VERSION_DEVEL=2.15.12
```

currently. `c-v-i.py` parses this to:

```
@c ********************** Version numbers ************
@macro version
2.15.13
@end macro

@macro versionStable
2.14.2
@end macro

@macro versionDevel
2.15.12
@end macro
```

`create-weblinks-itexi.py` creates a load of texi macros (of the order of 1000) similar to:

```
@macro manualStableGlossaryPdf
@uref{../doc/v2.14/Documentation/music-glossary.pdf,Music glossary.pdf}
@end macro.
```

It loads its languages from langdefs.py, and therefore outputs the following unhelpful warning:

`langdefs.py: warning: lilypond-doc gettext domain not found.`

Next:

```
website-xrefs: website-version
        for l in '' $(WEB_LANGS); do \
```

is the start of the rule, truncated for brevity. This loops through the languages to be used on the website, processing some variables which I don't fully understand, to run this command:

```
python /home/phil/lilypond-git/scripts/build/extract_texi_filenames.py \
        -I /home/phil/lilypond-git/Documentation \
        -I /home/phil/lilypond-git/Documentation/"$l" \
        -I out-website -o out-website --split=node \
        --known-missing-files= \
                /home/phil/lilypond-git/scripts/build/website-known-missing-files.txt \
        -q \
        /home/phil/lilypond-git/Documentation/"$l"/web.texi ;\
```

There's a good description of what `extract_texi_filenames.py` does at the top of the script, but a shortened version is:

`If this script is run on a file texifile.texi, it produces a file texifile[.LANG].xref-map with tab-separated entries of the form NODE\tFILENAME\tANCHOR.`

An example from `web.nl.xref-map` is:

```
Inleiding        Introduction        Introduction
```

`e-t-f.py` follows the includes from document to document. We know some have not been created yet, and `known-missing-files` option tells `e-t-f.py` which these are.

It then does this:

```
for m in $(MANUALS); do \
```

to run `e-t-f.py` against all of the manuals, in each language. Next:

```
website-bibs: website-version
        BSTINPUTS=$(top-src-dir)/Documentation/web \
```

```
$(WEB_BIBS) -s web \
-s $(top-src-dir)/Documentation/lily-bib \
-o $(OUT)/others-did.itexi \
$(quiet-flag) \
$(top-src-dir)/Documentation/web/others-did.bib
```

This is half the command. It runs `bib2texi.py` on 2 `.bib` files - `others-did.bib` and `we-wrote.bib`. This converts bibliography files into texi files with `bibtex`.

Next the commands in the `website-texinfo` rule are run:

```
for l in '' $(WEB_LANGS); do \
```

run `texi2html`. This is the program that outputs the progress message (found in `Documentation/lilypond-texi2html.init`):

```
Processing web site: []
```

It also outputs warning messages like:

```
WARNING: Unable to find node 'Řešení potíží' in book usage.
```

```
website-css:
        cp $(top-src-dir)/Documentation/css/*.css $(OUT)/website
```

Copies 3 css files to out-website/website. Then:

```
website-pictures:
        mkdir -p $(OUT)/website/pictures
        if [ -d $(PICTURES) ]; \
        then \
                cp $(PICTURES)/* $(OUT)/website/pictures ; \
                ln -sf website/pictures $(OUT)/pictures  ;\
        fi
```

which translates as:

```
if [ -d Documentation/pictures/out-www ]; \
    then \
        cp Documentation/pictures/out-www/* out-website/website/pictures ; \
        ln -sf website/pictures out-website/pictures  ;\
    fi
```

i.e. it copies the contents of `build/Documentation/pictures/out-www/*` to `out-website/website/pictures`. Unfortunately, the pictures are only created once `make doc` has been run, so an initial run of `make website` copies nothing, and the pictures on the website (e.g. the logo) do not exist. Next:

```
website-examples:
        mkdir -p $(OUT)/website/ly-examples
        if [ -d $(EXAMPLES) ]; \
        then \
                cp $(EXAMPLES)/* $(OUT)/website/ly-examples ; \
        fi
```

translates to:

```
mkdir -p out-website/website/ly-examples
if [ -d Documentation/web/ly-examples/out-www ]; \
    then \
        cp Documentation/web/ly-examples/out-www/* out-website/website/ly-examples ; \
    fi
```

This does the same with the LilyPond examples (found at http://lilypond.org/examples.html). Again, these are actually only created by `make doc` (and since they are generated from LilyPond source files, require a working LilyPond `exe` made with `make`). So this does nothing initially. Then:

```
web-post:
        $(WEB_POST) $(OUT)/website
```

which is:

```
python /home/phil/lilypond-git/scripts/build/website_post.py out-website/website
```

which describes itself as:

```
This is web_post.py. This script deals with translations in the "make website"
target.
```

It also does a number of other things, including adding the Google tracker code and the language selection footer. We're now at the end of our story. The final 4 lines of the recipe for website are:

```
cp $(SERVER_FILES)/favicon.ico $(OUT)/website
cp $(SERVER_FILES)/robots.txt $(OUT)/website
cp $(top-htaccess) $(OUT)/.htaccess
cp $(dir-htaccess) $(OUT)/website/.htaccess
```

The first translates as:

```
cp /home/phil/lilypond-git/Documentation/web/server/favicon.ico out-website/website
```

so we see these are just copying the support files for the web server.

website.make summary

Recipes in '`website.make`':

- `website:` this is the "master" rule. It calls the other rules in order, then copies some extra files around - see below for further of the process it produces.
- `website-version`: this calls the python scripts below:
  - `scripts/build/create-version-itexi.py`

    This writes a @version, @versionStable, and @versionDevel based on the top-level VERSIONS file, to `out-website/version.itexi`
  - `scripts/build/create-weblinks-itexi.py`

    This creates a ton of macros in `out-website/weblinks.itexi`. Stuff like @downloadStableLinuxNormal, @downloadStableWidows, `@stableDocsNotationPdf{}`, @downloadDevelSourch-zh.

    It's quite monstrous because it deals with combinations of stable/devel, source/docs, lang/lang/lang*10, etc.
- `website-xrefs:` creates files used for complicated "out-of-build" references to `out-website/*.xref-map`

  If you just write @ref{}, then all's groovy and we wouldn't need this. But if you write @rlearning{}, then our custom texi2html init file needs to know about our custom xref file format, which tells our custom texi2html init file how to create the link.

  GP: we should have a separate @node to discuss xrefs. Also, take a quick look at a generated xref file – it's basically just a list of @node's [sic teenager pluralization rule] from the file.
- `website-bib:` generates the bibliography texinfo files from the .bib files - in the case of the website build these are '`others-did.bib`' and '`we-wrote.bib`'.
- `website-texinfo:` this is the main part; it calles texi2html to generate the actual html. It also has a ton of options to texi2html to pass info to our custom init file.

  The file actually built is called '`web.texi`', and is either in the '`Documentation`' directory, or a sub-directory specific to the language.

The options file is '`/Documentation/lilypond-texi2html.init`'. This contains *lots* of option and configuration stuff, and also includes the line:

```
print STDERR "Initializing settings for web site: [$Texi2HTML::THISDOC{current_lang}]\n";
```

This is where one of the console messages is generated.

We have somewhere between 2-4 different ways "to pass info to our custom init file". This is highly Not Good (tm), but that's how things work at the moment.

After texi2html, it does some black magick to deal with untranslated nodes in the translations. Despite writing that part, I can't remember how it works. But in theory, you could figure it out by copy&pasting each part of the command (by "part", I mean "stuff before each | pipe"), substituting the variables, then looking at the text that's output. For example,

```
ls $(OUT)/$$l/*.html
```

is going to print a list of all html files, in all languages, in the build directory. Then more stuff happens to each of those files (that's what xargs does).

- `website-css:` just copies files to the build dir.
- `website-pictures, website-examples:` more file copies, with an if statement to handle if you don't have any generated pictures/examples.
- `web-post:` runs:

  ```
  scripts/build/website_post.py
  ```

  which, it adds the "this page is translated in klingon" to the bottom of html pages, and adds the google analytics javascript. It also has hard-coded lilypond version numbers, which is Bad (tm).

Here's a summary of what gets called, in what order, when we run `make website`

```
website:
  website-texinfo:
    website-version:
      creates version.itexi and weblinks.itexi
    website-xrefs:
      runs extract_texi_filenames.py
    website-bibs:
      creates bibliography files, described above
  website-css:
    copies css files
  website-pictures:
    copies pictures
  website-examples:
    copies examples
  web-post:
    runs website_post.py
  Then some file copying
```

12.6 Building an Ubuntu distro

Here's the short instruction on how to create lilybuntu iso image (Jonathan Kulp did this on a spare drive, but he supposes it can be done in a VM too):

1. Install ubuntu, reboot.
2. Run all updates, reboot if asked.
3. Enable src repos, refresh package lists.
4. Install LilyPond build deps:

```
sudo apt-get build-dep lilypond
```

5. Install git and autoconf:

   ```
   sudo apt-get install git-core gitk autoconf
   ```

6. Test to see whether everything works fine now:
   1. use `lily-git.tcl` to grab source files
   2. go to source dir and do

      ```
      "./autogen.sh" ; make ; make doc
      ```

   3. if all compiles, move on to iso creation...
7. Download & install "remastersys": http://sourceforge.net/projects/remastersys/
8. Copy `lily-git.tcl` script file into '`/etc/skel/`'.
9. Modify '`/etc/remastersys.conf`' as desired (change `.iso` name, default live session username, etc).
10. Remove non-essential desktop software as desired.
11. Create iso:

    ```
    sudo remastersys dist
    ```

    New iso is in '`/home/remastersys/remastersys/`'.
12. Test iso by installing in VM and repeating steps above for getting source files and building lp and docs.

13 Modifying the feta font

13.1 Overview of the feta font

The feta font is a font that was created specifically for use in LilyPond. The sources for the font are found in mf/*.mf.

The feta font is merged from a number of subfonts. Each subfont can contain at most 224 glyphs. This is because each subfont is limited to a one-byte address space (256 glyphs maximum) and we avoid the first 32 points in that address space, since they are non-printing control characters in ASCII.

In LilyPond, glyphs are accessed by glyph name, rather than by code point. Therefore, the naming of glyphs is significant.

Information about correctly creating glyphs is found in '`mf/README`'. Please make sure you read and understand this file.

TODO – we should get mf/README automatically generated from texinfo source and include it here.

13.2 Font creation tools

The sources for the feta font are written in metafont. The definitive reference for metafont is "The METAFONT book". Source for the book is available at CTAN.

mf2pt1 is used to create type 1 fonts from the metafont sources.

FontForge is used to postprocess the output of mf2pt1 and clean up details of the font. It can also be used by a developer to display the resulting glyph shapes.

13.3 Adding a new font section

The font is divided into sections, each of which contains less than 224 glyphs. If more than 224 glyphs are included in a section, an error will be generated.

Each of the sections is contained in a separate `.mf` file. The files are named according to the type of glyphs in that section.

When adding a new section, it will be necessary to add the following:

- The code for the glyphs, in a file `<section-name>.mf`
- Driver files used to create the font in different sizes
- An entry in the generic file used to create the font, or a new generic file
- If necessary, new entries in the GNUmakefile
- An entry in '`scripts/build/gen-emmentaler-scripts.py`'

See the examples in `mf/` for more information.

13.4 Adding a new glyph

Adding a new glyph is done by modifying the .mf file to which the glyph will be added.

Necessary functions to draw the glyph can be added anywhere in the file, but it is standard to put them immediately before the glyph definition.

The glyph definition begins with:

```
fet_beginchar ("glyph description", "glyphname");
```

with `glyph description` replaced with a short description of the glyph, and `glyphname` replaced with the glyphname, which is chosen to comply with the naming rules in '`mf/README`'.

The metafont code used to draw the glyph follows the `fet_beginchar` entry. The glyph is finished with:

```
fet_endchar;
```

13.5 Building the changed font

In order to rebuild the font after making the changes, the existing font files must be deleted. The simplest and quickest way to do this is to do:

```
rm mf/out/*
make
```

13.6 METAFONT formatting rules

There are special formatting rules for METAFONT files.

Tabs are used for the indentation of commands.

When a path contains more than two points, put each point on a separate line, with the operator at the beginning of the line. The operators are indented to the same depth as the initial point on the path using spaces. The indentation mechanism is illustrated below, with '`------->`' indicating a tab character and any other indentation created using spaces.

```
def draw_something (test) =
------->if test:
------->------->fill z1
------->------->     -- z2
------->------->     -- z3
------->------->     .. cycle;
------->fi;
enddef;
```

14 Administrative policies

This chapter discusses miscellaneous administrative issues which don't fit anywhere else.

14.1 Meta-policy for this document

The Contributor's Guide as a whole is still a work in progress, but some chapters are much more complete than others. Chapters which are "almost finished" should not have major changes without a discussion on `-devel`; in other chapters, a disorganized "wiki-style dump" of information is encouraged.

Do not change (other than spelling mistakes) without discussion:

- Chapter 1 [Introduction to contributing], page 1
- Chapter 3 [Working with source code], page 12

Please dump info in an appropriate @section within these manuals, but discuss any large-scale reorganization:

- Chapter 4 [Compiling], page 41
- Chapter 5 [Documentation work], page 53
- Chapter 8 [Issues], page 90
- Chapter 9 [Regression tests], page 99
- Chapter 10 [Programming work], page 105

Totally disorganized; do whatever the mao you want:

- Chapter 6 [Website work], page 80
- Chapter 7 [LSR work], page 84
- Chapter 11 [Release work], page 137
- Chapter 14 [Administrative policies], page 164

14.2 Environment variables

Some maintenance scripts and instructions in this guide rely on the following environment variables. They should be predefined in LilyDev distribution (see Section 2.1 [LilyDev], page 5); if you set up your own development environment, you can set them by appending these settings to your '`~/.bashrc`' (or whatever defines your default environment variables for the user account for LilyPond development), then logging out and in (adapt directories to your setup):

```
LILYPOND_GIT=~/lilypond-git
export LILYPOND_GIT
LILYPOND_BUILD_DIR=~/lilypond-git/build
export LILYPOND_BUILD_DIR
```

The standard build and install procedure (with `autogen.sh`, `configure`, `make`, `make install`, `make doc` ...) does not rely on them.

In addition, for working on the website, `LILYPOND_WEB_MEDIA_GIT` should be set to the repository lilypond-extra, see [lilypond-extra], page 17.

14.3 Meisters

We have four jobs for organizing a team of contributors:

- Bug Meister: trains new Bug Squad volunteers, organizes who works on which part of their job, checks to make sure that everything is running smoothly, and has final say on our policy for Issues.

  Currently: Colin H

- Doc Meister: trains new doc editors/writers, organizes who works on which part of the job, checks to make sure that everything is running smoothly, and has final say on our policy for Documentation. Also includes LSR work.

  Currently: None
- Translation Meister: trains new translators, updates the translation priority list, and handles merging branches (in both directions).

  Currently: Francisco

14.4 Patchy

Introduction

Patchy is a set of Python scripts to automate two administrative tasks:

- `lilypond-patchy-staging.py`: checks that new commits in `staging` can compile the regtests and documentation before merging `staging` into `master`.

  (completely automatic)
- `test-patches.py`: checks that patches apply to Git `master`, compile, and lets a human check that there are no big unintended changes to the regtests.

  (requires some human input)

Installing Patchy

To install Patchy, you should do the following:

1. Create a new user on your box to run Patchy; this is a security step for your own protection. It is recommended that this should not be an administrator. New users are created from System; Administration; Users and Groups.
2. Get the Patchy scripts from

   `https://github.com/gperciva/lilypond-extra/`

   Patchy is in the '`patches/`' directory.
3. Put the scripts and Python libraries contained in '`patches`' in a sensible place on your system; this can be done by appending '`patches/`' full path to the *PATH* of the user that runs Patchy.
4. Create a new git repository with

   ```
   git clone git://git.sv.gnu.org/lilypond.git
   ```

   This will create a directory called lilypond with the repo in it. Make sure it's where you want it and name it lilypond-git (assuming you want to follow the standard naming conventions).
5. Create environment variables *LILYPOND_GIT* and *LILYPOND_BUILD_DIR*, see Section 14.2 [Environment variables], page 164.
6. Run Patchy once to set up config files, answer '`n`' when it asks for going on, unless the default config file happens to suit your setup:

   ```
   lilypond-patchy-staging.py
   ```
7. Edit '`$HOME/.lilypond-patchy-config`' to provide the location of your local lilypond Git repository, working directories for your build directory, your results directory, compiler options and notification method. If you don't want to use email notification, then delete everything after `smtp_command:`.
8. Ensure that your new user has git push access. Follow the instructions in the CG at Section 3.4.10 [Commit access], page 30. Do not set password protection for the key — if you do you will not be able to run patchy unattended.

lilypond-patchy-staging.py

`lilypond-patchy-staging.py` is run with

```
python lilypond-patchy-staging.py
```

Not much appears to happen except you can see a lot of CPU gets used if you open System Monitor. There's not much point running `lilypond-patchy-staging.py` unless there is something in `staging` to be merged to `master`, however, if there's nothing new in `staging` then the script won't waste resources by compiling anything.

The script fetches the current patches in staging and runs `make`, `make test` and `make doc` to ensure that all of these complete error-free. If you have set Patchy up to use email, it emails its results to you. If you haven't, then you can view them in a logfile. It also merges `staging` into `master`.

> **Note:** in case the build fails, do not try to push fixes on top of staging branch, for details see Section 3.4.11 [Pushing to staging], page 33.

When you have run Patchy a few successful times with email sending, you are ready for running it as a cron job. First, make sure you have the following in '`$HOME/.lilypond-patchy-config`' to avoid email flood:

```
[notification]
notify_non_action = no
```

Then, assuming Patchy run with user account `patchy`, write the following to '`$HOME/lilypond-patchy.cron`', adapting it as necessary (the `/2` means "run this every 2 hours"):

```
02 0-23/2 * * * /home/patchy/git/lilypond-extra/patches/lilypond-patchy-staging.py
```

> **Note:** `cron` will not inherit environment variables from your main setup, so you must re-define any variables inside '`$HOME/lilypond-patchy.cron`'. For instance, *LILYPOND_GIT* may need to be defined if *git_repository_dir* is not correctly set in '`$HOME/.lilypond-patchy-config`'.

Finally, install the cron job (you may need superuser privileges for this):

```
crontab -u patchy /home/patchy/lilypond-patchy.cron
```

test-patches.py

`test-patches.py` prepares a regtest comparison for a human to quickly glance at, to determine if the patch is ready for a review. After looking at the comparison (or the lack of a comparison in the case of problems), run `accept-patch.py` or `reject-patch.py`.

Once a patch has gotten a "LGTM" from Patchy, it should be reviewed by relevant developers, and if it passes this, it can be considered for countdown (see Section 3.3.4 [Commits and patches], page 22) and pushing to staging (see Section 3.4.11 [Pushing to staging], page 33).

14.5 Administrative mailing list

A mailing list for administrative issues is maintained at `lilypond-hackers@gnu.org`.

This list is intended to be used for discussions that should be kept private. Therefore, the archives are closed to the public.

Subscription to this list is limited to certain senior developers.

At the present time, the list is dormant.

Details about the criteria for membership, the types of discussion to take place on the list, and other policies for the hackers list will be finalized during the Section 14.6 [Grand Organization Project (GOP)], page 167.

14.6 Grand Organization Project (GOP)

GOP has two goals:

- Clarify the various development tasks by writing down the policies and techniques and/or simplifying the tasks directly.
- Get more people involved in development: specifically, find people to do easy tasks to allow advanced developers to concentrate on difficult tasks.

14.6.1 Motivation

Most readers are probably familiar with the LilyPond Grand Documentation Project, which ran from Aug 2007 to Aug 2008. This project involved over 20 people and resulted in an almost complete rewrite of the documentation. Most of those contributors were normal users who decided to volunteer their time and effort to improve lilypond for everybody. By any measure, it was a great success.

The Grand Organization Project aims to do the same thing with a larger scope – instead of focusing purely on documentation, the project aims to improve all parts of LilyPond and its community. Just as with GDP, the main goal is to encourage and train users to become more involved.

If you have never contributed to an open-source project before – especially if you use Windows or OSX and do not know how to program or compile programs – you may be wondering if there's anything you can do. Rest assured that you *can* help.

"Trickle-up" development

One of the reasons I'm organizing GOP is "trickle-up" development. The idea is this: doing easy tasks frees up advanced developers to do harder tasks. Don't ask "am I the *best* person for this job"; instead, ask "am I *capable* of doing this job, so that the current person can do stuff I *can't* do?".

For example, consider lilypond's poor handling of grace notes in conjunction with clef and tempo changes. Fixing this will require a fair amount of code rewriting, and would take an advanced developer a few weeks to do. It's clearly beyond the scope of a normal user, so we might as well sit back and do nothing, right?

No; we *can* help, indirectly. Suppose that our normal user starts answering more emails on lilypond-user. This in turn means that documentation writers don't need to answer those emails, so they can spend more time improving the docs. I've noticed that all doc writers tackle harder and harder subjects, and when they start writing docs on scheme programming and advanced tweaks, they start contributing bug fixes to lilypond. Having people performing these easy-to-moderate bug fixes frees up the advanced developers to work on the really hard stuff... like rewriting the grace note code.

Having 1 more normal user answering emails on lilypond-user won't have a dramatic 'trickle-up' effect all by itself, of course. But if we had 8 users volunteering to answer emails, 6 users starting to write documentation, and 2 users editing LSR... well, that would free up a lot of current bug-fixing-capable contributors to focus on that, and we could start to make a real dent in the number of bugs in lilypond. Quite apart from the eased workload, having that many new helpers will provide a great moral boost!

14.6.2 Ongoing jobs

Although GOP is a short-term project, the main goal is to train more people to handle ongoing jobs. The more people doing these jobs, the lighter the work will be, and the more we can get done with lilypond!

Also, it would be nice if we had at least one "replacement" / "understudy" for each role – too many tasks are only being done by one person, so if that person goes on vacation or gets very busy with other matters, work in that area grinds to a halt.

Jobs for normal users

- Consultant: LilyPond is sometimes critized for not listening to users, but whenever we ask for opinions about specific issues, we never get enough feedback. This is somewhat aggravating. We need a group of users to make a dedicated effort to test and give feedback. If there's new documentation, read it. If there's an experimental binary, download it and try compiling a score with it. If we're trying to name a new command, think about it and give serious suggestions.
- lilypond-user support: I think it would be nice if we had an official team of users helping other users.
- LilyPond Report: Keeping a monthly newsletter running is a non-trivial task. A lot of work is needed to organize it; it would be great if we could split up the work. One person could write the Snippet of the Month, another person could do Quotes of the Month, another person could do interviews, etc.
- Documentation: Although GDP (the Grand Documentation Project) did great work, there's still many tasks remaining.
- Translations: Keeping the documentation translations is a monumental task; we need all the help we can get!

Jobs for advanced users for developers

- Git help for writers: We often receive reports of typos and minor text updates to the documentation. It would be great if somebody could create properly-formatted patches for these corrections.

  Technical requirements: ability to run Section 2.1 [LilyDev], page 5.
- LSR editor: LSR contains many useful examples of lilypond, but some snippets are out of date and need updating. Other snippets need to be advertized, and new snippets need to be sorted. We could use another person to handle LSR.

  Technical requirements: use of a web browser. LilyPond requirements: you should be familiar with most of Notation chapters 1 and 2 (or be willing to read the docs to find out).
- Join the Frogs: "Frogs" are a team of bug-fixers (because frogs eat bugs, and you often find them in Ponds of Lilies) and new feature implementors.

  Technical requirements: development environment (such as Section 2.1 [LilyDev], page 5), ability to read+write scheme and/or C++ code.

14.6.3 Policy decisions

There are a number of policy decisions – some of them fairly important – which we have been postponing for a few years. We are now discussing them slowly and thoroughly; agenda and exact proposals are online:

http://lilypond.org/~graham/gop/index.html

Below is a list of policies which are not "on the agenda" yet.

Note that the presence of an item on this list does *not* mean that everybody thinks that something needs to be done. Inclusion in this simply means that one developer thinks that we

should discuss it. We are not going to filter this list; if any developer thinks we should discuss something, just add it to the bottom of the list. (the list is unsorted)

As GOP progresses, items from this list will be put on the agenda and removed from this list. I generally try to have one month's discussion planned in advance, but I may shuffle things around to respond to any immediate problems in the developer community.

There are some item(s) not displayed here; these are questions that were posed to me privately, and I do not feel justified in discussing them publicly without the consent of the person(s) that brought them up. They will initially be discussed privately on the lilypond-hackers mailing list – but the first question will be "do we absolutely need to do this privately", and if not, the discussion will take place on lilypond-devel like the other items.

In most policy discussions in lilypond over the past few years, the first half (or more) is wasted arguing on the basis of incorrect or incomplete data; once all the relevant facts are brought to light, the argument is generally resolved fairly quickly. In order to keep the GOP discussions focused, each topic will be introduced with a collection of relevant facts and/or proposals. It is, of course, impossible to predict exactly which facts will be relevant to the discussion – but spending an hour or two collecting information could still save hours of discussion.

> **Note:** The estimated time required for "prep work", and the following discussion, has been added to each item. At the moment, there is an estimated 30 hours of prep work and 140 hours of discussion.

- **Patch reviewing**: At the time of this writing, we have 23 (known) patches waiting for review. Some from main developers; some from new developers. We desperately need more people helping with lilypond, but ignoring patches is the best way to drive potential contributors away. This is not good.

  (prep: 2 hours. discuss: 10 hours)
- **Official links to other organizations?**: There's something called the "software freedom conservancy", and in general, there's a bunch of "umbrella organizations". Joining some of these might give us more visibility, possibly leading to more users, more developers, maybe even financial grants or use in schools, etc.

  (prep: 2 hours. discuss: 5 hours)
- **Issue tracking with google code**: We use the google issue tracker, but this means that we are relying on a commercial entity for a large part of our development. Would it be better (safer in the long run) to use the savannah bug tracker?

  (prep: 1 hour. discuss: 5 hours)
- **Patch review tool**: Reitveld is inconvenient in some respects: it requires a google account, and there's no way to see all patches relating to lilypond. Should we switch to something like gerritt? http://code.google.com/p/lilypond/issues/detail?id=1184

  (prep: 5 hours. discuss: 15 hours)
- **Clarity for sponsorships**: We currently do not advertize bounties and sponsorships on the webpage. How much advertising do we want, and what type? Should we change the "structure" / "framework" for bounties?

  (prep: 2 hours. discuss: 10 hours)
- **code readability**: "Our aim when producing source code for Lilypond in whatever language is that it should be totally comprehensible to a relatively inexperienced developer at the second reading."

  Rationale: - aids maintainability of code base - "second reading" so newer developers can look up unfamiliar stuff - will help to keep things simple, even if the code is doing complex stuff discourages "secret squirrel" coding, e.g. "how much functionality can I squeeze into

as few characters as possible" "comments are for wimps" - will aid not *discouraging* new developers to join the project

(prep: 2 hours. discuss: 10 hours)

- **C++ vs. scheme**: what should be in scheme, what should be in C++, what can/should be ported from one to the other, etc. Questions of maintainability, speed (especially considering guile 2.0), and the amount of current material in either form, are important.

  (prep: 5 hours. discuss: 15 hours)

- **always make an issue number for patches**: there is a proposal that we should always have a google code issue number for every patch. This proposal is closely tied to our choice of patch review tool; if we switch to a different tool (as suggested in a different proposal), this proposal may become moot.

  (prep: 1 hour. discuss: 5 hours)

- **initalizer lists**: shoudl we use initalizer lists for C++? AFAIK they make no difference for built-in types, but there's some weird case where it's more efficient for objects, or something.

  Probably not worth making this a weekly thing on its own, but we can probably wrap it up with some other code-related questions.

  (prep: 15 minutes. discuss: 3 hours)

14.6.4 Policy decisions (finished)

Here is a record the final decisions, along with links to the discussions.

14.6.4.1 GOP-PROP 1 - python formatting

We will follow the indentation described in PEP-8. http://www.python.org/dev/peps/pep-0008/

- use 4 spaces per indentation level
- never mix tabs and spaces (for indentation)
- Code indented with a mixture of tabs and spaces should be converted to using spaces exclusively

  Once this is done, we should add `python -tt` to the build system to avoid such errors in the future.

There should be absolutely no tab characters for indentation in any `.py` file in lilypond git. All such files should be converted to use spaces only.

Discussions

https://lists.gnu.org/archive/html/lilypond-devel/2011-06/msg00060.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-06/msg00084.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-06/msg00310.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-06/msg00574.html

14.6.4.2 GOP-PROP 2 - mentors and frogs

Nothing much was decided. The list of responsibilities was slightly altered; see the new one in Section 1.4 [Mentors], page 3. We should encourage more use of the Frogs mailing list. There's a list of contributor-mentor pairs in:

https://github.com/gperciva/lilypond-extra/blob/master/people/mentors.txt

That's pretty much it.

Discussions

https://lists.gnu.org/archive/html/lilypond-devel/2011-06/msg00311.html

14.6.4.3 GOP-PROP 3 - C++ formatting

Speaking academically, C++ code style is a "solved problem". Let's pick one of the existing solutions, and let a computer deal with this. Humans should not waste their time, energy, and creativity manually adding tabs or spaces to source code.

We have modified `fixcc.py` to use astyle, along with extra regex tweaks.

- the final script will be run **blindly** on the lilypond source code. We will accept whatever formatting the final version of this script produces, with no manual tweaking.
- patches which have been run through this tool will not be rejected for style reasons. Any code formatting "desires" which are not enforced by `fixcc.py` will not be considered grounds for rejecting a patch.
- for now, this style will not be enforced. It is not cause for concern if patches which do not follow the formatting done by `fixcc.py` are pushed. From time to time, Graham will run the formatter on the entire code base, and commit the resulting changes.

  In a few months, we will tighten up this policy item (with some sort of automatic processing), but that is outside the scope of this policy item and is a matter for later discussion.
- after the proposal is accepted, we will leave some time for existing patches to be accepted and pushed. The script was run on the source code on **2011 August 01**.

GNU code

LilyPond is a GNU project, so it makes sense to follow the GNU coding standards. These standards state:

> We don't think of these recommendations as requirements, because it causes no problems for users if two different programs have different formatting styles.
>
> But whatever style you use, please use it consistently, since a mixture of styles within one program tends to look ugly. If you are contributing changes to an existing program, please follow the style of that program.

(http://www.gnu.org/prep/standards/html_node/Formatting.html)

With that in mind, we do not think that we must blindly follow the formatting given by the currrent version of Emacs.

Implementation notes

We can avoid some of the style change pollution in git history by ignoring whitespaces changes:

```
git diff -w
```

Discussions

https://lists.gnu.org/archive/html/lilypond-devel/2011-06/msg00526.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-06/msg00796.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-07/msg00200.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-07/msg00525.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-07/msg00751.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-07/msg00751.html

14.6.4.4 GOP-PROP 4 - lessons from 2.14

History

A brief history of releases:

date (YYYY-MM-DD)	version	comment

2008-10-28	2.11.63	nobody checking regtests
2008-11-17	2.11.64	
2008-11-29	2.11.65	
2008-12-23	2.12.0	
2009-01-01		somewhere around here, Graham becomes officially release manager, but Han-Wen still builds the actual releases
2009-01-01	2.12.1	
2009-01-25	2.12.2	
2009-02-28	2.13.0	
2009-06-01	2.13.1	note jump in time!
2009-06-27	2.13.2	first Graham release?
2009-07-03	2.13.3	
2009-09-09		Graham arrives in Glasgow, gets a powerful desktop computer, and begins serious work on GUB (sending bug reports to Jan). It takes approximately 100 hours until GUB is stable enough to make regular releases.
2009-09-24	2.13.4	
2009-10-02	2.13.5	
2009-10-22	2.13.6	
2009-11-05	2.13.7	
...		
2010-01-13	2.12.3	
...		
2010-03-19	2.13.16	Bug squad starts doing a few regtest comparisons, but IIRC the effort dies out after a few weeks (BLUE)
...		
2010-08-04	2.13.29	Phil starts checking regtests (BLUE)
...		
2011-01-12	2.13.46	release candidate 1 (GREEN)
...		
2011-05-30	2.13.63	release candidate 7 (GREEN)
2011-06-06	2.14.0	

Carl's analysis of the bugs

A '`csv`' spreadsheet is available.

https://lists.gnu.org/archive/html/lilypond-devel/2011-06/msg00852.html

lilypond-issues-analysis.csv

lilypond-issues-analysis-trim-duplicates.csv

There 148 issues marked with Priority=Critical in the tracker.

I've done an analysis, and it looks to me like there was initially a backlog of critical issues that weren't fixed, and little work was being done to eliminate critical issues.

Somewhere about 2010-08-01, critical issues started to disappear, but occasional new ones appeared.

There were a couple of major changes that introduced unanticipated regressions (new spacing code, beam collision avoidance). These produced more than the expected number of regressions.

It appears to me that we didn't really get serious about eliminating critical bugs until about 2010-06-15 or so. After that point, the number of critical bugs more-or-less steadily decreased until we got to a release candidate.

Of particular interest, the first release candidate of 2.14 was released on 2011-01-12. Over the next 10 days, about a dozen bugs were reported and fixed. Release candidate 2 came out on 2011-02-09. No surge of bugs occurred with this release. Candidate 3 came out on 2011-03-13; we got 2 bugs per week. Candidate 4 came out on 2011-03-29; 2 new bugs. Candidate 6 came out on 2011-04-07. We got a couple of bugs per week.

Notes, commentary, and opinions

```
Han-Wen: Overall, I think this cycle took too long
Mike: I agree
Graham: +1
```

Discussions

https://lists.gnu.org/archive/html/lilypond-devel/2011-06/msg00797.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-07/msg00364.html

14.6.4.5 GOP-PROP 5 - build system output (not accepted)

This proposal was too broad; after a month of discussion, Graham withdrew the proposal. Portions of it will be introduced in later proposals.

Discussions

https://lists.gnu.org/archive/html/lilypond-devel/2011-07/msg00320.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-07/msg00527.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-07/msg00753.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-07/msg01042.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-08/msg00116.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-08/msg00310.html

14.6.4.6 GOP-PROP 6 - private mailing list

Potentially sensitive or private matters will be referred to Graham. He will then decide who should discuss the matter on an ad-hoc basis, and forward or CC them on future emails.

For emphasis, the project administrators are Han-Wen, Jan, and Graham; those three will always be CC'd on any important discussions.

The lilypond-hackers mailing list will be removed.

History

There is some unhappy history about this idea in our development community:

http://lists.gnu.org/archive/html/lilypond-devel/2010-09/msg00178.html
http://news.lilynet.net/spip.php?article121
http://lists.gnu.org/archive/html/lilypond-devel/2010-11/msg00076.html

Other projects

The idea of private mailing lists is hardly uncommon in open-source software. For example,

```
http://lwn.net/Articles/394660/   about debian-private
http://subversion.apache.org/mailing-lists.html  private@
http://www.freebsd.org/administration.html#t-core
http://foundation.gnome.org/legal/   board members pledge
to keep certain matters confidential

every security team of every GNU/Linux distribution and OS
```

In fact, Karl Fogel's "Producing Open Source Software" explicitly suggests a private mailing list for some circumstances:

```
[on granting commit/push access to a contributor]

But here is one of the rare instances where secrecy is
appropriate. You can't have votes about potential committers
posted to a public mailing list, because the candidate's feelings
(and reputation) could be hurt.

http://producingoss.com/en/consensus-democracy.html#electorate
```

Board of governers, voting, etc?

Many projects have an official board of directors, or a list of "core developers", with set term limits and elections and stuff.

I don't think that we're that big. I think we're still small enough, and there's enough trust and consensus decisions, that we can avoid that. I would rather that we kept on going with trust+consensus for at least the next 2-3 years, and spent more time+energy on bug fixes and new features instead of administrative stuff.

Project administrators are Han-Wen, Jan, and Graham.

Discussions

```
https://lists.gnu.org/archive/html/lilypond-devel/2011-07/msg00783.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-07/msg01004.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-08/msg00117.html
```

14.6.4.7 GOP-PROP 7 - developers as resources

We shall treat developers (and contributors) as **Independent volunteers**: each person does whatever they want, whenever they want. We have busy careers and lives; we make no expectations of action from anybody (with the exception of the 6 people in "Meister" positions).

Discussions

```
https://lists.gnu.org/archive/html/lilypond-devel/2011-07/msg01092.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-08/msg00087.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-08/msg00497.html
```

14.6.4.8 GOP-PROP 8 - issue priorities

We will delete the "priority" field of the issue tracker altogether. The "type" system will be tweaked.

Type-critical:

- a reproducible failure to build either `make` or `make doc`, from an empty build tree, in a first run, if `configure` does not report any errors.

- any program behaviour which is **unintentionally** worse than the previous stable version or the current development version. Developers may always use the "this is intentional", or even the "this is an unavoidable effect of an improvement in another area", reason to move this to a different type.
- anything which stops contributors from helping out (e.g. lily-git.tcl not working, source tree(s) not being available, LilyDev being unable to compile git master, inaccurate instructions in the Contributor's Guide 2 Quick start).

  To limit this scope of this point, we will assume that the contributor is using the latest LilyDev and has read the relevant part(s) of the Contributor's Guide. Problems in other chapters of the CG are not sufficient to qualify as Type-Critical.

More new/changed types and labels

Unless otherwise specified, the current types and labels will continue to be used. The new types introduced by this proposal are:

- Type-crash: any segfault, regardless of what the input file looks like or which options are given. Disclaimer: this might not be possible in some cases, for example certain guile programs (we certainly can't predict if a piece of scheme will ever stop running, i.e. the halting problem), or if we rely on other programs (i.e. ghostscript). If there are any such cases that make segfault-prevention impossible, we will document those exceptions (and the issue will remain as a "crash" instead of "documentation" until the warning has been pushed).
- Type-maintainability: anything which makes it difficult for serious contributors to help out (e.g. difficult to find the relevant source tree(s), confusing policies, problems with automatic indentation tools, etc).
- Type-ugly: replaces Type-collision, and it will include things like bad slurs in addition to actual collision.

A new label will be added:

- (label) Needs_evidence: it is not clear what the correct output should look like. We need scans, references, examples, etc.

Reminding users about stars

We can remind users that they can "star" an issue to indicate that they care about it. Since we resolved to treat developers as independent volunteers, there is no expectation that anybody will look at those stars, but if any developer want to organize their work schedule according to the stars, they are welcome to do so.

Discussions

https://lists.gnu.org/archive/html/lilypond-devel/2011-08/msg00019.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-08/msg00277.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-08/msg00413.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-08/msg00624.html

14.6.4.9 GOP-PROP 9 - behavior of make doc

If there are build problems, then it should be easier to find out why it's failing. This will be achieved with log files, as well as possibly including scripts which automatically display portions of those log files for a failing build.

We will also add targets for building a specific manual (for quick+easy checking of doc work), as well as for building all documentation in a specific language (either English or a translated language).

When you run `make doc`,

- All output will be saved to various log files, with the exception of output directly from `make(1)`.

  Note that `make(1)` refers to a specific executable file on unix computers, and is not a general term for the build system.
- By default, no other output will be displayed on the console, with one exception: if a build fails, we might display some portion(s) of log file(s) which give useful clues about the reason for the failure.

  The user may optionally request additional output to be printed; this is controlled with the `VERBOSE=x` flag. In such cases, all output will still be written to log files; the console output is strictly additional to the log files.
- Logfiles from calling lilypond (as part of lilypond-book) will go in the relevant '`$LILYPOND_BUILD_DIR/out/lybook-db/12/lily-123456.log`' file. All other logfiles will go in the '`$LILYPOND_BUILD_DIR/logfiles/`' directory.

  A single `make doc` will therefore result in hundreds of log files. Log files produced from individual lilypond runs are not under our control; apart from that, I anticipate having one or two dozen log files. As long as it is clear which log file is associated with which operation(s), I think this is entirely appropriate. The precise implementation will be discussed for specific patches as they appear.
- Both stderr and stdout will be saved in `*.log`. The order of lines from these streams should be preserved.
- There will be no additional "progress messages" during the build process. If you run `make --silent`, a non-failing build should print absolutely nothing to the screen.
- Assuming that the loglevels patch is accepted, lilypond (inside lilypond-book) will be run with –loglevel=WARN. http://codereview.appspot.com/4822055/
- Ideally, a failing build should provide hints about the reason why it failed, or at least hints about which log file(s) to examine.

If this proposal is accepted, none of these policies will be assumed to apply to any other aspect of the build system. Policies for any other aspect of the build system will be discussed in separate proposals.

Don't cause more build problems

However, there is a danger in this approach, that vital error messages can also be lost, thus preventing the cause of the failure of a make being found. We therefore need to be exceptionally careful to move cautiously, include plenty of tests, and give time for people to experiment/find problems in each stage before proceeding to the next stage.

This will be done by starting from individual lilypond calls within lilypond-book, and slowly moving to "larger" targets of the build system – after the individual lilypond calls are are producing the appropriate amount of output and this is saved in the right place and we can automatically isolate parts of a failing build, we will work on lilypond-book in general, and only then will we look at the build system itself.

Implementation notes

There is an existing make variable QUIET_BUILD, which alter the amount of output being displayed (`http://lilypond.org/doc/v2.15/Documentation/contributor/useful-make-variables`). We are not planning on keeping this make variable.

The standard way for GNU packages to give more output is with a `V=x` option. Presumably this is done by increasing `x`? If we support this option, we should still write log files; we would simply print more of the info in those log files to screen.

The command `tee` may be useful to write to a file and display to stdout (in the case of VERBOSE).

Discussions

https://lists.gnu.org/archive/html/lilypond-devel/2011-08/msg00378.html
https://lists.gnu.org/archive/html/lilypond-devel/2011-08/msg00703.html

14.7 Grand LilyPond Input Syntax Standardization (GLISS)

Summary

- Start: sortly after 2.14 comes out, which is currently estimated to happen in January 2011.
- Length: 6-12 months. We're not going to rush this.
- Goal: define an input which we commit to being machine-updateable for the forseeable future. Any future patches which change the syntax in a non-convert-ly-able format will be rejected. (subject to the limitations, below) Once this is finished, we will release lilypond 3.0.

The Problem

One of the biggest complaints people have with lilypond – other than silly thing like "there's no gui" – is the changing syntax. Now, inventing a language or standards is difficult. If you set it in stone too soon, you risk being stuck with decisions which may limit matters. If you keep on updating the syntax, interaction with older data (and other programs!) becomes complex.

Scope and Limitations

- tweaks will not be included. Anything with \override, \set, \overrideProperty, \tweak, \revert, \unset... including even those command names themselves... is still fair game for NOT_SMART convert-ly updates.
- other than that, everything is on the table. Is it a problem to have the tagline inside \header? What should the default behavior of \include be?
- we need to get standards for command names. This will help users remember them, and reduce the options for future names (and potential renamings later on). \commandOn and \commandOff seem to work well (should we *always* have an Off command?), but what about the "command" part? Should it be \nounVerbOn, or \verbNounOn ? Or \verbNotesWithExtraInformationOn ?
- we need standards for the location of commands. Ligature brackets, I'm looking at you. (non-postfix notation must die!)
- this Grand Project doesn't affect whether we have a 2.16 or not. The main problem will be deciding what to do (with a bit of messiness anticipated for \tuplet); we should definitely release a 2.16 before merging _any_ of these changes.
- we obviously can't /guarantee/ that we'll /never/ make any non-convert-ly changes in the basic format. But we *can* guarantee that such changes would force lilypond 4.0, and that we would only do so for overwhelmingly good reasons.

Workflow

- We're going to have lots and lots of emails flying around. The vast majority won't really fit into either -devel or -user, so we'll use a list devoted to syntax issues.
- Once we have a serious proposal that gained general acceptance from the separate syntax mailing list, I'll bring it to -devel. We're not going to make any changes without discussing it on -devel, but if we're going to have huge threads about English grammar and silly ideas,

and I don't want to clutter up -devel. Once whatever chaotic silliness on the syntax list is settled down, I'll bring the ideas to -devel.

- as with GDP, I'll moderate the discussion. Not as with mailist moderation, but rather by introducing issues at specific times. We don't want a free-for-all discussion of all parts of the syntax at once; nothing will get resolved.
- Whenever possible, we'll decide on policies at the highest level of abstraction. For example, consider \numericTimeSignature, \slurUp, \xNotesOn, \startTextSpan, and \verylongfermata. One of them starts with the name of the notation first (slur). One has an abbreviation (x instead of cross). One has the verb at the end (On), another has it at the beginning (start). The adjective can come at the beginning (numeric, x) or end (Up). Most are in camelCase, but one isn't (verylongfermata).
- Instead of arguing about each individual command, we'll decide on abstract questions. Should each command begin the notation-noun, or the verb? Should all commands be in camelCase, or should we make everything other than articulations in camelCase but make articulations all lower-case? Are abbreviations allowed?
- Once we've answered such fundamental questions, most of the syntax should fall into place pretty easily. There might be a few odd questions left ("is it a span, or a spanner?"), but those can be settled fairly quickly.

Implementation

Nothing until the project is finished, then we declare the next stable release (2.16.0 or 2.18.0 ?) to be the final 2.x version, release it, then apply all the GLISS syntax changes and start testing a beta for 3.0 a week or two later.

Discussion

Don't respond to any of the specifics yet. Yes, we all have our pet irritations (like "what's up with \paper and \layout?!"). There will be plenty of time to discuss them once GLISS starts.

That said, we have a list of specific items that people really wanted to have written down. See Section 14.7.1 [Specific GLISS issues], page 178.

14.7.1 Specific GLISS issues

- add regtests for every piece of syntax (not one-command-per-file, but making a few files which, between them, use every single piece of syntax.) This is a great test for convert-ly.
- should GLISS cover suggested conventions? (indentation, one-bar-per-line, etc – the kind of stuff we list for the lilypond formatting in the docs ?)
- how much (if any) syntactic sugar should we add? i.e.

```
  \instrumentName #'foo
% instead of
  \set Staff.instrumentName
```

  ? Carl: maybe yes, Neil: no. (for example, it fails for pianostaff)
- the values that are used as arguments to common used overrides. Sometimes they are a symbol (e.g. #'around), sometimes a predefined variable referring to a Scheme value or object (e.g. #LEFT, #all-visible). The main trouble is that for novice users it is not clear when there should be an apostrophe and when not.
- When do we need -\command and when is it just \command ?
- Command-line options to the lilypond binary. -dfoo counts as a tweak; we won't be trying to pin those down.
-

```
\layout {
  \context { \Score
% vs.
\layout {
  \context {
    \Score
```

- If would be pedagogically simpler to realize this difference if the syntax was separate if you define a context from scratch (as is the case with \RemoveEmptyStaffContext) or if it's defined by adding onto an existing context. For example, a syntax like

```
\context{
 % Copy the current settings of the Staff context:
 \use Staff
 % do whatever additional settings
}
%%% could be used to distinguish from
\context{
 % Take settings from a variable:
 \Variable
 % do whatever additional settings
}

%%% and

\context{
 % Start from scratch:
 \type ...
 \name ...
 \consists ...
 ...
}
```

- Capitalization of identifiers: \VoiceOne ?
-

```
%%% Allow
{ music expression } * 4
%%% instead of
\repeat unfold 4 { music expression }
```

  ? patch here:
  http://lists.gnu.org/archive/html/lilypond-devel/2010-04/msg00467.html
- Personally, I find it easier to understand when there's a repeated 8 in the half-bar position; it's much easier to see that you have two groups of 4:

```
c8 c c c c8 c c c
%%% instead of one group of eight:
c8 c c c c c c c
```

- trivially simple bar-lines:

  c1 | c1 |

  encourage, allow, or discourage, or disallow?
- indentation of \\ inside a {} construct.
- barline checks at the end of line should be preceded by at least 2 spaces? barline checks should line up if possible (i.e. if you can use less than 4, 8, X empty spaces before a barline check to make them line up?)

- Why doesn't \transpose respect \relative mode?
- on \score vs. \new Score

  But in the light of a consistent syntax and semantic, I see no reason (from the users POV) to disallow it. After all, the real top-level context is a \book {}, isn't it, and I don't see a point in disallowing a \new Score construct just like \new Staff.

  From a syntactical POV, I see the following pros for \new Score: - You can write \with { ... } for every other context but \Score, which (for consistency) should also work with \new Score. - When there's a \new Foo Bar, there's also a \context Foo Bar, which makes the same as a parallel instantiation of all Bar's. - [Quoting Rune from http://www.mail-archive.com/lilypond-devel@gnu.org/msg14713.html "I know that the \score-statement is a syntactical construct, but I think it would be nice to hide this fact from the users. I think we could make the use of score-block much more intuitive if changing the syntax to \new \Score and adding an implicit sequential-statement to the score."
- Discussion on http://code.google.com/p/lilypond/issues/detail?id=1322 about \new vs. \context.
- Let users add their own items to the parser? comment 11 on: http://code.google.com/p/lilypond/issues/detail?id=1322
- should engravers be pluralized (note_heads_engraver) or not (note_head_engraver) ?
- should we allow numbers in identifier names? Issue: http://code.google.com/p/lilypond/issues/detail?id=1670
- should we officially allow accented characters? in general, how do we feel about utf-8 stuff?
- for the sake of completeness/simplicity, what about *disallowing* the "one-note" form of a music expression? i.e. only allowing stuff like

  ```
  \transpose c d { e1 }
  \transpose c d << e1 >>
  ```

  and never allowing

  ```
  \transpose c d e1
  ```
- What should be the officially encouraged way of writing music for transposing instruments? Maybe it should be simplified? See http://lists.gnu.org/archive/html/lilypond-user/2011-07/msg00130.html

14.8 Unsorted policies

Language-specific mailing lists

A translator can ask for an official lilypond-xy mailing list once they've finished all "priority 1" translation items.

Performing yearly copyright update ("grand-replace")

At the start of each year, copyright notices for all source files should be refreshed by running the following command from the top of the source tree:

```
make grand-replace
```

Internally, this invokes the script '`scripts/build/grand-replace.py`', which performs a regular expression substitution for old-year -> new-year wherever it finds a valid copyright notice.

Note that snapshots of third party files such as '`texinfo.tex`' should not be included in the automatic update; '`grand-replace.py`' ignores these files if they are listed in the variable `copied_files`.

Push git access

Git access is given out when a contributor has a significant record of patches being accepted without problems. If existing developers are tired of pushing patches for a contributor, we'll discuss giving them push access. Unsolicited requests from contributors for access will almost always be turned down.

Appendix A LilyPond grammar

This appendix contains a description of the LilyPond grammar, as output from the parser.

`Grammar`

```
start_symbol:  lilypond

start_symbol:  "#{" $ embedded_lilypond

lilypond:  /* empty */
         | lilypond toplevel_expression
         | lilypond assignment
         | lilypond error
         | lilypond "\version-error"

toplevel_expression:  $ lilypond_header
                    | book_block
                    | bookpart_block
                    | BOOK_IDENTIFIER
                    | score_block
                    | composite_music
                    | full_markup
                    | full_markup_list
                    | SCM_TOKEN
                    | embedded_scm_active
                    | output_def

embedded_scm_bare:  SCM_TOKEN
                  | SCM_IDENTIFIER

embedded_scm_active:  SCM_IDENTIFIER
                    | scm_function_call

embedded_scm_bare_arg:  SCM_ARG
                      | SCM_TOKEN
                      | FRACTION
                      | full_markup_list
                      | context_modification
                      | score_block
                      | context_def_spec_block
                      | book_block
                      | bookpart_block
                      | output_def

embedded_scm:  embedded_scm_bare
             | scm_function_call

embedded_scm_arg:  embedded_scm_bare_arg
                 | scm_function_call
                 | music_assign

scm_function_call:  SCM_FUNCTION function_arglist
```

```
41 embedded_lilypond:  /* empty */
42                   | identifier_init
43                   | music_embedded music_embedded music_list
44                   | error
45                   | "\version-error" embedded_lilypond

46 lilypond_header_body:  /* empty */
47                       | lilypond_header_body assignment
48                       | lilypond_header_body embedded_scm

49 lilypond_header:  "\header" '{' lilypond_header_body '}'

50 assignment_id:  STRING

51 assignment:  assignment_id '=' identifier_init
52           | assignment_id property_path '=' identifier_init
53           | assignment_id '.' property_path '=' identifier_init

54 identifier_init:  score_block
55                 | book_block
56                 | bookpart_block
57                 | output_def
58                 | context_def_spec_block
59                 | music_assign
60                 | post_event_nofinger post_events
61                 | number_expression
62                 | FRACTION
63                 | string
64                 | embedded_scm
65                 | full_markup_list
66                 | context_modification

67 context_def_spec_block:  "\context" '{' context_def_spec_body '}'

68 context_mod_arg:  embedded_scm

70 context_mod_arg:  $ composite_music

71 context_mod_embedded:  context_mod_arg

72 context_def_spec_body:  /* empty */
73                       | CONTEXT_DEF_IDENTIFIER
74                       | context_def_spec_body context_mod
75                       | context_def_spec_body context_modification
76                       | context_def_spec_body context_mod_embedded

77 book_block:  "\book" '{' book_body '}'

78 book_body:  /* empty */
79           | BOOK_IDENTIFIER
80           | book_body paper_block
```

```
 81          | book_body bookpart_block
 82          | book_body score_block
 83          | book_body composite_music
 84          | book_body full_markup
 85          | book_body full_markup_list
 86          | book_body SCM_TOKEN
 87          | book_body embedded_scm_active

 89 book_body:  book_body $ lilypond_header
 90          | book_body error

 91 bookpart_block:  "\bookpart" '{' bookpart_body '}'

 92 bookpart_body:  /* empty */
 93              | BOOK_IDENTIFIER
 94              | bookpart_body paper_block
 95              | bookpart_body score_block
 96              | bookpart_body composite_music
 97              | bookpart_body full_markup
 98              | bookpart_body full_markup_list
 99              | bookpart_body SCM_TOKEN
100              | bookpart_body embedded_scm_active

102 bookpart_body:  bookpart_body $ lilypond_header
103              | bookpart_body error

104 score_block:  "\score" '{' score_body '}'

105 score_headers:  /* empty */

107 score_headers:  score_headers $ lilypond_header
108              | score_headers output_def

109 score_body:  score_headers music
110           | embedded_scm_active

112 score_body:  score_body $ lilypond_header
113           | score_body output_def
114           | score_body error

115 paper_block:  output_def

116 output_def:  output_def_body '}'

117 output_def_head:  "\paper"
118                | "\midi"
119                | "\layout"

120 output_def_head_with_mode_switch:  output_def_head

121 music_or_context_def:  music_arg
122                     | context_def_spec_block
```

```
123 output_def_body:  output_def_head_with_mode_switch '{'
124                 | output_def_head_with_mode_switch
                        '{'
                        OUTPUT_DEF_IDENTIFIER
125                 | output_def_body assignment
126                 | output_def_body embedded_scm

128 output_def_body:  output_def_body $ music_or_context_def
129                 | output_def_body error

130 tempo_event:  "\tempo" steno_duration '=' tempo_range
131             | "\tempo" scalar steno_duration '=' tempo_range
132             | "\tempo" scalar

133 music_list:  /* empty */
134            | music_list music_embedded
135            | music_list error

136 braced_music_list:  '{' music_list '}'

137 music:  music_arg
138      | lyric_element_music

139 music_embedded:  music
140                | music_embedded_backup
141                | music_embedded_backup
                       "(backed-up?)"
                       lyric_element_music

142 music_embedded_backup:  embedded_scm

143 music_arg:  simple_music
144           | composite_music

145 music_assign:  simple_music
146              | composite_music

147 repeated_music:  "\repeat" simple_string unsigned_number music
148                | REPEAT_IDENTIFIER music
149                | "\repeat"
                       simple_string
                       unsigned_number
                       music
                       "\alternative"
                       braced_music_list
150                | REPEAT_IDENTIFIER
                       music
                       "\alternative"
                       braced_music_list

151 sequential_music:  "\sequential" braced_music_list
```

```
152                 | braced_music_list

153 simultaneous_music:  "\simultaneous" braced_music_list
154                   | "<<" music_list ">>"

155 simple_music:  event_chord
156             | music_property_def
157             | context_change

159 context_modification:  "\with" $ '{' context_mod_list '}'
160                      | "\with" CONTEXT_MOD_IDENTIFIER
161                      | CONTEXT_MOD_IDENTIFIER
162                      | "\with" context_modification_arg

163 context_modification_arg:  embedded_scm_closed
164                          | MUSIC_IDENTIFIER

165 optional_context_mod:  /* empty */
166                      | context_modification

167 context_mod_list:  /* empty */
168                 | context_mod_list context_mod
169                 | context_mod_list CONTEXT_MOD_IDENTIFIER
170                 | context_mod_list context_mod_embedded

171 composite_music:  complex_music
172                | music_bare

173 closed_music:  music_bare
174             | complex_music_prefix closed_music
175             | music_function_call_closed

176 music_bare:  mode_changed_music
177           | MUSIC_IDENTIFIER
178           | grouped_music_list

179 grouped_music_list:  simultaneous_music
180                   | sequential_music

181 function_arglist_nonbackup_common:  "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        post_event_nofinger
182                                   | "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        '-'
                                        UNSIGNED
183                                   | "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        '-'
```

```
                                        REAL
184                                   | "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        '-'
                                        NUMBER_IDENTIFIER

185 function_arglist_closed_nonbackup:  function_arglist_nonbackup_common
186                                   | function_arglist_closed_common
187                                   | "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        embedded_scm_arg_closed
188                                   | "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        bare_number_closed
189                                   | "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        SCM_IDENTIFIER
190                                   | "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        STRING
191                                   | "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        full_markup

192 symbol_list_arg:  SYMBOL_LIST
193                 | SYMBOL_LIST '.' symbol_list_rev

194 symbol_list_rev:  symbol_list_part
195                 | symbol_list_rev '.' symbol_list_part

196 symbol_list_part:  symbol_list_element

197 symbol_list_element:  STRING
198                     | embedded_scm_bare

199 function_arglist_nonbackup:  function_arglist_nonbackup_common
200                           | function_arglist_common
201                           | "optional?"
                                "scheme?"
                                function_arglist_nonbackup
                                embedded_scm_arg
202                           | "optional?"
                                "scheme?"
                                function_arglist_nonbackup
                                bare_number_common
203                           | function_arglist_nonbackup_reparse
```

```
                                  "(reparsed?)"
                                  duration_length
204                             | function_arglist_nonbackup_reparse
                                  "(reparsed?)"
                                  bare_number_common
205                             | function_arglist_nonbackup_reparse
                                  "(reparsed?)"
                                  SCM_ARG
206                             | function_arglist_nonbackup_reparse
                                  "(reparsed?)"
                                  lyric_element_music
207                             | function_arglist_nonbackup_reparse
                                  "(reparsed?)"
                                  symbol_list_arg

208 function_arglist_nonbackup_reparse:  "optional?"
                                         "scheme?"
                                         function_arglist_nonbackup
                                         SCM_IDENTIFIER
209                                    | "optional?"
                                         "scheme?"
                                         function_arglist_nonbackup
                                         STRING
210                                    | "optional?"
                                         "scheme?"
                                         function_arglist_nonbackup
                                         full_markup
211                                    | "optional?"
                                         "scheme?"
                                         function_arglist_nonbackup
                                         UNSIGNED
212                                    | "optional?"
                                         "scheme?"
                                         function_arglist_nonbackup
                                         DURATION_IDENTIFIER

213 function_arglist_backup:  function_arglist_common
214                         | "optional?"
                              "scheme?"
                              function_arglist_backup
                              embedded_scm_arg_closed
215                         | "optional?"
                              "scheme?"
                              function_arglist_backup
                              "\repeat"
                              simple_string
                              unsigned_number
216                         | "optional?"
                              "scheme?"
                              function_arglist_backup
                              chord_body
217                         | "optional?"
```

```
                        "scheme?"
                        function_arglist_backup
                        post_event_nofinger
218                   | "optional?"
                        "scheme?"
                        function_arglist_backup
                        full_markup
219                   | "optional?"
                        "scheme?"
                        function_arglist_backup
                        UNSIGNED
220                   | "optional?"
                        "scheme?"
                        function_arglist_backup
                        REAL
221                   | "optional?"
                        "scheme?"
                        function_arglist_backup
                        NUMBER_IDENTIFIER
222                   | "optional?"
                        "scheme?"
                        function_arglist_backup
                        '-'
                        UNSIGNED
223                   | "optional?"
                        "scheme?"
                        function_arglist_backup
                        '-'
                        REAL
224                   | "optional?"
                        "scheme?"
                        function_arglist_backup
                        '-'
                        NUMBER_IDENTIFIER
225                   | "optional?"
                        "scheme?"
                        function_arglist_backup
                        PITCH_IDENTIFIER
226                   | "optional?"
                        "scheme?"
                        function_arglist_backup
                        NOTENAME_PITCH
227                   | "optional?"
                        "scheme?"
                        function_arglist_backup
                        TONICNAME_PITCH
228                   | "optional?"
                        "scheme?"
                        function_arglist_backup
                        DURATION_IDENTIFIER
229                   | "optional?"
                        "scheme?"
```

```
                              function_arglist_backup
                              SCM_IDENTIFIER
230                         | "optional?"
                              "scheme?"
                              function_arglist_backup
                              STRING
231                         | function_arglist_backup
                              "(reparsed?)"
                              music_assign
232                         | function_arglist_backup
                              "(reparsed?)"
                              pitch_arg
233                         | function_arglist_backup
                              "(reparsed?)"
                              bare_number_common
234                         | function_arglist_backup
                              "(reparsed?)"
                              duration_length
235                         | function_arglist_backup
                              "(reparsed?)"
                              symbol_list_arg

236 function_arglist:  function_arglist_nonbackup
237                  | "optional?"
                       "scheme?"
                       function_arglist_skip_nonbackup
                       "\default"

238 function_arglist_skip_nonbackup:  function_arglist_nonbackup
239                                  | "optional?"
                                       "scheme?"
                                       function_arglist_skip_nonbackup

240 function_arglist_common:  EXPECT_NO_MORE_ARGS
241                         | "scheme?"
                              function_arglist_optional
                              embedded_scm_arg
242                         | "scheme?"
                              function_arglist_optional
                              bare_number_common
243                         | "scheme?"
                              function_arglist_optional
                              post_event_nofinger
244                         | "scheme?"
                              function_arglist_optional
                              '-'
                              NUMBER_IDENTIFIER
245                         | function_arglist_common_reparse
                              "(reparsed?)"
                              SCM_ARG
246                         | function_arglist_common_reparse
                              "(reparsed?)"
```

```
                              lyric_element_music
247                         | function_arglist_common_reparse
                              "(reparsed?)"
                              bare_number_common
248                         | function_arglist_common_reparse
                              "(reparsed?)"
                              duration_length
249                         | function_arglist_common_reparse
                              "(reparsed?)"
                              symbol_list_arg

250 function_arglist_common_reparse:  "scheme?"
                                       function_arglist_optional
                                       SCM_IDENTIFIER
251                                 | "scheme?"
                                       function_arglist_optional
                                       STRING
252                                 | "scheme?"
                                       function_arglist_optional
                                       full_markup
253                                 | "scheme?"
                                       function_arglist_optional
                                       UNSIGNED
254                                 | "scheme?"
                                       function_arglist_optional
                                       DURATION_IDENTIFIER
255                                 | "scheme?"
                                       function_arglist_optional
                                       '-'
                                       UNSIGNED
256                                 | "scheme?"
                                       function_arglist_optional
                                       '-'
                                       REAL

257 function_arglist_closed:  function_arglist_closed_nonbackup
258                         | "optional?"
                              "scheme?"
                              function_arglist_skip_nonbackup
                              "\default"

259 function_arglist_closed_common:  EXPECT_NO_MORE_ARGS
260                                | "scheme?"
                                     function_arglist_optional
                                     embedded_scm_arg_closed
261                                | "scheme?"
                                     function_arglist_optional
                                     bare_number_common_closed
262                                | "scheme?"
                                     function_arglist_optional
                                     '-'
                                     NUMBER_IDENTIFIER
```

```
263                                 | "scheme?"
                                        function_arglist_optional
                                        post_event_nofinger
264                                 | function_arglist_common_reparse
                                        "(reparsed?)"
                                        SCM_ARG
265                                 | function_arglist_common_reparse
                                        "(reparsed?)"
                                        bare_number_common_closed
266                                 | function_arglist_common_reparse
                                        "(reparsed?)"
                                        symbol_list_arg

267 function_arglist_optional:  function_arglist_backup
268                           | "optional?"
                                  "scheme?"
                                  function_arglist_skip_backup
                                  "\default"
269                           | function_arglist_skip_backup "(backed-up?)"

270 function_arglist_skip_backup:  function_arglist_backup
271                               | "optional?"
                                    "scheme?"
                                    function_arglist_skip_backup

272 embedded_scm_closed:  embedded_scm_bare
273                     | scm_function_call_closed

274 embedded_scm_arg_closed:  embedded_scm_bare_arg
275                         | scm_function_call_closed
276                         | closed_music

277 scm_function_call_closed:  SCM_FUNCTION function_arglist_closed

278 music_function_call:  MUSIC_FUNCTION function_arglist

279 optional_id:  /* empty */
280            | '=' simple_string

281 complex_music:  music_function_call
282               | repeated_music
283               | re_rhythmed_music
284               | complex_music_prefix music

285 complex_music_prefix:  "\context"
                           symbol
                           optional_id
                           optional_context_mod
286                     | "\new" symbol optional_id optional_context_mod

287 mode_changed_music:  mode_changing_head grouped_music_list
288                    | mode_changing_head_with_context
```

```
                        optional_context_mod
                        grouped_music_list

mode_changing_head:  "\notemode"
                   | "\drummode"
                   | "\figuremode"
                   | "\chordmode"
                   | "\lyricmode"

mode_changing_head_with_context:  "\drums"
                                | "\figures"
                                | "\chords"
                                | "\lyrics"

new_lyrics:  "\addlyrics" $0 composite_music

new_lyrics:  new_lyrics "\addlyrics" $1 composite_music

re_rhythmed_music:  composite_music new_lyrics

re_rhythmed_music:  "\lyricsto" simple_string $2 music

context_change:  "\change" symbol '=' simple_string

property_path:  symbol_list_rev
              | symbol_list_rev property_path

property_operation:  symbol '=' scalar
                   | "\unset" symbol
                   | "\override" property_path '=' scalar
                   | "\revert" revert_arg

revert_arg:  revert_arg_backup "(backed-up?)" symbol_list_arg

revert_arg_backup:  revert_arg_part

revert_arg_part:  symbol_list_part
                | revert_arg_backup
                    "(backed-up?)"
                    SCM_ARG
                    '.'
                    symbol_list_part
                | revert_arg_backup
                    "(backed-up?)"
                    SCM_ARG
                    symbol_list_part

context_def_mod:  "\consists"
                | "\remove"
                | "\accepts"
                | "\defaultchild"
                | "\denies"
```

```
322                | "\alias"
323                | "\type"
324                | "\description"
325                | "\name"

326 context_mod:  property_operation
327            | context_def_mod STRING
328            | context_def_mod embedded_scm

329 grob_prop_spec:  symbol_list_rev

330 grob_prop_path:  grob_prop_spec
331               | grob_prop_spec property_path

332 context_prop_spec:  symbol_list_rev

333 simple_music_property_def:  "\override" grob_prop_path '=' scalar
334                           | "\revert" simple_revert_context revert_arg
335                           | "\set" context_prop_spec '=' scalar
336                           | "\unset" context_prop_spec

337 simple_revert_context:  symbol_list_part

338 music_property_def:  simple_music_property_def

339 string:  STRING
340       | full_markup

341 simple_string:  STRING
342              | embedded_scm_bare

343 symbol:  STRING
344       | embedded_scm_bare

345 scalar:  embedded_scm_arg
346       | SCM_IDENTIFIER
347       | bare_number
348       | '-' bare_number
349       | STRING
350       | full_markup

351 event_chord:  simple_element post_events
352            | simple_chord_elements post_events
353            | CHORD_REPETITION optional_notemode_duration post_events
354            | MULTI_MEASURE_REST optional_notemode_duration post_events
355            | command_element
356            | note_chord_element

357 note_chord_element:  chord_body optional_notemode_duration post_events

358 chord_body:  "<" chord_body_elements ">"
359           | CHORD_BODY_IDENTIFIER
```

```
chord_body_elements:  /* empty */
                    | chord_body_elements chord_body_element

chord_body_element:  pitch
                       exclamations
                       questions
                       octave_check
                       post_events
                   | DRUM_PITCH post_events
                   | music_function_chord_body

music_function_chord_body:  music_function_call
                          | MUSIC_IDENTIFIER
                          | embedded_scm

music_function_call_closed:  MUSIC_FUNCTION function_arglist_closed

event_function_event:  EVENT_FUNCTION function_arglist_closed

command_element:  command_event

command_event:  tempo_event

post_events:  /* empty */
            | post_events post_event

post_event_nofinger:  direction_less_event
                    | script_dir music_function_call_closed
                    | "--"
                    | "__"
                    | script_dir direction_reqd_event
                    | script_dir direction_less_event
                    | '^' fingering
                    | '_' fingering

post_event:  post_event_nofinger
           | '-' fingering

string_number_event:  E_UNSIGNED

direction_less_event:  string_number_event
                     | EVENT_IDENTIFIER
                     | tremolo_type
                     | event_function_event

direction_reqd_event:  gen_text_def
                     | script_abbreviation

octave_check:  /* empty */
             | '=' quotes
```

```
393 quotes:  /* empty */
394       | sub_quotes
395       | sup_quotes

396 sup_quotes:  '\''
397           | sup_quotes '\''

398 sub_quotes:  ','
399           | sub_quotes ','

400 steno_pitch:  NOTENAME_PITCH quotes

401 steno_tonic_pitch:  TONICNAME_PITCH quotes

402 pitch:  steno_pitch
403      | PITCH_IDENTIFIER quotes

404 pitch_arg:  PITCH_ARG quotes

405 gen_text_def:  full_markup
406             | STRING
407             | embedded_scm_closed

408 fingering:  UNSIGNED

409 script_abbreviation:  '^'
410                     | '+'
411                     | '-'
412                     | '!'
413                     | ">"
414                     | '.'
415                     | '_'

416 script_dir:  '_'
417           | '^'
418           | '-'

419 duration_length:  multiplied_duration

420 maybe_notemode_duration:  /* empty */
421                         | multiplied_duration

422 optional_notemode_duration:  maybe_notemode_duration

423 steno_duration:  UNSIGNED dots
424               | DURATION_IDENTIFIER dots

425 multiplied_duration:  steno_duration
426                     | multiplied_duration '*' UNSIGNED
427                     | multiplied_duration '*' FRACTION

428 dots:  /* empty */
```

```
429     | dots '.'

430 tremolo_type:  ':'
431             | ':' UNSIGNED

432 bass_number:  UNSIGNED
433            | STRING
434            | full_markup
435            | embedded_scm_bare

436 figured_bass_alteration:  '-'
437                         | '+'
438                         | '!'

439 bass_figure:  "_"
440            | bass_number
441            | bass_figure ']'
442            | bass_figure figured_bass_alteration
443            | bass_figure figured_bass_modification

444 figured_bass_modification:  "\+"
445                           | "\!"
446                           | '/'
447                           | "\"

448 br_bass_figure:  bass_figure
449               | '[' bass_figure

450 figure_list:  /* empty */
451            | figure_list br_bass_figure

452 figure_spec:  FIGURE_OPEN figure_list FIGURE_CLOSE

453 optional_rest:  /* empty */
454              | "\rest"

455 simple_element:  pitch
                     exclamations
                     questions
                     octave_check
                     maybe_notemode_duration
                     optional_rest
456               | DRUM_PITCH optional_notemode_duration
457               | RESTNAME optional_notemode_duration

458 simple_chord_elements:  new_chord
459                      | figure_spec optional_notemode_duration

460 lyric_element:  full_markup
461              | STRING
462              | LYRIC_ELEMENT
```

```
463 lyric_element_music:  lyric_element
                          optional_notemode_duration
                          post_events

464 new_chord:  steno_tonic_pitch maybe_notemode_duration
465          | steno_tonic_pitch
                optional_notemode_duration
                chord_separator
                chord_items

466 chord_items:  /* empty */
467            | chord_items chord_item

468 chord_separator:  ":"
469                 | "^"
470                 | "/" steno_tonic_pitch
471                 | "/+" steno_tonic_pitch

472 chord_item:  chord_separator
473           | step_numbers
474           | CHORD_MODIFIER

475 step_numbers:  step_number
476              | step_numbers '.' step_number

477 step_number:  UNSIGNED
478            | UNSIGNED '+'
479            | UNSIGNED "-"

480 tempo_range:  unsigned_number
481            | unsigned_number '-' unsigned_number

482 number_expression:  number_expression '+' number_term
483                   | number_expression '-' number_term
484                   | number_term

485 number_term:  number_factor
486            | number_factor '*' number_factor
487            | number_factor '/' number_factor

488 number_factor:  '-' number_factor
489              | bare_number

490 bare_number_common:  bare_number_common_closed
491                    | REAL NUMBER_IDENTIFIER

492 bare_number_common_closed:  REAL
493                           | NUMBER_IDENTIFIER

494 bare_number:  bare_number_common
495            | UNSIGNED
496            | UNSIGNED NUMBER_IDENTIFIER
```

```
497 bare_number_closed:  UNSIGNED
498                    | bare_number_common_closed

499 unsigned_number:  UNSIGNED
500                 | NUMBER_IDENTIFIER
501                 | embedded_scm

502 exclamations:  /* empty */
503              | exclamations '!'

504 questions:  /* empty */
505           | questions '?'

507 full_markup_list:  "\markuplist" $3 markup_list

509 full_markup:  "\markup" $4 markup_top

510 markup_top:  markup_list
511            | markup_head_1_list simple_markup
512            | simple_markup

514 markup_scm:  embedded_scm_bare $5 "(backed-up?)"

515 markup_list:  markup_composed_list
516             | markup_uncomposed_list

517 markup_uncomposed_list:  markup_braced_list
518                         | markup_command_list
519                         | markup_scm MARKUPLIST_IDENTIFIER

520 markup_composed_list:  markup_head_1_list markup_uncomposed_list

521 markup_braced_list:  '{' markup_braced_list_body '}'

522 markup_braced_list_body:  /* empty */
523                          | markup_braced_list_body markup
524                          | markup_braced_list_body markup_list

525 markup_command_list:  MARKUP_LIST_FUNCTION markup_command_list_arguments

526 markup_command_basic_arguments:  "markup-list?"
                                      markup_command_list_arguments
                                      markup_list
527                                 | "scheme?"
                                      markup_command_list_arguments
                                      embedded_scm_closed
528                                 | EXPECT_NO_MORE_ARGS

529 markup_command_list_arguments:  markup_command_basic_arguments
530                               | "markup?"
                                    markup_command_list_arguments
```

```
                                    markup

  531 markup_head_1_item:  MARKUP_FUNCTION
                            "markup?"
                            markup_command_list_arguments

  532 markup_head_1_list:  markup_head_1_item
  533                    | markup_head_1_list markup_head_1_item

  534 simple_markup:  STRING

  536 simple_markup:  "\score" $6 '{' score_body '}'
  537               | MARKUP_FUNCTION markup_command_basic_arguments
  538               | markup_scm MARKUP_IDENTIFIER

  539 markup:  markup_head_1_list simple_markup
  540        | simple_markup


Terminals, with rules where they appear



    210 211 212 214 215 216 217 218 219 220 221 222 223 224 225 226
    210 211 212 214 215 216 217 218 219 220 221 222 223 224 225 226
    227 228 229 230 237 239 241 242 243 244 250 251 252 253 254 255
    227 228 229 230 237 239 258 268 271
    247 248 249 264 265 266
    256 258 260 261 262 263 268 271 527
    479 495 496 497 499
    481 483 488
    534
"#{" (339) 3
"(backed-up?)" (334) 141 269 312 315 316 514
"(reparsed?)" (335) 203 204 205 206 207 231 232 233 234 235 245 246
"-" (319) 479
"--" (266) 376
"/" (320) 470
"/+" (316) 471
":" (318) 468
"<" (321) 358
"<<" (323) 154
">" (322) 358 413
">>" (324) 154
"\!" (326) 445
"\" (325) 447
"\+" (327) 444
"\accepts" (274) 319
"\addlyrics" (263) 299 301
"\alias" (275) 322
"\alternative" (261) 149 150
"\book" (276) 77
```

"\bookpart" (277) 91
"\change" (278) 305
"\chordmode" (279) 292
"\chords" (280) 296
"\consists" (281) 317
"\context" (282) 67 285
"\default" (283) 237 258 268
"\defaultchild" (284) 320
"\denies" (285) 321
"\description" (286) 324
"\drummode" (287) 290
"\drums" (288) 294
"\figuremode" (289) 291
"\figures" (290) 295
"\header" (291) 49
"\layout" (293) 119
"\lyricmode" (294) 293
"\lyrics" (295) 297
"\lyricsto" (296) 304
"\markup" (297) 509
"\markuplist" (298) 507
"\midi" (299) 118
"\name" (300) 325
"\new" (315) 286
"\notemode" (301) 289
"\override" (302) 310 333
"\paper" (303) 117
"\remove" (304) 318
"\repeat" (260) 147 149 215
"\rest" (305) 454
"\revert" (306) 311 334
"\score" (307) 104 536
"\sequential" (308) 151
"\set" (309) 335
"\simultaneous" (310) 153
"\tempo" (311) 130 131 132
"\type" (312) 323
"\unset" (313) 309 336
"\version-error" (292) 8 45
"\with" (314) 159 160 162
"^" (317) 469
"_" (330) 439
"__" (265) 377
"end of input" (0) 0
"markup-list?" (336) 526
"markup?" (332) 530 531
"optional?" (337) 181 182 183 184 187 188 189 190 191 201 202 208 209
"scheme?" (333) 181 182 183 184 187 188 189 190 191 201 202 208 209
'!' (33) 412 438 503
'*' (42) 426 427 486
'+' (43) 410 437 478 482
',' (44) 398 399

```
'-' (45) 182 183 184 222 223 224 244 255 256 262 348 383 411 418 436
'.' (46) 53 193 195 315 414 429 476
'/' (47) 446 487
':' (58) 430 431
'=' (61) 51 52 53 130 131 280 305 308 310 333 335 392
'?' (63) 505
'[' (91) 449
'\'' (39) 396 397
']' (93) 441
'^' (94) 380 409 417
'_' (95) 381 415 416
'{' (123) 49 67 77 91 104 123 124 136 159 521 536
'}' (125) 49 67 77 91 104 116 136 159 521 536
BOOK_IDENTIFIER (340) 13 79 93
CHORD_BODY_IDENTIFIER (341) 359
CHORD_MODIFIER (342) 474
CHORD_REPETITION (343) 353
COMPOSITE (262)
CONTEXT_DEF_IDENTIFIER (344) 73
CONTEXT_MOD_IDENTIFIER (345) 160 161 169
DRUM_PITCH (346) 363 456
DURATION_IDENTIFIER (264) 212 228 254 424
E_UNSIGNED (269) 384
error (256) 7 44 90 103 114 129 135
EVENT_FUNCTION (267) 369
EVENT_IDENTIFIER (268) 386
EXPECT_NO_MORE_ARGS (338) 240 259 528
FIGURE_CLOSE (328) 452
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MARKUP_IDENTIFIER (353) 538
MARKUP_LIST_FUNCTION (352) 525
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MULTI_MEASURE_REST (331) 354
MUSIC_FUNCTION (355) 278 368
MUSIC_IDENTIFIER (356) 164 177 366
NOTENAME_PITCH (357) 226 400
NUMBER_IDENTIFIER (272) 184 221 224 244 262 491 493 496 500
OUTPUT_DEF_IDENTIFIER (358) 124
PITCH_ARG (348) 404
PITCH_IDENTIFIER (347) 225 403
PREC_BOT (258)
PREC_TOP (273)
REAL (270) 183 220 223 256 491 492
REPEAT_IDENTIFIER (259) 148 150
RESTNAME (359) 457
SCM_ARG (360) 25 205 245 264 315 316
SCM_FUNCTION (361) 40 277
SCM_IDENTIFIER (362) 22 23 189 208 229 250 346
SCM_TOKEN (363) 18 21 26 86 99
```

```
STRING (364) 50 190 197 209 230 251 327 339 341 343 349 406 433 461
SYMBOL_LIST (365) 192 193
TONICNAME_PITCH (366) 227 401
UNARY_MINUS (367)
UNSIGNED (271) 182 211 219 222 253 255 408 423 426 431 432 477 478

Nonterminals, with rules where they appear
```

```
"#{"  shift, and go to state 1

"(backed-up?)"  shift, and go to state 292

"(backed-up?)"  shift, and go to state 510

"(backed-up?)"  shift, and go to state 573

"(backed-up?)"  shift, and go to state 615

"(reparsed?)"  shift, and go to state 367

"(reparsed?)"  shift, and go to state 368

"(reparsed?)"  shift, and go to state 388

"(reparsed?)"  shift, and go to state 500

"-"  shift, and go to state 718
'+'  shift, and go to state 719

"\addlyrics"  shift, and go to state 207

"\addlyrics"  shift, and go to state 207

"\addlyrics"  shift, and go to state 207

"\addlyrics"  shift, and go to state 207

"\addlyrics"  shift, and go to state 207

"\addlyrics"  shift, and go to state 207

"\addlyrics"  shift, and go to state 207

"\addlyrics"  shift, and go to state 384
```

```
"\alternative"  shift, and go to state 322

"\alternative"  shift, and go to state 602

"\default"  shift, and go to state 640

"\default"  shift, and go to state 656

"\default"  shift, and go to state 705

"\header"  reduce using rule 101 ($@5)

"\header"  reduce using rule 111 ($@7)

"\header"  reduce using rule 111 ($@7)

"\header"  reduce using rule 88 ($@4)

"\header"  shift, and go to state 191

"\header"  shift, and go to state 191

"\header"  shift, and go to state 191

"\header"  shift, and go to state 191

"\header"  shift, and go to state 191

"\rest"  shift, and go to state 721

"end of input"  reduce using rule 41 (embedded_lilypond)

"end of input"  reduce using rule 41 (embedded_lilypond)

"end of input"  reduce using rule 43 (embedded_lilypond)

"end of input"  shift, and go to state 5

"markup?"  shift, and go to state 476

"scheme?"  shift, and go to state 366

"scheme?"  shift, and go to state 387

"scheme?"  shift, and go to state 499

"scheme?"  shift, and go to state 630

"scheme?"  shift, and go to state 689

$@1  go to state 4
```

```
$@10  go to state 383

$@11  go to state 531

$@12  go to state 333

$@13  go to state 174

$@14  go to state 173

$@15  go to state 485

$@16  go to state 475

$default  accept

$default  reduce using rule 10 (toplevel_expression)

$default  reduce using rule 100 (bookpart_body)

$default  reduce using rule 102 (bookpart_body)

$default  reduce using rule 103 (bookpart_body)

$default  reduce using rule 104 (score_block)

$default  reduce using rule 105 (score_headers)

$default  reduce using rule 105 (score_headers)

$default  reduce using rule 106 ($@6)

$default  reduce using rule 107 (score_headers)

$default  reduce using rule 108 (score_headers)

$default  reduce using rule 109 (score_body)

$default  reduce using rule 11 (toplevel_expression)

$default  reduce using rule 110 (score_body)

$default  reduce using rule 112 (score_body)

$default  reduce using rule 113 (score_body)

$default  reduce using rule 114 (score_body)

$default  reduce using rule 115 (paper_block)

$default  reduce using rule 116 (output_def)
```

```
$default  reduce using rule 117 (output_def_head)

$default  reduce using rule 118 (output_def_head)

$default  reduce using rule 119 (output_def_head)

$default  reduce using rule 12 (toplevel_expression)

$default  reduce using rule 120 (output_def_head_with_mode_switch)

$default  reduce using rule 121 (music_or_context_def)

$default  reduce using rule 122 (music_or_context_def)

$default  reduce using rule 123 (output_def_body)

$default  reduce using rule 124 (output_def_body)

$default  reduce using rule 125 (output_def_body)

$default  reduce using rule 126 (output_def_body)

$default  reduce using rule 128 (output_def_body)

$default  reduce using rule 129 (output_def_body)

$default  reduce using rule 13 (toplevel_expression)

$default  reduce using rule 130 (tempo_event)

$default  reduce using rule 131 (tempo_event)

$default  reduce using rule 132 (tempo_event)

$default  reduce using rule 133 (music_list)

$default  reduce using rule 133 (music_list)

$default  reduce using rule 133 (music_list)

$default  reduce using rule 134 (music_list)

$default  reduce using rule 135 (music_list)

$default  reduce using rule 136 (braced_music_list)

$default  reduce using rule 137 (music)

$default  reduce using rule 138 (music)

$default  reduce using rule 139 (music_embedded)
```

```
$default  reduce using rule 14 (toplevel_expression)

$default  reduce using rule 140 (music_embedded)

$default  reduce using rule 141 (music_embedded)

$default  reduce using rule 142 (music_embedded_backup)

$default  reduce using rule 143 (music_arg)

$default  reduce using rule 144 (music_arg)

$default  reduce using rule 145 (music_assign)

$default  reduce using rule 146 (music_assign)

$default  reduce using rule 147 (repeated_music)

$default  reduce using rule 148 (repeated_music)

$default  reduce using rule 149 (repeated_music)

$default  reduce using rule 15 (toplevel_expression)

$default  reduce using rule 150 (repeated_music)

$default  reduce using rule 151 (sequential_music)

$default  reduce using rule 152 (sequential_music)

$default  reduce using rule 153 (simultaneous_music)

$default  reduce using rule 154 (simultaneous_music)

$default  reduce using rule 155 (simple_music)

$default  reduce using rule 156 (simple_music)

$default  reduce using rule 157 (simple_music)

$default  reduce using rule 158 ($@9)

$default  reduce using rule 159 (context_modification)

$default  reduce using rule 16 (toplevel_expression)

$default  reduce using rule 160 (context_modification)

$default  reduce using rule 161 (context_modification)

$default  reduce using rule 162 (context_modification)
```

```
$default  reduce using rule 163 (context_modification_arg)

$default  reduce using rule 164 (context_modification_arg)

$default  reduce using rule 165 (optional_context_mod)

$default  reduce using rule 165 (optional_context_mod)

$default  reduce using rule 165 (optional_context_mod)

$default  reduce using rule 166 (optional_context_mod)

$default  reduce using rule 167 (context_mod_list)

$default  reduce using rule 168 (context_mod_list)

$default  reduce using rule 169 (context_mod_list)

$default  reduce using rule 17 (toplevel_expression)

$default  reduce using rule 170 (context_mod_list)

$default  reduce using rule 171 (composite_music)

$default  reduce using rule 172 (composite_music)

$default  reduce using rule 173 (closed_music)

$default  reduce using rule 174 (closed_music)

$default  reduce using rule 175 (closed_music)

$default  reduce using rule 176 (music_bare)

$default  reduce using rule 177 (music_bare)

$default  reduce using rule 178 (music_bare)

$default  reduce using rule 179 (grouped_music_list)

$default  reduce using rule 18 (toplevel_expression)

$default  reduce using rule 180 (grouped_music_list)

$default  reduce using rule 181 (function_arglist_nonbackup_common)

$default  reduce using rule 182 (function_arglist_nonbackup_common)

$default  reduce using rule 183 (function_arglist_nonbackup_common)

$default  reduce using rule 184 (function_arglist_nonbackup_common)
```

```
$default  reduce using rule 185 (function_arglist_closed_nonbackup)

$default  reduce using rule 186 (function_arglist_closed_nonbackup)

$default  reduce using rule 187 (function_arglist_closed_nonbackup)

$default  reduce using rule 188 (function_arglist_closed_nonbackup)

$default  reduce using rule 189 (function_arglist_closed_nonbackup)

$default  reduce using rule 19 (toplevel_expression)

$default  reduce using rule 190 (function_arglist_closed_nonbackup)

$default  reduce using rule 191 (function_arglist_closed_nonbackup)

$default  reduce using rule 192 (symbol_list_arg)

$default  reduce using rule 193 (symbol_list_arg)

$default  reduce using rule 194 (symbol_list_rev)

$default  reduce using rule 195 (symbol_list_rev)

$default  reduce using rule 196 (symbol_list_part)

$default  reduce using rule 197 (symbol_list_element)

$default  reduce using rule 198 (symbol_list_element)

$default  reduce using rule 199 (function_arglist_nonbackup)

$default  reduce using rule 2 ($@1)

$default  reduce using rule 20 (toplevel_expression)

$default  reduce using rule 200 (function_arglist_nonbackup)

$default  reduce using rule 201 (function_arglist_nonbackup)

$default  reduce using rule 202 (function_arglist_nonbackup)

$default  reduce using rule 203 (function_arglist_nonbackup)

$default  reduce using rule 204 (function_arglist_nonbackup)

$default  reduce using rule 205 (function_arglist_nonbackup)

$default  reduce using rule 206 (function_arglist_nonbackup)

$default  reduce using rule 207 (function_arglist_nonbackup)
```

```
$default  reduce using rule 208 (function_arglist_nonbackup_reparse)

$default  reduce using rule 209 (function_arglist_nonbackup_reparse)

$default  reduce using rule 21 (embedded_scm_bare)

$default  reduce using rule 210 (function_arglist_nonbackup_reparse)

$default  reduce using rule 211 (function_arglist_nonbackup_reparse)

$default  reduce using rule 212 (function_arglist_nonbackup_reparse)

$default  reduce using rule 213 (function_arglist_backup)

$default  reduce using rule 214 (function_arglist_backup)

$default  reduce using rule 215 (function_arglist_backup)

$default  reduce using rule 216 (function_arglist_backup)

$default  reduce using rule 217 (function_arglist_backup)

$default  reduce using rule 218 (function_arglist_backup)

$default  reduce using rule 219 (function_arglist_backup)

$default  reduce using rule 22 (embedded_scm_bare)

$default  reduce using rule 220 (function_arglist_backup)

$default  reduce using rule 221 (function_arglist_backup)

$default  reduce using rule 222 (function_arglist_backup)

$default  reduce using rule 223 (function_arglist_backup)

$default  reduce using rule 224 (function_arglist_backup)

$default  reduce using rule 225 (function_arglist_backup)

$default  reduce using rule 226 (function_arglist_backup)

$default  reduce using rule 227 (function_arglist_backup)

$default  reduce using rule 228 (function_arglist_backup)

$default  reduce using rule 229 (function_arglist_backup)

$default  reduce using rule 23 (embedded_scm_active)

$default  reduce using rule 230 (function_arglist_backup)
```

```
$default  reduce using rule 231 (function_arglist_backup)

$default  reduce using rule 232 (function_arglist_backup)

$default  reduce using rule 233 (function_arglist_backup)

$default  reduce using rule 234 (function_arglist_backup)

$default  reduce using rule 235 (function_arglist_backup)

$default  reduce using rule 236 (function_arglist)

$default  reduce using rule 237 (function_arglist)

$default  reduce using rule 238 (function_arglist_skip_nonbackup)

$default  reduce using rule 238 (function_arglist_skip_nonbackup)

$default  reduce using rule 239 (function_arglist_skip_nonbackup)

$default  reduce using rule 24 (embedded_scm_active)

$default  reduce using rule 240 (function_arglist_common)

$default  reduce using rule 241 (function_arglist_common)

$default  reduce using rule 242 (function_arglist_common)

$default  reduce using rule 243 (function_arglist_common)

$default  reduce using rule 244 (function_arglist_common)

$default  reduce using rule 245 (function_arglist_common)

$default  reduce using rule 246 (function_arglist_common)

$default  reduce using rule 247 (function_arglist_common)

$default  reduce using rule 248 (function_arglist_common)

$default  reduce using rule 249 (function_arglist_common)

$default  reduce using rule 25 (embedded_scm_bare_arg)

$default  reduce using rule 250 (function_arglist_common_reparse)

$default  reduce using rule 251 (function_arglist_common_reparse)

$default  reduce using rule 252 (function_arglist_common_reparse)

$default  reduce using rule 253 (function_arglist_common_reparse)
```

```
$default  reduce using rule 254 (function_arglist_common_reparse)

$default  reduce using rule 255 (function_arglist_common_reparse)

$default  reduce using rule 256 (function_arglist_common_reparse)

$default  reduce using rule 257 (function_arglist_closed)

$default  reduce using rule 258 (function_arglist_closed)

$default  reduce using rule 259 (function_arglist_closed_common)

$default  reduce using rule 26 (embedded_scm_bare_arg)

$default  reduce using rule 260 (function_arglist_closed_common)

$default  reduce using rule 261 (function_arglist_closed_common)

$default  reduce using rule 262 (function_arglist_closed_common)

$default  reduce using rule 263 (function_arglist_closed_common)

$default  reduce using rule 264 (function_arglist_closed_common)

$default  reduce using rule 265 (function_arglist_closed_common)

$default  reduce using rule 266 (function_arglist_closed_common)

$default  reduce using rule 268 (function_arglist_optional)

$default  reduce using rule 269 (function_arglist_optional)

$default  reduce using rule 27 (embedded_scm_bare_arg)

$default  reduce using rule 270 (function_arglist_skip_backup)

$default  reduce using rule 271 (function_arglist_skip_backup)

$default  reduce using rule 271 (function_arglist_skip_backup)

$default  reduce using rule 272 (embedded_scm_closed)

$default  reduce using rule 273 (embedded_scm_closed)

$default  reduce using rule 274 (embedded_scm_arg_closed)

$default  reduce using rule 275 (embedded_scm_arg_closed)

$default  reduce using rule 276 (embedded_scm_arg_closed)

$default  reduce using rule 277 (scm_function_call_closed)
```

```
$default  reduce using rule 278 (music_function_call)

$default  reduce using rule 279 (optional_id)

$default  reduce using rule 279 (optional_id)

$default  reduce using rule 28 (embedded_scm_bare_arg)

$default  reduce using rule 280 (optional_id)

$default  reduce using rule 281 (complex_music)

$default  reduce using rule 282 (complex_music)

$default  reduce using rule 283 (complex_music)

$default  reduce using rule 284 (complex_music)

$default  reduce using rule 285 (complex_music_prefix)

$default  reduce using rule 286 (complex_music_prefix)

$default  reduce using rule 287 (mode_changed_music)

$default  reduce using rule 288 (mode_changed_music)

$default  reduce using rule 289 (mode_changing_head)

$default  reduce using rule 29 (embedded_scm_bare_arg)

$default  reduce using rule 290 (mode_changing_head)

$default  reduce using rule 291 (mode_changing_head)

$default  reduce using rule 292 (mode_changing_head)

$default  reduce using rule 293 (mode_changing_head)

$default  reduce using rule 294 (mode_changing_head_with_context)

$default  reduce using rule 295 (mode_changing_head_with_context)

$default  reduce using rule 296 (mode_changing_head_with_context)

$default  reduce using rule 297 (mode_changing_head_with_context)

$default  reduce using rule 298 ($@10)

$default  reduce using rule 299 (new_lyrics)

$default  reduce using rule 3 (start_symbol)
```

```
$default  reduce using rule 30 (embedded_scm_bare_arg)

$default  reduce using rule 300 ($@11)

$default  reduce using rule 301 (new_lyrics)

$default  reduce using rule 302 (re_rhythmed_music)

$default  reduce using rule 303 ($@12)

$default  reduce using rule 304 (re_rhythmed_music)

$default  reduce using rule 305 (context_change)

$default  reduce using rule 306 (property_path)

$default  reduce using rule 307 (property_path)

$default  reduce using rule 308 (property_operation)

$default  reduce using rule 309 (property_operation)

$default  reduce using rule 31 (embedded_scm_bare_arg)

$default  reduce using rule 310 (property_operation)

$default  reduce using rule 311 (property_operation)

$default  reduce using rule 312 (revert_arg)

$default  reduce using rule 313 (revert_arg_backup)

$default  reduce using rule 314 (revert_arg_part)

$default  reduce using rule 315 (revert_arg_part)

$default  reduce using rule 316 (revert_arg_part)

$default  reduce using rule 317 (context_def_mod)

$default  reduce using rule 318 (context_def_mod)

$default  reduce using rule 319 (context_def_mod)

$default  reduce using rule 32 (embedded_scm_bare_arg)

$default  reduce using rule 320 (context_def_mod)

$default  reduce using rule 321 (context_def_mod)

$default  reduce using rule 322 (context_def_mod)
```

```
$default  reduce using rule 323 (context_def_mod)

$default  reduce using rule 324 (context_def_mod)

$default  reduce using rule 325 (context_def_mod)

$default  reduce using rule 326 (context_mod)

$default  reduce using rule 327 (context_mod)

$default  reduce using rule 328 (context_mod)

$default  reduce using rule 329 (grob_prop_spec)

$default  reduce using rule 33 (embedded_scm_bare_arg)

$default  reduce using rule 330 (grob_prop_path)

$default  reduce using rule 331 (grob_prop_path)

$default  reduce using rule 332 (context_prop_spec)

$default  reduce using rule 333 (simple_music_property_def)

$default  reduce using rule 334 (simple_music_property_def)

$default  reduce using rule 335 (simple_music_property_def)

$default  reduce using rule 336 (simple_music_property_def)

$default  reduce using rule 337 (simple_revert_context)

$default  reduce using rule 338 (music_property_def)

$default  reduce using rule 339 (string)

$default  reduce using rule 34 (embedded_scm_bare_arg)

$default  reduce using rule 340 (string)

$default  reduce using rule 341 (simple_string)

$default  reduce using rule 342 (simple_string)

$default  reduce using rule 343 (symbol)

$default  reduce using rule 344 (symbol)

$default  reduce using rule 345 (scalar)

$default  reduce using rule 346 (scalar)
```

```
$default  reduce using rule 347 (scalar)

$default  reduce using rule 348 (scalar)

$default  reduce using rule 349 (scalar)

$default  reduce using rule 35 (embedded_scm)

$default  reduce using rule 350 (scalar)

$default  reduce using rule 351 (event_chord)

$default  reduce using rule 352 (event_chord)

$default  reduce using rule 353 (event_chord)

$default  reduce using rule 354 (event_chord)

$default  reduce using rule 355 (event_chord)

$default  reduce using rule 356 (event_chord)

$default  reduce using rule 357 (note_chord_element)

$default  reduce using rule 358 (chord_body)

$default  reduce using rule 359 (chord_body)

$default  reduce using rule 36 (embedded_scm)

$default  reduce using rule 360 (chord_body_elements)

$default  reduce using rule 361 (chord_body_elements)

$default  reduce using rule 362 (chord_body_element)

$default  reduce using rule 363 (chord_body_element)

$default  reduce using rule 364 (chord_body_element)

$default  reduce using rule 365 (music_function_chord_body)

$default  reduce using rule 366 (music_function_chord_body)

$default  reduce using rule 367 (music_function_chord_body)

$default  reduce using rule 368 (music_function_call_closed)

$default  reduce using rule 369 (event_function_event)

$default  reduce using rule 37 (embedded_scm_arg)
```

```
$default  reduce using rule 370 (command_element)

$default  reduce using rule 371 (command_event)

$default  reduce using rule 372 (post_events)

$default  reduce using rule 372 (post_events)

$default  reduce using rule 372 (post_events)

$default  reduce using rule 372 (post_events)

$default  reduce using rule 372 (post_events)

$default  reduce using rule 372 (post_events)

$default  reduce using rule 372 (post_events)

$default  reduce using rule 372 (post_events)

$default  reduce using rule 372 (post_events)

$default  reduce using rule 372 (post_events)

$default  reduce using rule 373 (post_events)

$default  reduce using rule 374 (post_event_nofinger)

$default  reduce using rule 375 (post_event_nofinger)

$default  reduce using rule 376 (post_event_nofinger)

$default  reduce using rule 377 (post_event_nofinger)

$default  reduce using rule 378 (post_event_nofinger)

$default  reduce using rule 379 (post_event_nofinger)

$default  reduce using rule 38 (embedded_scm_arg)

$default  reduce using rule 380 (post_event_nofinger)

$default  reduce using rule 381 (post_event_nofinger)

$default  reduce using rule 382 (post_event)

$default  reduce using rule 383 (post_event)

$default  reduce using rule 384 (string_number_event)

$default  reduce using rule 385 (direction_less_event)

$default  reduce using rule 386 (direction_less_event)
```

```
$default  reduce using rule 387 (direction_less_event)

$default  reduce using rule 388 (direction_less_event)

$default  reduce using rule 389 (direction_reqd_event)

$default  reduce using rule 39 (embedded_scm_arg)

$default  reduce using rule 390 (direction_reqd_event)

$default  reduce using rule 391 (octave_check)

$default  reduce using rule 391 (octave_check)

$default  reduce using rule 392 (octave_check)

$default  reduce using rule 393 (quotes)

$default  reduce using rule 393 (quotes)

$default  reduce using rule 393 (quotes)

$default  reduce using rule 393 (quotes)

$default  reduce using rule 393 (quotes)

$default  reduce using rule 394 (quotes)

$default  reduce using rule 395 (quotes)

$default  reduce using rule 396 (sup_quotes)

$default  reduce using rule 397 (sup_quotes)

$default  reduce using rule 398 (sub_quotes)

$default  reduce using rule 399 (sub_quotes)

$default  reduce using rule 4 (lilypond)

$default  reduce using rule 40 (scm_function_call)

$default  reduce using rule 400 (steno_pitch)

$default  reduce using rule 401 (steno_tonic_pitch)

$default  reduce using rule 402 (pitch)

$default  reduce using rule 403 (pitch)

$default  reduce using rule 404 (pitch_arg)
```

```
$default  reduce using rule 405 (gen_text_def)

$default  reduce using rule 406 (gen_text_def)

$default  reduce using rule 407 (gen_text_def)

$default  reduce using rule 408 (fingering)

$default  reduce using rule 409 (script_abbreviation)

$default  reduce using rule 410 (script_abbreviation)

$default  reduce using rule 411 (script_abbreviation)

$default  reduce using rule 412 (script_abbreviation)

$default  reduce using rule 413 (script_abbreviation)

$default  reduce using rule 414 (script_abbreviation)

$default  reduce using rule 415 (script_abbreviation)

$default  reduce using rule 416 (script_dir)

$default  reduce using rule 417 (script_dir)

$default  reduce using rule 418 (script_dir)

$default  reduce using rule 418 (script_dir)

$default  reduce using rule 418 (script_dir)

$default  reduce using rule 418 (script_dir)

$default  reduce using rule 418 (script_dir)

$default  reduce using rule 418 (script_dir)

$default  reduce using rule 419 (duration_length)

$default  reduce using rule 42 (embedded_lilypond)

$default  reduce using rule 420 (maybe_notemode_duration)

$default  reduce using rule 420 (maybe_notemode_duration)

$default  reduce using rule 420 (maybe_notemode_duration)

$default  reduce using rule 420 (maybe_notemode_duration)

$default  reduce using rule 420 (maybe_notemode_duration)
```

```
$default  reduce using rule 420 (maybe_notemode_duration)

$default  reduce using rule 420 (maybe_notemode_duration)

$default  reduce using rule 420 (maybe_notemode_duration)

$default  reduce using rule 420 (maybe_notemode_duration)

$default  reduce using rule 421 (maybe_notemode_duration)

$default  reduce using rule 422 (optional_notemode_duration)

$default  reduce using rule 423 (steno_duration)

$default  reduce using rule 424 (steno_duration)

$default  reduce using rule 425 (multiplied_duration)

$default  reduce using rule 426 (multiplied_duration)

$default  reduce using rule 427 (multiplied_duration)

$default  reduce using rule 428 (dots)

$default  reduce using rule 428 (dots)

$default  reduce using rule 429 (dots)

$default  reduce using rule 430 (tremolo_type)

$default  reduce using rule 431 (tremolo_type)

$default  reduce using rule 432 (bass_number)

$default  reduce using rule 433 (bass_number)

$default  reduce using rule 434 (bass_number)

$default  reduce using rule 435 (bass_number)

$default  reduce using rule 436 (figured_bass_alteration)

$default  reduce using rule 437 (figured_bass_alteration)

$default  reduce using rule 438 (figured_bass_alteration)

$default  reduce using rule 439 (bass_figure)

$default  reduce using rule 44 (embedded_lilypond)

$default  reduce using rule 440 (bass_figure)
```

```
$default  reduce using rule 441 (bass_figure)

$default  reduce using rule 442 (bass_figure)

$default  reduce using rule 443 (bass_figure)

$default  reduce using rule 444 (figured_bass_modification)

$default  reduce using rule 445 (figured_bass_modification)

$default  reduce using rule 446 (figured_bass_modification)

$default  reduce using rule 447 (figured_bass_modification)

$default  reduce using rule 448 (br_bass_figure)

$default  reduce using rule 449 (br_bass_figure)

$default  reduce using rule 45 (embedded_lilypond)

$default  reduce using rule 450 (figure_list)

$default  reduce using rule 451 (figure_list)

$default  reduce using rule 452 (figure_spec)

$default  reduce using rule 453 (optional_rest)

$default  reduce using rule 454 (optional_rest)

$default  reduce using rule 455 (simple_element)

$default  reduce using rule 456 (simple_element)

$default  reduce using rule 457 (simple_element)

$default  reduce using rule 458 (simple_chord_elements)

$default  reduce using rule 459 (simple_chord_elements)

$default  reduce using rule 46 (lilypond_header_body)

$default  reduce using rule 460 (lyric_element)

$default  reduce using rule 461 (lyric_element)

$default  reduce using rule 462 (lyric_element)

$default  reduce using rule 463 (lyric_element_music)

$default  reduce using rule 465 (new_chord)
```

```
$default  reduce using rule 466 (chord_items)

$default  reduce using rule 467 (chord_items)

$default  reduce using rule 468 (chord_separator)

$default  reduce using rule 469 (chord_separator)

$default  reduce using rule 47 (lilypond_header_body)

$default  reduce using rule 470 (chord_separator)

$default  reduce using rule 471 (chord_separator)

$default  reduce using rule 472 (chord_item)

$default  reduce using rule 473 (chord_item)

$default  reduce using rule 474 (chord_item)

$default  reduce using rule 475 (step_numbers)

$default  reduce using rule 476 (step_numbers)

$default  reduce using rule 477 (step_number)

$default  reduce using rule 478 (step_number)

$default  reduce using rule 479 (step_number)

$default  reduce using rule 48 (lilypond_header_body)

$default  reduce using rule 480 (tempo_range)

$default  reduce using rule 481 (tempo_range)

$default  reduce using rule 482 (number_expression)

$default  reduce using rule 483 (number_expression)

$default  reduce using rule 484 (number_expression)

$default  reduce using rule 485 (number_term)

$default  reduce using rule 486 (number_term)

$default  reduce using rule 487 (number_term)

$default  reduce using rule 488 (number_factor)

$default  reduce using rule 489 (number_factor)
```

```
$default  reduce using rule 49 (lilypond_header)

$default  reduce using rule 490 (bare_number_common)

$default  reduce using rule 491 (bare_number_common)

$default  reduce using rule 492 (bare_number_common_closed)

$default  reduce using rule 492 (bare_number_common_closed)

$default  reduce using rule 493 (bare_number_common_closed)

$default  reduce using rule 494 (bare_number)

$default  reduce using rule 495 (bare_number)

$default  reduce using rule 496 (bare_number)

$default  reduce using rule 497 (bare_number_closed)

$default  reduce using rule 498 (bare_number_closed)

$default  reduce using rule 499 (unsigned_number)

$default  reduce using rule 5 (lilypond)

$default  reduce using rule 50 (assignment_id)

$default  reduce using rule 500 (unsigned_number)

$default  reduce using rule 501 (unsigned_number)

$default  reduce using rule 502 (exclamations)

$default  reduce using rule 502 (exclamations)

$default  reduce using rule 503 (exclamations)

$default  reduce using rule 504 (questions)

$default  reduce using rule 504 (questions)

$default  reduce using rule 505 (questions)

$default  reduce using rule 506 ($@13)

$default  reduce using rule 507 (full_markup_list)

$default  reduce using rule 508 ($@14)

$default  reduce using rule 509 (full_markup)
```

```
$default  reduce using rule 51 (assignment)

$default  reduce using rule 510 (markup_top)

$default  reduce using rule 511 (markup_top)

$default  reduce using rule 512 (markup_top)

$default  reduce using rule 513 ($@15)

$default  reduce using rule 514 (markup_scm)

$default  reduce using rule 515 (markup_list)

$default  reduce using rule 516 (markup_list)

$default  reduce using rule 517 (markup_uncomposed_list)

$default  reduce using rule 518 (markup_uncomposed_list)

$default  reduce using rule 519 (markup_uncomposed_list)

$default  reduce using rule 52 (assignment)

$default  reduce using rule 520 (markup_composed_list)

$default  reduce using rule 521 (markup_braced_list)

$default  reduce using rule 522 (markup_braced_list_body)

$default  reduce using rule 523 (markup_braced_list_body)

$default  reduce using rule 524 (markup_braced_list_body)

$default  reduce using rule 525 (markup_command_list)

$default  reduce using rule 526 (markup_command_basic_arguments)

$default  reduce using rule 527 (markup_command_basic_arguments)

$default  reduce using rule 528 (markup_command_basic_arguments)

$default  reduce using rule 529 (markup_command_list_arguments)

$default  reduce using rule 53 (assignment)

$default  reduce using rule 530 (markup_command_list_arguments)

$default  reduce using rule 531 (markup_head_1_item)

$default  reduce using rule 532 (markup_head_1_list)
```

```
$default  reduce using rule 533 (markup_head_1_list)

$default  reduce using rule 534 (simple_markup)

$default  reduce using rule 535 ($@16)

$default  reduce using rule 536 (simple_markup)

$default  reduce using rule 537 (simple_markup)

$default  reduce using rule 538 (simple_markup)

$default  reduce using rule 539 (markup)

$default  reduce using rule 54 (identifier_init)

$default  reduce using rule 540 (markup)

$default  reduce using rule 55 (identifier_init)

$default  reduce using rule 56 (identifier_init)

$default  reduce using rule 57 (identifier_init)

$default  reduce using rule 58 (identifier_init)

$default  reduce using rule 59 (identifier_init)

$default  reduce using rule 6 (lilypond)

$default  reduce using rule 60 (identifier_init)

$default  reduce using rule 61 (identifier_init)

$default  reduce using rule 62 (identifier_init)

$default  reduce using rule 63 (identifier_init)

$default  reduce using rule 64 (identifier_init)

$default  reduce using rule 65 (identifier_init)

$default  reduce using rule 66 (identifier_init)

$default  reduce using rule 67 (context_def_spec_block)

$default  reduce using rule 68 (context_mod_arg)

$default  reduce using rule 69 ($@3)

$default  reduce using rule 69 ($@3)
```

```
$default  reduce using rule 7 (lilypond)

$default  reduce using rule 70 (context_mod_arg)

$default  reduce using rule 71 (context_mod_embedded)

$default  reduce using rule 72 (context_def_spec_body)

$default  reduce using rule 73 (context_def_spec_body)

$default  reduce using rule 74 (context_def_spec_body)

$default  reduce using rule 75 (context_def_spec_body)

$default  reduce using rule 76 (context_def_spec_body)

$default  reduce using rule 77 (book_block)

$default  reduce using rule 78 (book_body)

$default  reduce using rule 79 (book_body)

$default  reduce using rule 8 (lilypond)

$default  reduce using rule 80 (book_body)

$default  reduce using rule 81 (book_body)

$default  reduce using rule 82 (book_body)

$default  reduce using rule 83 (book_body)

$default  reduce using rule 84 (book_body)

$default  reduce using rule 85 (book_body)

$default  reduce using rule 86 (book_body)

$default  reduce using rule 87 (book_body)

$default  reduce using rule 89 (book_body)

$default  reduce using rule 90 (book_body)

$default  reduce using rule 91 (bookpart_block)

$default  reduce using rule 92 (bookpart_body)

$default  reduce using rule 93 (bookpart_body)

$default  reduce using rule 94 (bookpart_body)
```

```
    $default  reduce using rule 95 (bookpart_body)

    $default  reduce using rule 96 (bookpart_body)

    $default  reduce using rule 97 (bookpart_body)

    $default  reduce using rule 98 (bookpart_body)

    $default  reduce using rule 99 (bookpart_body)

    '!'  shift, and go to state 440

    '!'  shift, and go to state 440

    '*'  shift, and go to state 320
    '/'  shift, and go to state 321

    '*'  shift, and go to state 425

    '*'  shift, and go to state 425

    ','  shift, and go to state 428

    '-'  shift, and go to state 318
    '+'  shift, and go to state 319

    '-'  shift, and go to state 667

    '.'  shift, and go to state 376

    '.'  shift, and go to state 376

    '.'  shift, and go to state 376

    '.'  shift, and go to state 575

    '.'  shift, and go to state 575

    '.'  shift, and go to state 641

    '.'  shift, and go to state 720

    '='  shift, and go to state 331

    '='  shift, and go to state 331

    '='  shift, and go to state 378

    '='  shift, and go to state 389

    '='  shift, and go to state 393
```

```
    '='  shift, and go to state 398

    '='  shift, and go to state 403

    '='  shift, and go to state 527

    '='  shift, and go to state 576

    '='  shift, and go to state 599
    '?'  shift, and go to state 600

    '='  shift, and go to state 599
    '?'  shift, and go to state 600

    '='  shift, and go to state 663

    '='  shift, and go to state 712

    '\''  shift, and go to state 280
    ','   shift, and go to state 281

    '\''  shift, and go to state 280
    ','   shift, and go to state 281

    '\''  shift, and go to state 280
    ','   shift, and go to state 281

    '\''  shift, and go to state 280
    ','   shift, and go to state 281

    '\''  shift, and go to state 280
    ','   shift, and go to state 281

    '\''  shift, and go to state 427

    '{'  shift, and go to state 167

    '{'  shift, and go to state 168

    '{'  shift, and go to state 175

    '{'  shift, and go to state 201

    '{'  shift, and go to state 370

    '{'  shift, and go to state 40

    '{'  shift, and go to state 40

    '{'  shift, and go to state 40
```

```
'{'  shift, and go to state 40

'{'  shift, and go to state 405

'{'  shift, and go to state 605

0 $accept:  .  start_symbol "end of input"

0 $accept:  start_symbol "end of input" .

0 $accept:  start_symbol .  "end of input"

3 start_symbol:  "#{" $@1 .  embedded_lilypond

3 start_symbol:  "#{" $@1 embedded_lilypond .

3 start_symbol:  "#{" .  $@1 embedded_lilypond

5 lilypond:  lilypond toplevel_expression .

6 lilypond:  lilypond assignment .

7 lilypond:  lilypond error .

8 lilypond:  lilypond "\version-error" .

book_body  go to state 328

BOOK_IDENTIFIER  shift, and go to state 327

BOOK_IDENTIFIER  shift, and go to state 329

bookpart_body  go to state 330

braced_music_list  go to state 176

braced_music_list  go to state 177

braced_music_list  go to state 448

braced_music_list  go to state 681

chord_body_elements  go to state 271

chord_items  go to state 598

chord_separator  go to state 439

CONTEXT_DEF_IDENTIFIER  shift, and go to state 390

context_def_spec_body  go to state 391
```

```
context_mod_list  go to state 579

dots  go to state 399

dots  go to state 400

dots  go to state 400

exclamations  go to state 297

exclamations  go to state 581

figure_list  go to state 272

fingering  go to state 215

fingering  go to state 216

fingering  go to state 595

lilypond_header  go to state 192

lilypond_header  go to state 603

lilypond_header  go to state 604

lilypond_header  go to state 616

lilypond_header  go to state 617

lilypond_header_body  go to state 526

markup_braced_list_body  go to state 484

markup_command_basic_arguments  go to state 480

MARKUP_IDENTIFIER  shift, and go to state 486

MARKUPLIST_IDENTIFIER  shift, and go to state 487

music_list  go to state 179

music_list  go to state 190

music_list  go to state 429

new_lyrics  go to state 208

new_lyrics  go to state 208

new_lyrics  go to state 208
```

```
new_lyrics  go to state 208

new_lyrics  go to state 208

new_lyrics  go to state 208

new_lyrics  go to state 208

new_lyrics  go to state 208

new_lyrics  go to state 208

NUMBER_IDENTIFIER  shift, and go to state 225

NUMBER_IDENTIFIER  shift, and go to state 226

NUMBER_IDENTIFIER  shift, and go to state 226

octave_check  go to state 601

octave_check  go to state 717

optional_id  go to state 332

optional_id  go to state 357

optional_rest  go to state 722

OUTPUT_DEF_IDENTIFIER  shift, and go to state 379

post_events  go to state 294

post_events  go to state 315

post_events  go to state 316

post_events  go to state 424

post_events  go to state 426

post_events  go to state 431

post_events  go to state 443

post_events  go to state 580

post_events  go to state 731

questions  go to state 441

questions  go to state 672
```

```
start_symbol  go to state 2
lilypond      go to state 3

steno_duration  go to state 402

steno_tonic_pitch  go to state 596

steno_tonic_pitch  go to state 597

step_number  go to state 732

symbol_list_arg  go to state 665

TONICNAME_PITCH  shift, and go to state 106

TONICNAME_PITCH  shift, and go to state 106

UNSIGNED  shift, and go to state 213

UNSIGNED  shift, and go to state 214

UNSIGNED  shift, and go to state 214

UNSIGNED  shift, and go to state 214

UNSIGNED  shift, and go to state 673
10 toplevel_expression:  $@2 .  lilypond_header
10 toplevel_expression:  $@2 lilypond_header .
11 toplevel_expression:  book_block .
12 toplevel_expression:  bookpart_block .
13 toplevel_expression:  BOOK_IDENTIFIER .
14 toplevel_expression:  score_block .
15 toplevel_expression:  composite_music .
16 toplevel_expression:  full_markup .
17 toplevel_expression:  full_markup_list .
18 toplevel_expression:  SCM_TOKEN .
19 toplevel_expression:  embedded_scm_active .
20 toplevel_expression:  output_def .
21 embedded_scm_bare:  SCM_TOKEN .
22 embedded_scm_bare:  SCM_IDENTIFIER .
23 embedded_scm_active:  SCM_IDENTIFIER .
24 embedded_scm_active:  scm_function_call .
25 embedded_scm_bare_arg:  SCM_ARG .
26 embedded_scm_bare_arg:  SCM_TOKEN .
27 embedded_scm_bare_arg:  FRACTION .
28 embedded_scm_bare_arg:  full_markup_list .
29 embedded_scm_bare_arg:  context_modification .
30 embedded_scm_bare_arg:  score_block .
31 embedded_scm_bare_arg:  context_def_spec_block .
32 embedded_scm_bare_arg:  book_block .
33 embedded_scm_bare_arg:  bookpart_block .
34 embedded_scm_bare_arg:  output_def .
```

```
35 embedded_scm:  embedded_scm_bare .
35 embedded_scm:  embedded_scm_bare .
36 embedded_scm:  scm_function_call .
37 embedded_scm_arg:  embedded_scm_bare_arg .
38 embedded_scm_arg:  scm_function_call .
39 embedded_scm_arg:  music_assign .
40 scm_function_call:  SCM_FUNCTION . function_arglist
40 scm_function_call:  SCM_FUNCTION function_arglist .
42 embedded_lilypond:  identifier_init .
43 embedded_lilypond:  music_embedded .  music_embedded music_list
43 embedded_lilypond:  music_embedded music_embedded .  music_list
43 embedded_lilypond:  music_embedded music_embedded music_list .
44 embedded_lilypond:  error .
45 embedded_lilypond:  "\version-error" .  embedded_lilypond
45 embedded_lilypond:  "\version-error" embedded_lilypond .
47 lilypond_header_body:  lilypond_header_body .  assignment
47 lilypond_header_body:  lilypond_header_body assignment .
48                     | lilypond_header_body .  embedded_scm
48 lilypond_header_body:  lilypond_header_body embedded_scm .
49 lilypond_header:  "\header" '{' .  lilypond_header_body '}'
49 lilypond_header:  "\header" '{' lilypond_header_body '}' .
49 lilypond_header:  "\header" '{' lilypond_header_body .  '}'
49 lilypond_header:  "\header" .  '{' lilypond_header_body '}'
50 assignment_id:  STRING .
51 assignment:  assignment_id '=' .  identifier_init
51 assignment:  assignment_id '=' identifier_init .
51 assignment:  assignment_id .  '=' identifier_init
52           | assignment_id .  property_path '=' identifier_init
52 assignment:  assignment_id property_path '=' .  identifier_init
52 assignment:  assignment_id property_path '=' identifier_init .
52 assignment:  assignment_id property_path .  '=' identifier_init
53           | assignment_id .  '.' property_path '=' identifier_init
53 assignment:  assignment_id '.' .  property_path '=' identifier_init
53 assignment:  assignment_id '.' property_path '=' .  identifier_init
53 assignment:  assignment_id '.' property_path '=' identifier_init .
53 assignment:  assignment_id '.' property_path .  '=' identifier_init
54 identifier_init:  score_block .
55 identifier_init:  book_block .
56 identifier_init:  bookpart_block .
57 identifier_init:  output_def .
58 identifier_init:  context_def_spec_block .
59 identifier_init:  music_assign .
60 identifier_init:  post_event_nofinger .  post_events
60 identifier_init:  post_event_nofinger post_events .
61 identifier_init:  number_expression .
62 identifier_init:  FRACTION .
63 identifier_init:  string .
64 identifier_init:  embedded_scm .
64 identifier_init:  embedded_scm .
65 identifier_init:  full_markup_list .
66 identifier_init:  context_modification .
67 context_def_spec_block:  "\context" '{' .  context_def_spec_body '}'
```

```
67 context_def_spec_block:  "\context" '{' context_def_spec_body '}' .
67 context_def_spec_block:  "\context" '{' context_def_spec_body .  '}'
67 context_def_spec_block:  "\context" .  '{' context_def_spec_body '}'
68 context_mod_arg:  embedded_scm .
70 context_mod_arg:  $@3 .  composite_music
70 context_mod_arg:  $@3 composite_music .
71 context_mod_embedded:  context_mod_arg .
73 context_def_spec_body:  CONTEXT_DEF_IDENTIFIER .
74 context_def_spec_body:  context_def_spec_body .  context_mod
74 context_def_spec_body:  context_def_spec_body context_mod .
75                       | context_def_spec_body .  context_modification
75 context_def_spec_body:  context_def_spec_body context_modification .
76                       | context_def_spec_body .  context_mod_embedded
76 context_def_spec_body:  context_def_spec_body context_mod_embedded .
77 book_block:  "\book" '{' .  book_body '}'
77 book_block:  "\book" '{' book_body '}' .
77 book_block:  "\book" '{' book_body .  '}'
77 book_block:  "\book" .  '{' book_body '}'
79 book_body:  BOOK_IDENTIFIER .
80 book_body:  book_body .  paper_block
80 book_body:  book_body paper_block .
81          | book_body .  bookpart_block
81 book_body:  book_body bookpart_block .
82          | book_body .  score_block
82 book_body:  book_body score_block .
83          | book_body .  composite_music
83 book_body:  book_body composite_music .
84          | book_body .  full_markup
84 book_body:  book_body full_markup .
85          | book_body .  full_markup_list
85 book_body:  book_body full_markup_list .
86          | book_body .  SCM_TOKEN
86 book_body:  book_body SCM_TOKEN .
87          | book_body .  embedded_scm_active
87 book_body:  book_body embedded_scm_active .
89          | book_body .  $@4 lilypond_header
89 book_body:  book_body $@4 .  lilypond_header
89 book_body:  book_body $@4 lilypond_header .
90          | book_body .  error
90 book_body:  book_body error .
91 bookpart_block:  "\bookpart" '{' .  bookpart_body '}'
91 bookpart_block:  "\bookpart" '{' bookpart_body '}' .
91 bookpart_block:  "\bookpart" '{' bookpart_body .  '}'
91 bookpart_block:  "\bookpart" .  '{' bookpart_body '}'
93 bookpart_body:  BOOK_IDENTIFIER .
94 bookpart_body:  bookpart_body .  paper_block
94 bookpart_body:  bookpart_body paper_block .
95              | bookpart_body .  score_block
95 bookpart_body:  bookpart_body score_block .
96              | bookpart_body .  composite_music
96 bookpart_body:  bookpart_body composite_music .
97              | bookpart_body .  full_markup
```

```
 97 bookpart_body:  bookpart_body full_markup .
 98               | bookpart_body .  full_markup_list
 98 bookpart_body:  bookpart_body full_markup_list .
 99               | bookpart_body .  SCM_TOKEN
 99 bookpart_body:  bookpart_body SCM_TOKEN .
100               | bookpart_body .  embedded_scm_active
100 bookpart_body:  bookpart_body embedded_scm_active .
102               | bookpart_body .  $@5 lilypond_header
102 bookpart_body:  bookpart_body $@5 .  lilypond_header
102 bookpart_body:  bookpart_body $@5 lilypond_header .
103               | bookpart_body .  error
103 bookpart_body:  bookpart_body error .
104 score_block:  "\score" '{' .  score_body '}'
104 score_block:  "\score" '{' score_body '}' .
104 score_block:  "\score" '{' score_body .  '}'
104 score_block:  "\score" .  '{' score_body '}'
107 score_headers:  score_headers $@6 .  lilypond_header
107 score_headers:  score_headers $@6 lilypond_header .
107 score_headers:  score_headers .  $@6 lilypond_header
108               | score_headers .  output_def
108 score_headers:  score_headers output_def .
109 score_body:  score_headers .  music
109 score_body:  score_headers music .
110 score_body:  embedded_scm_active .
112 score_body:  score_body $@7 .  lilypond_header
112 score_body:  score_body $@7 lilypond_header .
112 score_body:  score_body .  $@7 lilypond_header
112 score_body:  score_body .  $@7 lilypond_header
113            | score_body .  output_def
113            | score_body .  output_def
113 score_body:  score_body output_def .
114            | score_body .  error
114            | score_body .  error
114 score_body:  score_body error .
115 paper_block:  output_def .
116 output_def:  output_def_body '}' .
116 output_def:  output_def_body .  '}'
117 output_def_head:  "\paper" .
118 output_def_head:  "\midi" .
119 output_def_head:  "\layout" .
120 output_def_head_with_mode_switch:  output_def_head .
121 music_or_context_def:  music_arg .
122 music_or_context_def:  context_def_spec_block .
123 output_def_body:  output_def_head_with_mode_switch '{' .
123 output_def_body:  output_def_head_with_mode_switch .  '{'
124                 | output_def_head_with_mode_switch
                      '{'
                      .
                      OUTPUT_DEF_IDENTIFIER
124                 | output_def_head_with_mode_switch
                      .
                      '{'
```

```
                      OUTPUT_DEF_IDENTIFIER
124 output_def_body:  output_def_head_with_mode_switch
                      '{'
                      OUTPUT_DEF_IDENTIFIER
                      .
125 output_def_body:  output_def_body .  assignment
125 output_def_body:  output_def_body assignment .
126                 | output_def_body .  embedded_scm
126 output_def_body:  output_def_body embedded_scm .
128                 | output_def_body .  $@8 music_or_context_def
128 output_def_body:  output_def_body $@8 .  music_or_context_def
128 output_def_body:  output_def_body $@8 music_or_context_def .
129                 | output_def_body .  error
129 output_def_body:  output_def_body error .
130 tempo_event:  "\tempo" .  steno_duration '=' tempo_range
130 tempo_event:  "\tempo" steno_duration '=' .  tempo_range
130 tempo_event:  "\tempo" steno_duration '=' tempo_range .
130 tempo_event:  "\tempo" steno_duration .  '=' tempo_range
131             | "\tempo" .  scalar steno_duration '=' tempo_range
131 tempo_event:  "\tempo" scalar .  steno_duration '=' tempo_range
131 tempo_event:  "\tempo" scalar steno_duration '=' .  tempo_range
131 tempo_event:  "\tempo" scalar steno_duration '=' tempo_range .
131 tempo_event:  "\tempo" scalar steno_duration .  '=' tempo_range
132             | "\tempo" .  scalar
132             | "\tempo" scalar .
134 music_list:  music_list .  music_embedded
134 music_list:  music_list .  music_embedded
134 music_list:  music_list .  music_embedded
134 music_list:  music_list music_embedded .
135            | music_list .  error
135            | music_list .  error
135            | music_list .  error
135 music_list:  music_list error .
136 braced_music_list:  '{' .  music_list '}'
136 braced_music_list:  '{' music_list '}' .
136 braced_music_list:  '{' music_list .  '}'
137 music:  music_arg .
138 music:  lyric_element_music .
139 music_embedded:  music .
140 music_embedded:  music_embedded_backup .
141                | music_embedded_backup
                       .
                       "(backed-up?)"
                       lyric_element_music
141 music_embedded:  music_embedded_backup
                       "(backed-up?)"
                       .
                       lyric_element_music
141 music_embedded:  music_embedded_backup
                       "(backed-up?)"
                       lyric_element_music
                       .
```

```
142 music_embedded_backup:  embedded_scm .
142 music_embedded_backup:  embedded_scm .
143 music_arg:  simple_music .
143 music_arg:  simple_music .
144 music_arg:  composite_music .
144 music_arg:  composite_music .
145 music_assign:  simple_music .
145 music_assign:  simple_music .
146 music_assign:  composite_music .
146 music_assign:  composite_music .
147 repeated_music:  "\repeat" .  simple_string unsigned_number music
147 repeated_music:  "\repeat" simple_string .  unsigned_number music
147 repeated_music:  "\repeat" simple_string unsigned_number .  music
147 repeated_music:  "\repeat" simple_string unsigned_number music .
148 repeated_music:  REPEAT_IDENTIFIER . music
148 repeated_music:  REPEAT_IDENTIFIER music .
149               | "\repeat"
                      .
                      simple_string
                      unsigned_number
                      music
                      "\alternative"
                      braced_music_list
149               | "\repeat"
                      simple_string
                      .
                      unsigned_number
                      music
                      "\alternative"
                      braced_music_list
149               | "\repeat"
                      simple_string
                      unsigned_number
                      .
                      music
                      "\alternative"
                      braced_music_list
149               | "\repeat"
                      simple_string
                      unsigned_number
                      music
                      .
                      "\alternative"
                      braced_music_list
149 repeated_music:  "\repeat"
                      simple_string
                      unsigned_number
                      music
                      "\alternative"
                      .
                      braced_music_list
149 repeated_music:  "\repeat"
```

```
                      simple_string
                      unsigned_number
                      music
                      "\alternative"
                      braced_music_list
                      .
150                | REPEAT_IDENTIFIER
                      .
                      music
                      "\alternative"
                      braced_music_list
150                | REPEAT_IDENTIFIER
                      music
                      .
                      "\alternative"
                      braced_music_list
150 repeated_music:  REPEAT_IDENTIFIER
                      music
                      "\alternative"
                      .
                      braced_music_list
150 repeated_music:  REPEAT_IDENTIFIER
                      music
                      "\alternative"
                      braced_music_list
                      .
151 sequential_music:  "\sequential" .  braced_music_list
151 sequential_music:  "\sequential" braced_music_list .
152 sequential_music:  braced_music_list .
153 simultaneous_music:  "\simultaneous" .  braced_music_list
153 simultaneous_music:  "\simultaneous" braced_music_list .
154 simultaneous_music:  "<<" .  music_list ">>"
154 simultaneous_music:  "<<" music_list ">>" .
154 simultaneous_music:  "<<" music_list .  ">>"
155 simple_music:  event_chord .
156 simple_music:  music_property_def .
157 simple_music:  context_change .
159 context_modification:  "\with" $@9 '{' .  context_mod_list '}'
159 context_modification:  "\with" $@9 '{' context_mod_list '}' .
159 context_modification:  "\with" $@9 '{' context_mod_list .  '}'
159 context_modification:  "\with" $@9 .  '{' context_mod_list '}'
159 context_modification:  "\with" .  $@9 '{' context_mod_list '}'
160                     | "\with" .  CONTEXT_MOD_IDENTIFIER
160 context_modification:  "\with" CONTEXT_MOD_IDENTIFIER .
161 context_modification:  CONTEXT_MOD_IDENTIFIER .
162                     | "\with" .  context_modification_arg
162 context_modification:  "\with" context_modification_arg .
163 context_modification_arg:  embedded_scm_closed .
164 context_modification_arg:  MUSIC_IDENTIFIER .
166 optional_context_mod:  context_modification .
168 context_mod_list:  context_mod_list .  context_mod
168 context_mod_list:  context_mod_list context_mod .
```

```
169                 | context_mod_list .  CONTEXT_MOD_IDENTIFIER
169 context_mod_list:  context_mod_list CONTEXT_MOD_IDENTIFIER .
170                 | context_mod_list .  context_mod_embedded
170 context_mod_list:  context_mod_list context_mod_embedded .
171 composite_music:  complex_music .
172 composite_music:  music_bare .
173 closed_music:  music_bare .
174 closed_music:  complex_music_prefix .  closed_music
174 closed_music:  complex_music_prefix closed_music .
175 closed_music:  music_function_call_closed .
176 music_bare:  mode_changed_music .
177 music_bare:  MUSIC_IDENTIFIER .
178 music_bare:  grouped_music_list .
179 grouped_music_list:  simultaneous_music .
180 grouped_music_list:  sequential_music .
181 function_arglist_nonbackup_common:  "optional?"
                                        "scheme?"
                                        .
                                        function_arglist_nonbackup
                                        post_event_nofinger
181 function_arglist_nonbackup_common:  "optional?"
                                        "scheme?"
                                        .
                                        function_arglist_nonbackup
                                        post_event_nofinger
181 function_arglist_nonbackup_common:  "optional?"
                                        "scheme?"
                                        .
                                        function_arglist_nonbackup
                                        post_event_nofinger
181 function_arglist_nonbackup_common:  "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        .
                                        post_event_nofinger
181 function_arglist_nonbackup_common:  "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        .
                                        post_event_nofinger
181 function_arglist_nonbackup_common:  "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        post_event_nofinger
                                        .
181 function_arglist_nonbackup_common:  "optional?"
                                        .
                                        "scheme?"
                                        function_arglist_nonbackup
                                        post_event_nofinger
181 function_arglist_nonbackup_common:  "optional?"
                                        .
```

```
                                        "scheme?"
                                        function_arglist_nonbackup
                                        post_event_nofinger
181 function_arglist_nonbackup_common:  "optional?"
                                        .
                                        "scheme?"
                                        function_arglist_nonbackup
                                        post_event_nofinger
182                                   | "optional?"
                                        "scheme?"
                                        .
                                        function_arglist_nonbackup
                                        '-'
                                        UNSIGNED
182                                   | "optional?"
                                        "scheme?"
                                        .
                                        function_arglist_nonbackup
                                        '-'
                                        UNSIGNED
182                                   | "optional?"
                                        "scheme?"
                                        .
                                        function_arglist_nonbackup
                                        '-'
                                        UNSIGNED
182                                   | "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        .
                                        '-'
                                        UNSIGNED
182                                   | "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        .
                                        '-'
                                        UNSIGNED
182                                   | "optional?"
                                        .
                                        "scheme?"
                                        function_arglist_nonbackup
                                        '-'
                                        UNSIGNED
182                                   | "optional?"
                                        .
                                        "scheme?"
                                        function_arglist_nonbackup
                                        '-'
                                        UNSIGNED
182                                   | "optional?"
                                        .
```

```
                                        "scheme?"
                                        function_arglist_nonbackup
                                        '-'
                                        UNSIGNED
182 function_arglist_nonbackup_common:  "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        '-'
                                        .
                                        UNSIGNED
182 function_arglist_nonbackup_common:  "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        '-'
                                        UNSIGNED
                                        .
183                                   | "optional?"
                                        "scheme?"
                                        .
                                        function_arglist_nonbackup
                                        '-'
                                        REAL
183                                   | "optional?"
                                        "scheme?"
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                                        function_arglist_nonbackup
                                        '-'
                                        REAL
183                                   | "optional?"
                                        "scheme?"
                                        .
                                        function_arglist_nonbackup
                                        '-'
                                        REAL
183                                   | "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        '-'
                                        .
                                        REAL
183                                   | "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        .
                                        '-'
                                        REAL
183                                   | "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        .
                                        '-'
                                        REAL
```

```
183                                  | "optional?"
                                       .
                                       "scheme?"
                                       function_arglist_nonbackup
                                       '-'
                                       REAL
183                                  | "optional?"
                                       .
                                       "scheme?"
                                       function_arglist_nonbackup
                                       '-'
                                       REAL
183                                  | "optional?"
                                       .
                                       "scheme?"
                                       function_arglist_nonbackup
                                       '-'
                                       REAL
183 function_arglist_nonbackup_common:  "optional?"
                                       "scheme?"
                                       function_arglist_nonbackup
                                       '-'
                                       REAL
                                       .
184                                  | "optional?"
                                       "scheme?"
                                       .
                                       function_arglist_nonbackup
                                       '-'
                                       NUMBER_IDENTIFIER
184                                  | "optional?"
                                       "scheme?"
                                       .
                                       function_arglist_nonbackup
                                       '-'
                                       NUMBER_IDENTIFIER
184                                  | "optional?"
                                       "scheme?"
                                       .
                                       function_arglist_nonbackup
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184                                  | "optional?"
                                       "scheme?"
                                       function_arglist_nonbackup
                                       '-'
                                       .
                                       NUMBER_IDENTIFIER
184                                  | "optional?"
                                       "scheme?"
                                       function_arglist_nonbackup
                                       .
```

```
                                    '-'
                                    NUMBER_IDENTIFIER
184                               | "optional?"
                                    "scheme?"
                                    function_arglist_nonbackup
                                    .
                                    '-'
                                    NUMBER_IDENTIFIER
184                               | "optional?"
                                    .
                                    "scheme?"
                                    function_arglist_nonbackup
                                    '-'
                                    NUMBER_IDENTIFIER
184                               | "optional?"
                                    .
                                    "scheme?"
                                    function_arglist_nonbackup
                                    '-'
                                    NUMBER_IDENTIFIER
184                               | "optional?"
                                    .
                                    "scheme?"
                                    function_arglist_nonbackup
                                    '-'
                                    NUMBER_IDENTIFIER
184 function_arglist_nonbackup_common:  "optional?"
                                    "scheme?"
                                    function_arglist_nonbackup
                                    '-'
                                    NUMBER_IDENTIFIER
                                    .
185 function_arglist_closed_nonbackup:  function_arglist_nonbackup_common .
186 function_arglist_closed_nonbackup:  function_arglist_closed_common .
187 function_arglist_closed_nonbackup:  "optional?"
                                    "scheme?"
                                    .
                                    function_arglist_nonbackup
                                    embedded_scm_arg_closed
187 function_arglist_closed_nonbackup:  "optional?"
                                    "scheme?"
                                    function_arglist_nonbackup
                                    .
                                    embedded_scm_arg_closed
187 function_arglist_closed_nonbackup:  "optional?"
                                    "scheme?"
                                    function_arglist_nonbackup
                                    embedded_scm_arg_closed
                                    .
187 function_arglist_closed_nonbackup:  "optional?"
                                    .
                                    "scheme?"
```

```
                                        function_arglist_nonbackup
                                        embedded_scm_arg_closed
  188                                 | "optional?"
                                        "scheme?"
                                        .
                                        function_arglist_nonbackup
                                        bare_number_closed
  188                                 | "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        .
                                        bare_number_closed
  188                                 | "optional?"
                                        .
                                        "scheme?"
                                        function_arglist_nonbackup
                                        bare_number_closed
  188 function_arglist_closed_nonbackup:  "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        bare_number_closed
                                        .
  189                                 | "optional?"
                                        "scheme?"
                                        .
                                        function_arglist_nonbackup
                                        SCM_IDENTIFIER
  189                                 | "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        .
                                        SCM_IDENTIFIER
  189                                 | "optional?"
                                        .
                                        "scheme?"
                                        function_arglist_nonbackup
                                        SCM_IDENTIFIER
  189 function_arglist_closed_nonbackup:  "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        SCM_IDENTIFIER
                                        .
  190                                 | "optional?"
                                        "scheme?"
                                        .
                                        function_arglist_nonbackup
                                        STRING
  190                                 | "optional?"
                                        "scheme?"
                                        function_arglist_nonbackup
                                        .
                                        STRING
```

```
190                                   | "optional?"
                                          .
                                          "scheme?"
                                          function_arglist_nonbackup
                                          STRING
190 function_arglist_closed_nonbackup:  "optional?"
                                          "scheme?"
                                          function_arglist_nonbackup
                                          STRING
                                          .
191                                   | "optional?"
                                          "scheme?"
                                          .
                                          function_arglist_nonbackup
                                          full_markup
191                                   | "optional?"
                                          "scheme?"
                                          function_arglist_nonbackup
                                          .
                                          full_markup
191                                   | "optional?"
                                          .
                                          "scheme?"
                                          function_arglist_nonbackup
                                          full_markup
191 function_arglist_closed_nonbackup:  "optional?"
                                          "scheme?"
                                          function_arglist_nonbackup
                                          full_markup
                                          .
192 symbol_list_arg:  SYMBOL_LIST .
193                 | SYMBOL_LIST . '.' symbol_list_rev
193 symbol_list_arg:  SYMBOL_LIST '.' .  symbol_list_rev
193 symbol_list_arg:  SYMBOL_LIST '.' symbol_list_rev .
194 symbol_list_rev:  symbol_list_part .
195 symbol_list_rev:  symbol_list_rev '.' .  symbol_list_part
195 symbol_list_rev:  symbol_list_rev '.' symbol_list_part .
195 symbol_list_rev:  symbol_list_rev .  '.' symbol_list_part
195 symbol_list_rev:  symbol_list_rev .  '.' symbol_list_part
195 symbol_list_rev:  symbol_list_rev .  '.' symbol_list_part
195 symbol_list_rev:  symbol_list_rev .  '.' symbol_list_part
196 symbol_list_part:  symbol_list_element .
197 symbol_list_element:  STRING .
198 symbol_list_element:  embedded_scm_bare .
199 function_arglist_nonbackup:  function_arglist_nonbackup_common .
200 function_arglist_nonbackup:  function_arglist_common .
201 function_arglist_nonbackup:  "optional?"
                                  "scheme?"
                                  .
                                  function_arglist_nonbackup
                                  embedded_scm_arg
201 function_arglist_nonbackup:  "optional?"
```

```
                                  "scheme?"
                                  .
                                  function_arglist_nonbackup
                                  embedded_scm_arg
  201 function_arglist_nonbackup: "optional?"
                                  "scheme?"
                                  function_arglist_nonbackup
                                  .
                                  embedded_scm_arg
  201 function_arglist_nonbackup: "optional?"
                                  "scheme?"
                                  function_arglist_nonbackup
                                  embedded_scm_arg
                                  .
  201 function_arglist_nonbackup: "optional?"
                                  .
                                  "scheme?"
                                  function_arglist_nonbackup
                                  embedded_scm_arg
  201 function_arglist_nonbackup: "optional?"
                                  .
                                  "scheme?"
                                  function_arglist_nonbackup
                                  embedded_scm_arg
  202                           | "optional?"
                                  "scheme?"
                                  .
                                  function_arglist_nonbackup
                                  bare_number_common
  202                           | "optional?"
                                  "scheme?"
                                  .
                                  function_arglist_nonbackup
                                  bare_number_common
  202                           | "optional?"
                                  "scheme?"
                                  function_arglist_nonbackup
                                  .
                                  bare_number_common
  202                           | "optional?"
                                  .
                                  "scheme?"
                                  function_arglist_nonbackup
                                  bare_number_common
  202                           | "optional?"
                                  .
                                  "scheme?"
                                  function_arglist_nonbackup
                                  bare_number_common
  202 function_arglist_nonbackup: "optional?"
                                  "scheme?"
                                  function_arglist_nonbackup
```

```
                                  bare_number_common
                                  .
203 function_arglist_nonbackup:   function_arglist_nonbackup_reparse
                                  "(reparsed?)"
                                  .
                                  duration_length
203 function_arglist_nonbackup:   function_arglist_nonbackup_reparse
                                  "(reparsed?)"
                                  duration_length
                                  .
203 function_arglist_nonbackup:   function_arglist_nonbackup_reparse
                                  .
                                  "(reparsed?)"
                                  duration_length
204                             | function_arglist_nonbackup_reparse
                                  "(reparsed?)"
                                  .
                                  bare_number_common
204                             | function_arglist_nonbackup_reparse
                                  .
                                  "(reparsed?)"
                                  bare_number_common
204 function_arglist_nonbackup:   function_arglist_nonbackup_reparse
                                  "(reparsed?)"
                                  bare_number_common
                                  .
205                             | function_arglist_nonbackup_reparse
                                  "(reparsed?)"
                                  .
                                  SCM_ARG
205                             | function_arglist_nonbackup_reparse
                                  .
                                  "(reparsed?)"
                                  SCM_ARG
205 function_arglist_nonbackup:   function_arglist_nonbackup_reparse
                                  "(reparsed?)"
                                  SCM_ARG
                                  .
206                             | function_arglist_nonbackup_reparse
                                  "(reparsed?)"
                                  .
                                  lyric_element_music
206                             | function_arglist_nonbackup_reparse
                                  .
                                  "(reparsed?)"
                                  lyric_element_music
206 function_arglist_nonbackup:   function_arglist_nonbackup_reparse
                                  "(reparsed?)"
                                  lyric_element_music
                                  .
207                             | function_arglist_nonbackup_reparse
                                  "(reparsed?)"
```

```
                                  .
                                  symbol_list_arg
207                             | function_arglist_nonbackup_reparse
                                  .
                                  "(reparsed?)"
                                  symbol_list_arg
207 function_arglist_nonbackup:  function_arglist_nonbackup_reparse
                                  "(reparsed?)"
                                  symbol_list_arg
                                  .
208 function_arglist_nonbackup_reparse:  "optional?"
                                          "scheme?"
                                          .
                                          function_arglist_nonbackup
                                          SCM_IDENTIFIER
208 function_arglist_nonbackup_reparse:  "optional?"
                                          "scheme?"
                                          .
                                          function_arglist_nonbackup
                                          SCM_IDENTIFIER
208 function_arglist_nonbackup_reparse:  "optional?"
                                          "scheme?"
                                          function_arglist_nonbackup
                                          .
                                          SCM_IDENTIFIER
208 function_arglist_nonbackup_reparse:  "optional?"
                                          "scheme?"
                                          function_arglist_nonbackup
                                          SCM_IDENTIFIER
                                          .
208 function_arglist_nonbackup_reparse:  "optional?"
                                          .
                                          "scheme?"
                                          function_arglist_nonbackup
                                          SCM_IDENTIFIER
208 function_arglist_nonbackup_reparse:  "optional?"
                                          .
                                          "scheme?"
                                          function_arglist_nonbackup
                                          SCM_IDENTIFIER
209                                    | "optional?"
                                          "scheme?"
                                          .
                                          function_arglist_nonbackup
                                          STRING
209                                    | "optional?"
                                          "scheme?"
                                          .
                                          function_arglist_nonbackup
                                          STRING
209                                    | "optional?"
                                          "scheme?"
```

```
                                      function_arglist_nonbackup
                                      .
                                      STRING
209                                 | "optional?"
                                      .
                                      "scheme?"
                                      function_arglist_nonbackup
                                      STRING
209                                 | "optional?"
                                      .
                                      "scheme?"
                                      function_arglist_nonbackup
                                      STRING
209 function_arglist_nonbackup_reparse:  "optional?"
                                      "scheme?"
                                      function_arglist_nonbackup
                                      STRING
                                      .
210                                 | "optional?"
                                      "scheme?"
                                      .
                                      function_arglist_nonbackup
                                      full_markup
210                                 | "optional?"
                                      "scheme?"
                                      .
                                      function_arglist_nonbackup
                                      full_markup
210                                 | "optional?"
                                      "scheme?"
                                      function_arglist_nonbackup
                                      .
                                      full_markup
210                                 | "optional?"
                                      .
                                      "scheme?"
                                      function_arglist_nonbackup
                                      full_markup
210                                 | "optional?"
                                      .
                                      "scheme?"
                                      function_arglist_nonbackup
                                      full_markup
210 function_arglist_nonbackup_reparse:  "optional?"
                                      "scheme?"
                                      function_arglist_nonbackup
                                      full_markup
                                      .
211                                 | "optional?"
                                      "scheme?"
                                      .
                                      function_arglist_nonbackup
```

```
                                      UNSIGNED
211                                 | "optional?"
                                      "scheme?"
                                      .
                                      function_arglist_nonbackup
                                      UNSIGNED
211                                 | "optional?"
                                      "scheme?"
                                      function_arglist_nonbackup
                                      .
                                      UNSIGNED
211                                 | "optional?"
                                      .
                                      "scheme?"
                                      function_arglist_nonbackup
                                      UNSIGNED
211                                 | "optional?"
                                      .
                                      "scheme?"
                                      function_arglist_nonbackup
                                      UNSIGNED
211 function_arglist_nonbackup_reparse:  "optional?"
                                      "scheme?"
                                      function_arglist_nonbackup
                                      UNSIGNED
                                      .
212                                 | "optional?"
                                      "scheme?"
                                      .
                                      function_arglist_nonbackup
                                      DURATION_IDENTIFIER
212                                 | "optional?"
                                      "scheme?"
                                      .
                                      function_arglist_nonbackup
                                      DURATION_IDENTIFIER
212                                 | "optional?"
                                      "scheme?"
                                      function_arglist_nonbackup
                                      .
                                      DURATION_IDENTIFIER
212                                 | "optional?"
                                      .
                                      "scheme?"
                                      function_arglist_nonbackup
                                      DURATION_IDENTIFIER
212                                 | "optional?"
                                      .
                                      "scheme?"
                                      function_arglist_nonbackup
                                      DURATION_IDENTIFIER
212 function_arglist_nonbackup_reparse:  "optional?"
```

```
                                        "scheme?"
                                        function_arglist_nonbackup
                                        DURATION_IDENTIFIER
                                        .
213 function_arglist_backup:  function_arglist_common .
214 function_arglist_backup:  "optional?"
                               "scheme?"
                               .
                               function_arglist_backup
                               embedded_scm_arg_closed
214 function_arglist_backup:  "optional?"
                               "scheme?"
                               .
                               function_arglist_backup
                               embedded_scm_arg_closed
214 function_arglist_backup:  "optional?"
                               "scheme?"
                               function_arglist_backup
                               .
                               embedded_scm_arg_closed
214 function_arglist_backup:  "optional?"
                               "scheme?"
                               function_arglist_backup
                               embedded_scm_arg_closed
                               .
214 function_arglist_backup:  "optional?"
                               .
                               "scheme?"
                               function_arglist_backup
                               embedded_scm_arg_closed
214 function_arglist_backup:  "optional?"
                               .
                               "scheme?"
                               function_arglist_backup
                               embedded_scm_arg_closed
215                         | "optional?"
                               "scheme?"
                               .
                               function_arglist_backup
                               "\repeat"
                               simple_string
                               unsigned_number
215                         | "optional?"
                               "scheme?"
                               .
                               function_arglist_backup
                               "\repeat"
                               simple_string
                               unsigned_number
215                         | "optional?"
                               "scheme?"
                               function_arglist_backup
```

```
                                .
                                "\repeat"
                                simple_string
                                unsigned_number
215                           | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                "\repeat"
                                simple_string
                                unsigned_number
215                           | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                "\repeat"
                                simple_string
                                unsigned_number
215 function_arglist_backup:  "optional?"
                                "scheme?"
                                function_arglist_backup
                                "\repeat"
                                .
                                simple_string
                                unsigned_number
215 function_arglist_backup:  "optional?"
                                "scheme?"
                                function_arglist_backup
                                "\repeat"
                                simple_string
                                .
                                unsigned_number
215 function_arglist_backup:  "optional?"
                                "scheme?"
                                function_arglist_backup
                                "\repeat"
                                simple_string
                                unsigned_number
                                .
216                           | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                chord_body
216                           | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                chord_body
216                           | "optional?"
                                "scheme?"
                                function_arglist_backup
```

```
                                .
                                chord_body
216                           | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                chord_body
216                           | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                chord_body
216 function_arglist_backup:   "optional?"
                                "scheme?"
                                function_arglist_backup
                                chord_body
                                .
217                           | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                post_event_nofinger
217                           | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                post_event_nofinger
217                           | "optional?"
                                "scheme?"
                                function_arglist_backup
                                .
                                post_event_nofinger
217                           | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                post_event_nofinger
217                           | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                post_event_nofinger
217 function_arglist_backup:   "optional?"
                                "scheme?"
                                function_arglist_backup
                                post_event_nofinger
                                .
218                           | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                full_markup
```

```
218                          | "optional?"
                               "scheme?"
                               .
                               function_arglist_backup
                               full_markup
218                          | "optional?"
                               "scheme?"
                               function_arglist_backup
                               .
                               full_markup
218                          | "optional?"
                               .
                               "scheme?"
                               function_arglist_backup
                               full_markup
218                          | "optional?"
                               .
                               "scheme?"
                               function_arglist_backup
                               full_markup
218 function_arglist_backup:  "optional?"
                               "scheme?"
                               function_arglist_backup
                               full_markup
                               .
219                          | "optional?"
                               "scheme?"
                               .
                               function_arglist_backup
                               UNSIGNED
219                          | "optional?"
                               "scheme?"
                               .
                               function_arglist_backup
                               UNSIGNED
219                          | "optional?"
                               "scheme?"
                               function_arglist_backup
                               .
                               UNSIGNED
219                          | "optional?"
                               .
                               "scheme?"
                               function_arglist_backup
                               UNSIGNED
219                          | "optional?"
                               .
                               "scheme?"
                               function_arglist_backup
                               UNSIGNED
219 function_arglist_backup:  "optional?"
                               "scheme?"
```

```
                              function_arglist_backup
                              UNSIGNED
                              .
220                         | "optional?"
                              "scheme?"
                              .
                              function_arglist_backup
                              REAL
220                         | "optional?"
                              "scheme?"
                              .
                              function_arglist_backup
                              REAL
220                         | "optional?"
                              "scheme?"
                              function_arglist_backup
                              .
                              REAL
220                         | "optional?"
                              .
                              "scheme?"
                              function_arglist_backup
                              REAL
220                         | "optional?"
                              .
                              "scheme?"
                              function_arglist_backup
                              REAL
220 function_arglist_backup:  "optional?"
                              "scheme?"
                              function_arglist_backup
                              REAL
                              .
221                         | "optional?"
                              "scheme?"
                              .
                              function_arglist_backup
                              NUMBER_IDENTIFIER
221                         | "optional?"
                              "scheme?"
                              .
                              function_arglist_backup
                              NUMBER_IDENTIFIER
221                         | "optional?"
                              "scheme?"
                              function_arglist_backup
                              .
                              NUMBER_IDENTIFIER
221                         | "optional?"
                              .
                              "scheme?"
                              function_arglist_backup
```

```
                                NUMBER_IDENTIFIER
221                           | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                NUMBER_IDENTIFIER
221 function_arglist_backup:   "optional?"
                                "scheme?"
                                function_arglist_backup
                                NUMBER_IDENTIFIER
                                .
222                           | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                '-'
                                UNSIGNED
222                           | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                '-'
                                UNSIGNED
222                           | "optional?"
                                "scheme?"
                                function_arglist_backup
                                .
                                '-'
                                UNSIGNED
222                           | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                '-'
                                UNSIGNED
222                           | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                '-'
                                UNSIGNED
222 function_arglist_backup:   "optional?"
                                "scheme?"
                                function_arglist_backup
                                '-'
                                .
                                UNSIGNED
222 function_arglist_backup:   "optional?"
                                "scheme?"
                                function_arglist_backup
                                '-'
                                UNSIGNED
```

```
                                .
223                           | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                '-'
                                REAL
223                           | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                '-'
                                REAL
223                           | "optional?"
                                "scheme?"
                                function_arglist_backup
                                '-'
                                .
                                REAL
223                           | "optional?"
                                "scheme?"
                                function_arglist_backup
                                .
                                '-'
                                REAL
223                           | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                '-'
                                REAL
223                           | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                '-'
                                REAL
223 function_arglist_backup:    "optional?"
                                "scheme?"
                                function_arglist_backup
                                '-'
                                REAL
                                .
224                           | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                '-'
                                NUMBER_IDENTIFIER
224                           | "optional?"
                                "scheme?"
                                .
```

```
                              function_arglist_backup
                              '-'
                              NUMBER_IDENTIFIER
224                         | "optional?"
                              "scheme?"
                              function_arglist_backup
                              '-'
                              .
                              NUMBER_IDENTIFIER
224                         | "optional?"
                              "scheme?"
                              function_arglist_backup
                              .
                              '-'
                              NUMBER_IDENTIFIER
224                         | "optional?"
                              .
                              "scheme?"
                              function_arglist_backup
                              '-'
                              NUMBER_IDENTIFIER
224                         | "optional?"
                              .
                              "scheme?"
                              function_arglist_backup
                              '-'
                              NUMBER_IDENTIFIER
224 function_arglist_backup:  "optional?"
                              "scheme?"
                              function_arglist_backup
                              '-'
                              NUMBER_IDENTIFIER
                              .
225                         | "optional?"
                              "scheme?"
                              .
                              function_arglist_backup
                              PITCH_IDENTIFIER
225                         | "optional?"
                              "scheme?"
                              .
                              function_arglist_backup
                              PITCH_IDENTIFIER
225                         | "optional?"
                              "scheme?"
                              function_arglist_backup
                              .
                              PITCH_IDENTIFIER
225                         | "optional?"
                              .
                              "scheme?"
                              function_arglist_backup
```

```
                                PITCH_IDENTIFIER
225                           | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                PITCH_IDENTIFIER
225 function_arglist_backup:   "optional?"
                                "scheme?"
                                function_arglist_backup
                                PITCH_IDENTIFIER
                                .
226                           | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                NOTENAME_PITCH
226                           | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                NOTENAME_PITCH
226                           | "optional?"
                                "scheme?"
                                function_arglist_backup
                                .
                                NOTENAME_PITCH
226                           | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                NOTENAME_PITCH
226                           | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                NOTENAME_PITCH
226 function_arglist_backup:   "optional?"
                                "scheme?"
                                function_arglist_backup
                                NOTENAME_PITCH
                                .
227                           | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                TONICNAME_PITCH
227                           | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                TONICNAME_PITCH
227                           | "optional?"
```

```
                                "scheme?"
                                function_arglist_backup
                                .
                                TONICNAME_PITCH
227                           | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                TONICNAME_PITCH
227                           | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                TONICNAME_PITCH
227 function_arglist_backup:   "optional?"
                                "scheme?"
                                function_arglist_backup
                                TONICNAME_PITCH
                                .
228                           | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                DURATION_IDENTIFIER
228                           | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                DURATION_IDENTIFIER
228                           | "optional?"
                                "scheme?"
                                function_arglist_backup
                                .
                                DURATION_IDENTIFIER
228                           | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                DURATION_IDENTIFIER
228                           | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                DURATION_IDENTIFIER
228 function_arglist_backup:   "optional?"
                                "scheme?"
                                function_arglist_backup
                                DURATION_IDENTIFIER
                                .
229                           | "optional?"
                                "scheme?"
                                .
```

```
                                function_arglist_backup
                                SCM_IDENTIFIER
  229                         | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                SCM_IDENTIFIER
  229                         | "optional?"
                                "scheme?"
                                function_arglist_backup
                                .
                                SCM_IDENTIFIER
  229                         | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                SCM_IDENTIFIER
  229                         | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                SCM_IDENTIFIER
  229 function_arglist_backup:  "optional?"
                                "scheme?"
                                function_arglist_backup
                                SCM_IDENTIFIER
                                .
  230                         | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                STRING
  230                         | "optional?"
                                "scheme?"
                                .
                                function_arglist_backup
                                STRING
  230                         | "optional?"
                                "scheme?"
                                function_arglist_backup
                                .
                                STRING
  230                         | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                STRING
  230                         | "optional?"
                                .
                                "scheme?"
                                function_arglist_backup
                                STRING
```

```
230 function_arglist_backup:  "optional?"
                             "scheme?"
                             function_arglist_backup
                             STRING
                             .
231                        | function_arglist_backup
                             .
                             "(reparsed?)"
                             music_assign
231 function_arglist_backup:  function_arglist_backup
                             "(reparsed?)"
                             .
                             music_assign
231 function_arglist_backup:  function_arglist_backup
                             "(reparsed?)"
                             music_assign
                             .
231 function_arglist_backup:  function_arglist_backup
                             .
                             "(reparsed?)"
                             music_assign
232                        | function_arglist_backup
                             "(reparsed?)"
                             .
                             pitch_arg
232                        | function_arglist_backup
                             .
                             "(reparsed?)"
                             pitch_arg
232                        | function_arglist_backup
                             .
                             "(reparsed?)"
                             pitch_arg
232 function_arglist_backup:  function_arglist_backup
                             "(reparsed?)"
                             pitch_arg
                             .
233                        | function_arglist_backup
                             "(reparsed?)"
                             .
                             bare_number_common
233                        | function_arglist_backup
                             .
                             "(reparsed?)"
                             bare_number_common
233                        | function_arglist_backup
                             .
                             "(reparsed?)"
                             bare_number_common
233 function_arglist_backup:  function_arglist_backup
                             "(reparsed?)"
                             bare_number_common
```

```
                              .
234                         | function_arglist_backup
                              "(reparsed?)"
                              .
                              duration_length
234                         | function_arglist_backup
                              .
                              "(reparsed?)"
                              duration_length
234                         | function_arglist_backup
                              .
                              "(reparsed?)"
                              duration_length
234 function_arglist_backup:  function_arglist_backup
                              "(reparsed?)"
                              duration_length
                              .
235                         | function_arglist_backup
                              "(reparsed?)"
                              .
                              symbol_list_arg
235                         | function_arglist_backup
                              .
                              "(reparsed?)"
                              symbol_list_arg
235                         | function_arglist_backup
                              .
                              "(reparsed?)"
                              symbol_list_arg
235 function_arglist_backup:  function_arglist_backup
                              "(reparsed?)"
                              symbol_list_arg
                              .
236 function_arglist:  function_arglist_nonbackup .
237 function_arglist:  "optional?"
                       "scheme?"
                       .
                       function_arglist_skip_nonbackup
                       "\default"
237 function_arglist:  "optional?"
                       "scheme?"
                       function_arglist_skip_nonbackup
                       "\default"
                       .
237 function_arglist:  "optional?"
                       "scheme?"
                       function_arglist_skip_nonbackup
                       .
                       "\default"
237 function_arglist:  "optional?"
                       .
                       "scheme?"
```

```
                        function_arglist_skip_nonbackup
                        "\default"
238 function_arglist_skip_nonbackup:  function_arglist_nonbackup .
238 function_arglist_skip_nonbackup:  function_arglist_nonbackup .
239 function_arglist_skip_nonbackup:  "optional?"
                                      "scheme?"
                                      .
                                      function_arglist_skip_nonbackup
239 function_arglist_skip_nonbackup:  "optional?"
                                      "scheme?"
                                      function_arglist_skip_nonbackup
                                      .
239 function_arglist_skip_nonbackup:  "optional?"
                                      .
                                      "scheme?"
                                      function_arglist_skip_nonbackup
240 function_arglist_common:  EXPECT_NO_MORE_ARGS .
241 function_arglist_common:  "scheme?"
                               .
                               function_arglist_optional
                               embedded_scm_arg
241 function_arglist_common:  "scheme?"
                               function_arglist_optional
                               .
                               embedded_scm_arg
241 function_arglist_common:  "scheme?"
                               function_arglist_optional
                               embedded_scm_arg
                               .
242                         | "scheme?"
                               .
                               function_arglist_optional
                               bare_number_common
242                         | "scheme?"
                               function_arglist_optional
                               .
                               bare_number_common
242 function_arglist_common:  "scheme?"
                               function_arglist_optional
                               bare_number_common
                               .
243                         | "scheme?"
                               .
                               function_arglist_optional
                               post_event_nofinger
243                         | "scheme?"
                               function_arglist_optional
                               .
                               post_event_nofinger
243 function_arglist_common:  "scheme?"
                               function_arglist_optional
                               post_event_nofinger
```

```
                                .
244                           | "scheme?"
                                .
                                function_arglist_optional
                                '-'
                                NUMBER_IDENTIFIER
244                           | "scheme?"
                                function_arglist_optional
                                .
                                '-'
                                NUMBER_IDENTIFIER
244 function_arglist_common:  "scheme?"
                                function_arglist_optional
                                '-'
                                .
                                NUMBER_IDENTIFIER
244 function_arglist_common:  "scheme?"
                                function_arglist_optional
                                '-'
                                NUMBER_IDENTIFIER
                                .
245 function_arglist_common:  function_arglist_common_reparse
                                "(reparsed?)"
                                .
                                SCM_ARG
245 function_arglist_common:  function_arglist_common_reparse
                                "(reparsed?)"
                                SCM_ARG
                                .
245 function_arglist_common:  function_arglist_common_reparse
                                .
                                "(reparsed?)"
                                SCM_ARG
246                           | function_arglist_common_reparse
                                "(reparsed?)"
                                .
                                lyric_element_music
246                           | function_arglist_common_reparse
                                .
                                "(reparsed?)"
                                lyric_element_music
246 function_arglist_common:  function_arglist_common_reparse
                                "(reparsed?)"
                                lyric_element_music
                                .
247                           | function_arglist_common_reparse
                                "(reparsed?)"
                                .
                                bare_number_common
247                           | function_arglist_common_reparse
                                .
                                "(reparsed?)"
```

```
                              bare_number_common
247 function_arglist_common:  function_arglist_common_reparse
                              "(reparsed?)"
                              bare_number_common
                              .
248                         | function_arglist_common_reparse
                              "(reparsed?)"
                              .
                              duration_length
248                         | function_arglist_common_reparse
                              .
                              "(reparsed?)"
                              duration_length
248 function_arglist_common:  function_arglist_common_reparse
                              "(reparsed?)"
                              duration_length
                              .
249                         | function_arglist_common_reparse
                              "(reparsed?)"
                              .
                              symbol_list_arg
249                         | function_arglist_common_reparse
                              .
                              "(reparsed?)"
                              symbol_list_arg
249 function_arglist_common:  function_arglist_common_reparse
                              "(reparsed?)"
                              symbol_list_arg
                              .
250 function_arglist_common_reparse:  "scheme?"
                                       .
                                       function_arglist_optional
                                       SCM_IDENTIFIER
250 function_arglist_common_reparse:  "scheme?"
                                       .
                                       function_arglist_optional
                                       SCM_IDENTIFIER
250 function_arglist_common_reparse:  "scheme?"
                                       function_arglist_optional
                                       .
                                       SCM_IDENTIFIER
250 function_arglist_common_reparse:  "scheme?"
                                       function_arglist_optional
                                       .
                                       SCM_IDENTIFIER
250 function_arglist_common_reparse:  "scheme?"
                                       function_arglist_optional
                                       SCM_IDENTIFIER
                                       .
251                                 | "scheme?"
                                       .
                                       function_arglist_optional
```

```
                                    STRING
251                               | "scheme?"
                                    .
                                    function_arglist_optional
                                    STRING
251                               | "scheme?"
                                    function_arglist_optional
                                    .
                                    STRING
251                               | "scheme?"
                                    function_arglist_optional
                                    .
                                    STRING
251 function_arglist_common_reparse:  "scheme?"
                                    function_arglist_optional
                                    STRING
                                    .
252                               | "scheme?"
                                    .
                                    function_arglist_optional
                                    full_markup
252                               | "scheme?"
                                    .
                                    function_arglist_optional
                                    full_markup
252                               | "scheme?"
                                    function_arglist_optional
                                    .
                                    full_markup
252                               | "scheme?"
                                    function_arglist_optional
                                    .
                                    full_markup
252 function_arglist_common_reparse:  "scheme?"
                                    function_arglist_optional
                                    full_markup
                                    .
253                               | "scheme?"
                                    .
                                    function_arglist_optional
                                    UNSIGNED
253                               | "scheme?"
                                    .
                                    function_arglist_optional
                                    UNSIGNED
253                               | "scheme?"
                                    function_arglist_optional
                                    .
                                    UNSIGNED
253                               | "scheme?"
                                    function_arglist_optional
                                    .
```

```
                                    UNSIGNED
253 function_arglist_common_reparse:  "scheme?"
                                    function_arglist_optional
                                    UNSIGNED
                                    .
254                               | "scheme?"
                                    .
                                    function_arglist_optional
                                    DURATION_IDENTIFIER
254                               | "scheme?"
                                    .
                                    function_arglist_optional
                                    DURATION_IDENTIFIER
254                               | "scheme?"
                                    function_arglist_optional
                                    .
                                    DURATION_IDENTIFIER
254                               | "scheme?"
                                    function_arglist_optional
                                    .
                                    DURATION_IDENTIFIER
254 function_arglist_common_reparse:  "scheme?"
                                    function_arglist_optional
                                    DURATION_IDENTIFIER
                                    .
255                               | "scheme?"
                                    .
                                    function_arglist_optional
                                    '-'
                                    UNSIGNED
255                               | "scheme?"
                                    .
                                    function_arglist_optional
                                    '-'
                                    UNSIGNED
255                               | "scheme?"
                                    function_arglist_optional
                                    .
                                    '-'
                                    UNSIGNED
255                               | "scheme?"
                                    function_arglist_optional
                                    .
                                    '-'
                                    UNSIGNED
255 function_arglist_common_reparse:  "scheme?"
                                    function_arglist_optional
                                    '-'
                                    .
                                    UNSIGNED
255 function_arglist_common_reparse:  "scheme?"
                                    function_arglist_optional
```

```
                                    '-'
                                    .
                                    UNSIGNED
255 function_arglist_common_reparse:  "scheme?"
                                    function_arglist_optional
                                    '-'
                                    UNSIGNED
                                    .
256                               | "scheme?"
                                    .
                                    function_arglist_optional
                                    '-'
                                    REAL
256                               | "scheme?"
                                    .
                                    function_arglist_optional
                                    '-'
                                    REAL
256                               | "scheme?"
                                    function_arglist_optional
                                    '-'
                                    .
                                    REAL
256                               | "scheme?"
                                    function_arglist_optional
                                    '-'
                                    .
                                    REAL
256                               | "scheme?"
                                    function_arglist_optional
                                    .
                                    '-'
                                    REAL
256                               | "scheme?"
                                    function_arglist_optional
                                    .
                                    '-'
                                    REAL
256 function_arglist_common_reparse:  "scheme?"
                                    function_arglist_optional
                                    '-'
                                    REAL
                                    .
257 function_arglist_closed:  function_arglist_closed_nonbackup .
258 function_arglist_closed:  "optional?"
                              "scheme?"
                              .
                              function_arglist_skip_nonbackup
                              "\default"
258 function_arglist_closed:  "optional?"
                              "scheme?"
                              function_arglist_skip_nonbackup
```

```
                                "\default"
                                .
258 function_arglist_closed:  "optional?"
                                "scheme?"
                                function_arglist_skip_nonbackup
                                .
                                "\default"
258 function_arglist_closed:  "optional?"
                                .
                                "scheme?"
                                function_arglist_skip_nonbackup
                                "\default"
259 function_arglist_closed_common:  EXPECT_NO_MORE_ARGS .
260 function_arglist_closed_common:  "scheme?"
                                    .
                                    function_arglist_optional
                                    embedded_scm_arg_closed
260 function_arglist_closed_common:  "scheme?"
                                    function_arglist_optional
                                    .
                                    embedded_scm_arg_closed
260 function_arglist_closed_common:  "scheme?"
                                    function_arglist_optional
                                    embedded_scm_arg_closed
                                    .
261                               | "scheme?"
                                    .
                                    function_arglist_optional
                                    bare_number_common_closed
261                               | "scheme?"
                                    function_arglist_optional
                                    .
                                    bare_number_common_closed
261 function_arglist_closed_common:  "scheme?"
                                    function_arglist_optional
                                    bare_number_common_closed
                                    .
262                               | "scheme?"
                                    .
                                    function_arglist_optional
                                    '-'
                                    NUMBER_IDENTIFIER
262                               | "scheme?"
                                    function_arglist_optional
                                    .
                                    '-'
                                    NUMBER_IDENTIFIER
262 function_arglist_closed_common:  "scheme?"
                                    function_arglist_optional
                                    '-'
                                    .
                                    NUMBER_IDENTIFIER
```

```
262 function_arglist_closed_common:  "scheme?"
                                     function_arglist_optional
                                     '-'
                                     NUMBER_IDENTIFIER
                                     .
263                                | "scheme?"
                                     .
                                     function_arglist_optional
                                     post_event_nofinger
263                                | "scheme?"
                                     function_arglist_optional
                                     .
                                     post_event_nofinger
263 function_arglist_closed_common:  "scheme?"
                                     function_arglist_optional
                                     post_event_nofinger
                                     .
264 function_arglist_closed_common:  function_arglist_common_reparse
                                     "(reparsed?)"
                                     .
                                     SCM_ARG
264 function_arglist_closed_common:  function_arglist_common_reparse
                                     "(reparsed?)"
                                     SCM_ARG
                                     .
264 function_arglist_closed_common:  function_arglist_common_reparse
                                     .
                                     "(reparsed?)"
                                     SCM_ARG
265                                | function_arglist_common_reparse
                                     "(reparsed?)"
                                     .
                                     bare_number_common_closed
265                                | function_arglist_common_reparse
                                     .
                                     "(reparsed?)"
                                     bare_number_common_closed
265 function_arglist_closed_common:  function_arglist_common_reparse
                                     "(reparsed?)"
                                     bare_number_common_closed
                                     .
266                                | function_arglist_common_reparse
                                     "(reparsed?)"
                                     .
                                     symbol_list_arg
266                                | function_arglist_common_reparse
                                     .
                                     "(reparsed?)"
                                     symbol_list_arg
266 function_arglist_closed_common:  function_arglist_common_reparse
                                     "(reparsed?)"
                                     symbol_list_arg
```

```
                                    .
267 function_arglist_optional:  function_arglist_backup .
268 function_arglist_optional:  "optional?"
                                 "scheme?"
                                 .
                                 function_arglist_skip_backup
                                 "\default"
268 function_arglist_optional:  "optional?"
                                 "scheme?"
                                 function_arglist_skip_backup
                                 "\default"
                                 .
268 function_arglist_optional:  "optional?"
                                 "scheme?"
                                 function_arglist_skip_backup
                                 .
                                 "\default"
268 function_arglist_optional:  "optional?"
                                 .
                                 "scheme?"
                                 function_arglist_skip_backup
                                 "\default"
269 function_arglist_optional:  function_arglist_skip_backup
                                 "(backed-up?)"
                                 .
269 function_arglist_optional:  function_arglist_skip_backup
                                 .
                                 "(backed-up?)"
270 function_arglist_skip_backup:  function_arglist_backup .
270 function_arglist_skip_backup:  function_arglist_backup .
271 function_arglist_skip_backup:  "optional?"
                                    "scheme?"
                                    .
                                    function_arglist_skip_backup
271 function_arglist_skip_backup:  "optional?"
                                    "scheme?"
                                    .
                                    function_arglist_skip_backup
271 function_arglist_skip_backup:  "optional?"
                                    "scheme?"
                                    function_arglist_skip_backup
                                    .
271 function_arglist_skip_backup:  "optional?"
                                    "scheme?"
                                    function_arglist_skip_backup
                                    .
271 function_arglist_skip_backup:  "optional?"
                                    .
                                    "scheme?"
                                    function_arglist_skip_backup
271 function_arglist_skip_backup:  "optional?"
                                    .
```

```
                                  "scheme?"
                                  function_arglist_skip_backup
272 embedded_scm_closed:  embedded_scm_bare .
273 embedded_scm_closed:  scm_function_call_closed .
274 embedded_scm_arg_closed:  embedded_scm_bare_arg .
275 embedded_scm_arg_closed:  scm_function_call_closed .
276 embedded_scm_arg_closed:  closed_music .
277 scm_function_call_closed:  SCM_FUNCTION . function_arglist_closed
277 scm_function_call_closed:  SCM_FUNCTION function_arglist_closed .
278 music_function_call:  MUSIC_FUNCTION . function_arglist
278 music_function_call:  MUSIC_FUNCTION function_arglist .
280 optional_id:  '=' .  simple_string
280 optional_id:  '=' simple_string .
281 complex_music:  music_function_call .
282 complex_music:  repeated_music .
283 complex_music:  re_rhythmed_music .
284 complex_music:  complex_music_prefix .  music
284 complex_music:  complex_music_prefix music .
285 complex_music_prefix:  "\context"
                           .
                           symbol
                           optional_id
                           optional_context_mod
285 complex_music_prefix:  "\context"
                           .
                           symbol
                           optional_id
                           optional_context_mod
285 complex_music_prefix:  "\context"
                           symbol
                           .
                           optional_id
                           optional_context_mod
285 complex_music_prefix:  "\context"
                           symbol
                           optional_id
                           .
                           optional_context_mod
285 complex_music_prefix:  "\context"
                           symbol
                           optional_id
                           optional_context_mod
                           .
286 complex_music_prefix:  "\new" .  symbol optional_id optional_context_mod
286 complex_music_prefix:  "\new" symbol .  optional_id optional_context_mod
286 complex_music_prefix:  "\new" symbol optional_id .  optional_context_mod
286 complex_music_prefix:  "\new" symbol optional_id optional_context_mod .
287 mode_changed_music:  mode_changing_head .  grouped_music_list
287 mode_changed_music:  mode_changing_head grouped_music_list .
288 mode_changed_music:  mode_changing_head_with_context
                         .
                         optional_context_mod
```

```
                          grouped_music_list
288 mode_changed_music:  mode_changing_head_with_context
                          optional_context_mod
                          .
                          grouped_music_list
288 mode_changed_music:  mode_changing_head_with_context
                          optional_context_mod
                          grouped_music_list
                          .
289 mode_changing_head:  "\notemode" .
290 mode_changing_head:  "\drummode" .
291 mode_changing_head:  "\figuremode" .
292 mode_changing_head:  "\chordmode" .
293 mode_changing_head:  "\lyricmode" .
294 mode_changing_head_with_context:  "\drums" .
295 mode_changing_head_with_context:  "\figures" .
296 mode_changing_head_with_context:  "\chords" .
297 mode_changing_head_with_context:  "\lyrics" .
299 new_lyrics:  "\addlyrics" $@10 .  composite_music
299 new_lyrics:  "\addlyrics" $@10 composite_music .
299 new_lyrics:  "\addlyrics" .  $@10 composite_music
301 new_lyrics:  new_lyrics "\addlyrics" $@11 .  composite_music
301 new_lyrics:  new_lyrics "\addlyrics" $@11 composite_music .
301 new_lyrics:  new_lyrics "\addlyrics" .  $@11 composite_music
301 new_lyrics:  new_lyrics .  "\addlyrics" $@11 composite_music
302 re_rhythmed_music:  composite_music .  new_lyrics
302 re_rhythmed_music:  composite_music .  new_lyrics
302 re_rhythmed_music:  composite_music .  new_lyrics
302 re_rhythmed_music:  composite_music .  new_lyrics
302 re_rhythmed_music:  composite_music .  new_lyrics
302 re_rhythmed_music:  composite_music .  new_lyrics
302 re_rhythmed_music:  composite_music .  new_lyrics
302 re_rhythmed_music:  composite_music .  new_lyrics
302 re_rhythmed_music:  composite_music .  new_lyrics
302 re_rhythmed_music:  composite_music new_lyrics .
304 re_rhythmed_music:  "\lyricsto" .  simple_string $@12 music
304 re_rhythmed_music:  "\lyricsto" simple_string $@12 .  music
304 re_rhythmed_music:  "\lyricsto" simple_string $@12 music .
304 re_rhythmed_music:  "\lyricsto" simple_string .  $@12 music
305 context_change:  "\change" .  symbol '=' simple_string
305 context_change:  "\change" symbol '=' .  simple_string
305 context_change:  "\change" symbol '=' simple_string .
305 context_change:  "\change" symbol .  '=' simple_string
306 property_path:  symbol_list_rev .
307              | symbol_list_rev .  property_path
307 property_path:  symbol_list_rev property_path .
308 property_operation:  symbol '=' .  scalar
308 property_operation:  symbol '=' scalar .
308 property_operation:  symbol .  '=' scalar
309 property_operation:  "\unset" .  symbol
309 property_operation:  "\unset" symbol .
310 property_operation:  "\override" .  property_path '=' scalar
```

```
310 property_operation:  "\override" property_path '=' .  scalar
310 property_operation:  "\override" property_path '=' scalar .
310 property_operation:  "\override" property_path .  '=' scalar
311 property_operation:  "\revert" .  revert_arg
311 property_operation:  "\revert" revert_arg .
312 revert_arg:  revert_arg_backup "(backed-up?)" .  symbol_list_arg
312 revert_arg:  revert_arg_backup "(backed-up?)" symbol_list_arg .
312 revert_arg:  revert_arg_backup .  "(backed-up?)" symbol_list_arg
313 revert_arg_backup:  revert_arg_part .
314 revert_arg_part:  symbol_list_part .
315 revert_arg_part:  revert_arg_backup
                      "(backed-up?)"
                      .
                      SCM_ARG
                      '.'
                      symbol_list_part
315 revert_arg_part:  revert_arg_backup
                      "(backed-up?)"
                      SCM_ARG
                      '.'
                      .
                      symbol_list_part
315 revert_arg_part:  revert_arg_backup
                      "(backed-up?)"
                      SCM_ARG
                      '.'
                      symbol_list_part
                      .
315 revert_arg_part:  revert_arg_backup
                      "(backed-up?)"
                      SCM_ARG
                      .
                      '.'
                      symbol_list_part
315 revert_arg_part:  revert_arg_backup
                      .
                      "(backed-up?)"
                      SCM_ARG
                      '.'
                      symbol_list_part
316                 | revert_arg_backup
                      "(backed-up?)"
                      .
                      SCM_ARG
                      symbol_list_part
316                 | revert_arg_backup
                      "(backed-up?)"
                      SCM_ARG
                      .
                      symbol_list_part
316                 | revert_arg_backup
                      .
```

```
                      "(backed-up?)"
                      SCM_ARG
                      symbol_list_part
316 revert_arg_part:  revert_arg_backup
                      "(backed-up?)"
                      SCM_ARG
                      symbol_list_part
                      .
317 context_def_mod:  "\consists" .
318 context_def_mod:  "\remove" .
319 context_def_mod:  "\accepts" .
320 context_def_mod:  "\defaultchild" .
321 context_def_mod:  "\denies" .
322 context_def_mod:  "\alias" .
323 context_def_mod:  "\type" .
324 context_def_mod:  "\description" .
325 context_def_mod:  "\name" .
326 context_mod:  property_operation .
327 context_mod:  context_def_mod .  STRING
327 context_mod:  context_def_mod STRING .
328            | context_def_mod .  embedded_scm
328 context_mod:  context_def_mod embedded_scm .
329 grob_prop_spec:  symbol_list_rev .
330 grob_prop_path:  grob_prop_spec .
331              | grob_prop_spec .  property_path
331 grob_prop_path:  grob_prop_spec property_path .
332 context_prop_spec:  symbol_list_rev .
333 simple_music_property_def:  "\override" .  grob_prop_path '=' scalar
333 simple_music_property_def:  "\override" grob_prop_path '=' .  scalar
333 simple_music_property_def:  "\override" grob_prop_path '=' scalar .
333 simple_music_property_def:  "\override" grob_prop_path .  '=' scalar
334 simple_music_property_def:  "\revert"
                               .
                               simple_revert_context
                               revert_arg
334 simple_music_property_def:  "\revert"
                               simple_revert_context
                               .
                               revert_arg
334 simple_music_property_def:  "\revert"
                               simple_revert_context
                               revert_arg
                               .
335 simple_music_property_def:  "\set" .  context_prop_spec '=' scalar
335 simple_music_property_def:  "\set" context_prop_spec '=' .  scalar
335 simple_music_property_def:  "\set" context_prop_spec '=' scalar .
335 simple_music_property_def:  "\set" context_prop_spec .  '=' scalar
336 simple_music_property_def:  "\unset" .  context_prop_spec
336 simple_music_property_def:  "\unset" context_prop_spec .
337 simple_revert_context:  symbol_list_part .
338 music_property_def:  simple_music_property_def .
339 string:  STRING .
```

```
339 string:  STRING .
340 string:  full_markup .
340 string:  full_markup .
341 simple_string:  STRING .
342 simple_string:  embedded_scm_bare .
343 symbol:  STRING .
344 symbol:  embedded_scm_bare .
344 symbol:  embedded_scm_bare .
345 scalar:  embedded_scm_arg .
346 scalar:  SCM_IDENTIFIER .
347 scalar:  bare_number .
348 scalar:  '-' .  bare_number
348 scalar:  '-' bare_number .
349 scalar:  STRING .
350 scalar:  full_markup .
351 event_chord:  simple_element .  post_events
351 event_chord:  simple_element post_events .
352 event_chord:  simple_chord_elements .  post_events
352 event_chord:  simple_chord_elements post_events .
353 event_chord:  CHORD_REPETITION . optional_notemode_duration post_events
353 event_chord:  CHORD_REPETITION optional_notemode_duration .  post_events
353 event_chord:  CHORD_REPETITION optional_notemode_duration post_events .
354 event_chord:  MULTI_MEASURE_REST
                   .
                   optional_notemode_duration
                   post_events
354 event_chord:  MULTI_MEASURE_REST
                   optional_notemode_duration
                   .
                   post_events
354 event_chord:  MULTI_MEASURE_REST
                   optional_notemode_duration
                   post_events
                   .
355 event_chord:  command_element .
356 event_chord:  note_chord_element .
357 note_chord_element:  chord_body .  optional_notemode_duration post_events
357 note_chord_element:  chord_body optional_notemode_duration .  post_events
357 note_chord_element:  chord_body optional_notemode_duration post_events .
358 chord_body:  "<" .  chord_body_elements ">"
358 chord_body:  "<" chord_body_elements ">" .
358 chord_body:  "<" chord_body_elements .  ">"
359 chord_body:  CHORD_BODY_IDENTIFIER .
361 chord_body_elements:  chord_body_elements .  chord_body_element
361 chord_body_elements:  chord_body_elements chord_body_element .
362 chord_body_element:  pitch
                         .
                         exclamations
                         questions
                         octave_check
                         post_events
362 chord_body_element:  pitch
```

```
                          exclamations
                          .
                          questions
                          octave_check
                          post_events
  362 chord_body_element:  pitch
                          exclamations
                          questions
                          .
                          octave_check
                          post_events
  362 chord_body_element:  pitch
                          exclamations
                          questions
                          octave_check
                          .
                          post_events
  362 chord_body_element:  pitch
                          exclamations
                          questions
                          octave_check
                          post_events
                          .
  363 chord_body_element:  DRUM_PITCH . post_events
  363 chord_body_element:  DRUM_PITCH post_events .
  364 chord_body_element:  music_function_chord_body .
  365 music_function_chord_body:  music_function_call .
  366 music_function_chord_body:  MUSIC_IDENTIFIER .
  367 music_function_chord_body:  embedded_scm .
  368 music_function_call_closed:  MUSIC_FUNCTION . function_arglist_closed
  368 music_function_call_closed:  MUSIC_FUNCTION function_arglist_closed .
  369 event_function_event:  EVENT_FUNCTION . function_arglist_closed
  369 event_function_event:  EVENT_FUNCTION function_arglist_closed .
  370 command_element:  command_event .
  371 command_event:  tempo_event .
  373 post_events:  post_events .  post_event
  373 post_events:  post_events .  post_event
  373 post_events:  post_events .  post_event
  373 post_events:  post_events .  post_event
  373 post_events:  post_events .  post_event
  373 post_events:  post_events .  post_event
  373 post_events:  post_events .  post_event
  373 post_events:  post_events .  post_event
  373 post_events:  post_events .  post_event
  373 post_events:  post_events post_event .
  374 post_event_nofinger:  direction_less_event .
  375 post_event_nofinger:  script_dir .  music_function_call_closed
  375 post_event_nofinger:  script_dir music_function_call_closed .
  376 post_event_nofinger:  "--" .
  377 post_event_nofinger:  "__" .
  378                     | script_dir .  direction_reqd_event
  378 post_event_nofinger:  script_dir direction_reqd_event .
```

```
379                     | script_dir .  direction_less_event
379 post_event_nofinger:  script_dir direction_less_event .
380 post_event_nofinger:  '^' .  fingering
380 post_event_nofinger:  '^' fingering .
381 post_event_nofinger:  '_' .  fingering
381 post_event_nofinger:  '_' fingering .
382 post_event:  post_event_nofinger .
383 post_event:  '-' .  fingering
383 post_event:  '-' fingering .
384 string_number_event:  E_UNSIGNED .
385 direction_less_event:  string_number_event .
386 direction_less_event:  EVENT_IDENTIFIER .
387 direction_less_event:  tremolo_type .
388 direction_less_event:  event_function_event .
389 direction_reqd_event:  gen_text_def .
390 direction_reqd_event:  script_abbreviation .
392 octave_check:  '=' .  quotes
392 octave_check:  '=' quotes .
394 quotes:  sub_quotes .
395 quotes:  sup_quotes .
396 sup_quotes:  '\'' .
397 sup_quotes:  sup_quotes '\'' .
397 sup_quotes:  sup_quotes .  '\''
398 sub_quotes:  ',' .
399 sub_quotes:  sub_quotes ',' .
399 sub_quotes:  sub_quotes .  ','
400 steno_pitch:  NOTENAME_PITCH . quotes
400 steno_pitch:  NOTENAME_PITCH quotes .
401 steno_tonic_pitch:  TONICNAME_PITCH . quotes
401 steno_tonic_pitch:  TONICNAME_PITCH quotes .
402 pitch:  steno_pitch .
403 pitch:  PITCH_IDENTIFIER . quotes
403 pitch:  PITCH_IDENTIFIER quotes .
404 pitch_arg:  PITCH_ARG . quotes
404 pitch_arg:  PITCH_ARG quotes .
405 gen_text_def:  full_markup .
406 gen_text_def:  STRING .
407 gen_text_def:  embedded_scm_closed .
408 fingering:  UNSIGNED .
409 script_abbreviation:  '^' .
410 script_abbreviation:  '+' .
411 script_abbreviation:  '-' .
412 script_abbreviation:  '!' .
413 script_abbreviation:  ">" .
414 script_abbreviation:  '.' .
415 script_abbreviation:  '_' .
416 script_dir:  '_' .
417 script_dir:  '^' .
418 script_dir:  '-' .
418 script_dir:  '-' .
418 script_dir:  '-' .
418 script_dir:  '-' .
```

```
418 script_dir:  '-' .
418 script_dir:  '-' .
419 duration_length:  multiplied_duration .
421 maybe_notemode_duration:  multiplied_duration .
422 optional_notemode_duration:  maybe_notemode_duration .
422 optional_notemode_duration:  maybe_notemode_duration .
423 steno_duration:  UNSIGNED . dots
423 steno_duration:  UNSIGNED . dots
423 steno_duration:  UNSIGNED dots .
424 steno_duration:  DURATION_IDENTIFIER . dots
424 steno_duration:  DURATION_IDENTIFIER dots .
425 multiplied_duration:  steno_duration .
426 multiplied_duration:  multiplied_duration '*' .  UNSIGNED
426 multiplied_duration:  multiplied_duration '*' UNSIGNED .
426 multiplied_duration:  multiplied_duration .  '*' UNSIGNED
426 multiplied_duration:  multiplied_duration .  '*' UNSIGNED
427                     | multiplied_duration '*' .  FRACTION
427                     | multiplied_duration .  '*' FRACTION
427                     | multiplied_duration .  '*' FRACTION
427 multiplied_duration:  multiplied_duration '*' FRACTION .
429 dots:  dots '.' .
429 dots:  dots .  '.'
429 dots:  dots .  '.'
430 tremolo_type:  ':' .
431             | ':' .  UNSIGNED
431 tremolo_type:  ':' UNSIGNED .
432 bass_number:  UNSIGNED .
433 bass_number:  STRING .
434 bass_number:  full_markup .
435 bass_number:  embedded_scm_bare .
436 figured_bass_alteration:  '-' .
437 figured_bass_alteration:  '+' .
438 figured_bass_alteration:  '!' .
439 bass_figure:  "_" .
440 bass_figure:  bass_number .
441 bass_figure:  bass_figure ']' .
441 bass_figure:  bass_figure .  ']'
441 bass_figure:  bass_figure .  ']'
442             | bass_figure .  figured_bass_alteration
442             | bass_figure .  figured_bass_alteration
442 bass_figure:  bass_figure figured_bass_alteration .
443             | bass_figure .  figured_bass_modification
443             | bass_figure .  figured_bass_modification
443 bass_figure:  bass_figure figured_bass_modification .
444 figured_bass_modification:  "\+" .
445 figured_bass_modification:  "\!" .
446 figured_bass_modification:  '/' .
447 figured_bass_modification:  "\" .
448 br_bass_figure:  bass_figure .
449 br_bass_figure:  '[' .  bass_figure
449 br_bass_figure:  '[' bass_figure .
451 figure_list:  figure_list .  br_bass_figure
```

```
451 figure_list:  figure_list br_bass_figure .
452 figure_spec:  FIGURE_OPEN . figure_list FIGURE_CLOSE
452 figure_spec:  FIGURE_OPEN figure_list .  FIGURE_CLOSE
452 figure_spec:  FIGURE_OPEN figure_list FIGURE_CLOSE .
454 optional_rest:  "\rest" .
455 simple_element:  pitch
                      .
                      exclamations
                      questions
                      octave_check
                      maybe_notemode_duration
                      optional_rest
455 simple_element:  pitch
                      exclamations
                      .
                      questions
                      octave_check
                      maybe_notemode_duration
                      optional_rest
455 simple_element:  pitch
                      exclamations
                      questions
                      .
                      octave_check
                      maybe_notemode_duration
                      optional_rest
455 simple_element:  pitch
                      exclamations
                      questions
                      octave_check
                      .
                      maybe_notemode_duration
                      optional_rest
455 simple_element:  pitch
                      exclamations
                      questions
                      octave_check
                      maybe_notemode_duration
                      .
                      optional_rest
455 simple_element:  pitch
                      exclamations
                      questions
                      octave_check
                      maybe_notemode_duration
                      optional_rest
                      .
456 simple_element:  DRUM_PITCH . optional_notemode_duration
456 simple_element:  DRUM_PITCH optional_notemode_duration .
457 simple_element:  RESTNAME . optional_notemode_duration
457 simple_element:  RESTNAME optional_notemode_duration .
458 simple_chord_elements:  new_chord .
```

```
459 simple_chord_elements:  figure_spec .  optional_notemode_duration
459 simple_chord_elements:  figure_spec optional_notemode_duration .
460 lyric_element:  full_markup .
460 lyric_element:  full_markup .
461 lyric_element:  STRING .
461 lyric_element:  STRING .
462 lyric_element:  LYRIC_ELEMENT .
463 lyric_element_music:  lyric_element
                         .
                         optional_notemode_duration
                         post_events
463 lyric_element_music:  lyric_element
                         optional_notemode_duration
                         .
                         post_events
463 lyric_element_music:  lyric_element
                         optional_notemode_duration
                         post_events
                         .
464 new_chord:  steno_tonic_pitch .  maybe_notemode_duration
464 new_chord:  steno_tonic_pitch maybe_notemode_duration .
465           | steno_tonic_pitch
                .
                optional_notemode_duration
                chord_separator
                chord_items
465 new_chord:  steno_tonic_pitch
                optional_notemode_duration
                .
                chord_separator
                chord_items
465 new_chord:  steno_tonic_pitch
                optional_notemode_duration
                chord_separator
                .
                chord_items
465 new_chord:  steno_tonic_pitch
                optional_notemode_duration
                chord_separator
                chord_items
                .
467 chord_items:  chord_items .  chord_item
467 chord_items:  chord_items chord_item .
468 chord_separator:  ":" .
469 chord_separator:  "^" .
470 chord_separator:  "/" .  steno_tonic_pitch
470 chord_separator:  "/" steno_tonic_pitch .
471 chord_separator:  "/+" .  steno_tonic_pitch
471 chord_separator:  "/+" steno_tonic_pitch .
472 chord_item:  chord_separator .
473 chord_item:  step_numbers .
474 chord_item:  CHORD_MODIFIER .
```

```
475 step_numbers:  step_number .
476 step_numbers:  step_numbers '.' .  step_number
476 step_numbers:  step_numbers '.' step_number .
476 step_numbers:  step_numbers .  '.' step_number
477 step_number:  UNSIGNED .
478            | UNSIGNED . '+'
478 step_number:  UNSIGNED '+' .
479            | UNSIGNED . "-"
479 step_number:  UNSIGNED "-" .
480 tempo_range:  unsigned_number .
481            | unsigned_number .  '-' unsigned_number
481 tempo_range:  unsigned_number '-' .  unsigned_number
481 tempo_range:  unsigned_number '-' unsigned_number .
482 number_expression:  number_expression '+' .  number_term
482 number_expression:  number_expression '+' number_term .
482 number_expression:  number_expression .  '+' number_term
483                  | number_expression .  '-' number_term
483 number_expression:  number_expression '-' .  number_term
483 number_expression:  number_expression '-' number_term .
484 number_expression:  number_term .
485 number_term:  number_factor .
486            | number_factor .  '*' number_factor
486 number_term:  number_factor '*' .  number_factor
486 number_term:  number_factor '*' number_factor .
487            | number_factor .  '/' number_factor
487 number_term:  number_factor '/' .  number_factor
487 number_term:  number_factor '/' number_factor .
488 number_factor:  '-' .  number_factor
488 number_factor:  '-' .  number_factor
488 number_factor:  '-' number_factor .
489 number_factor:  bare_number .
490 bare_number_common:  bare_number_common_closed .
491 bare_number_common:  REAL . NUMBER_IDENTIFIER
491 bare_number_common:  REAL NUMBER_IDENTIFIER .
492 bare_number_common_closed:  REAL .
492 bare_number_common_closed:  REAL .
493 bare_number_common_closed:  NUMBER_IDENTIFIER .
494 bare_number:  bare_number_common .
495 bare_number:  UNSIGNED .
495 bare_number:  UNSIGNED .
496            | UNSIGNED . NUMBER_IDENTIFIER
496            | UNSIGNED . NUMBER_IDENTIFIER
496 bare_number:  UNSIGNED NUMBER_IDENTIFIER .
497 bare_number_closed:  UNSIGNED .
498 bare_number_closed:  bare_number_common_closed .
499 unsigned_number:  UNSIGNED .
500 unsigned_number:  NUMBER_IDENTIFIER .
501 unsigned_number:  embedded_scm .
503 exclamations:  exclamations '!' .
503 exclamations:  exclamations .  '!'
503 exclamations:  exclamations .  '!'
505 questions:  questions '?' .
```

```
505 questions:  questions .  '?'
505 questions:  questions .  '?'
507 full_markup_list:  "\markuplist" $@13 .  markup_list
507 full_markup_list:  "\markuplist" $@13 markup_list .
507 full_markup_list:  "\markuplist" .  $@13 markup_list
509 full_markup:  "\markup" $@14 .  markup_top
509 full_markup:  "\markup" $@14 markup_top .
509 full_markup:  "\markup" .  $@14 markup_top
510 markup_top:  markup_list .
511 markup_top:  markup_head_1_list .  simple_markup
511 markup_top:  markup_head_1_list simple_markup .
512 markup_top:  simple_markup .
514 markup_scm:  embedded_scm_bare $@15 "(backed-up?)" .
514 markup_scm:  embedded_scm_bare $@15 .  "(backed-up?)"
514 markup_scm:  embedded_scm_bare .  $@15 "(backed-up?)"
515 markup_list:  markup_composed_list .
516 markup_list:  markup_uncomposed_list .
517 markup_uncomposed_list:  markup_braced_list .
518 markup_uncomposed_list:  markup_command_list .
519 markup_uncomposed_list:  markup_scm .  MARKUPLIST_IDENTIFIER
519 markup_uncomposed_list:  markup_scm .  MARKUPLIST_IDENTIFIER
519 markup_uncomposed_list:  markup_scm MARKUPLIST_IDENTIFIER .
520 markup_composed_list:  markup_head_1_list .  markup_uncomposed_list
520 markup_composed_list:  markup_head_1_list .  markup_uncomposed_list
520 markup_composed_list:  markup_head_1_list .  markup_uncomposed_list
520 markup_composed_list:  markup_head_1_list markup_uncomposed_list .
521 markup_braced_list:  '{' .  markup_braced_list_body '}'
521 markup_braced_list:  '{' markup_braced_list_body '}' .
521 markup_braced_list:  '{' markup_braced_list_body .  '}'
523 markup_braced_list_body:  markup_braced_list_body .  markup
523 markup_braced_list_body:  markup_braced_list_body markup .
524                         | markup_braced_list_body .  markup_list
524 markup_braced_list_body:  markup_braced_list_body markup_list .
525 markup_command_list:  MARKUP_LIST_FUNCTION
                           .
                           markup_command_list_arguments
525 markup_command_list:  MARKUP_LIST_FUNCTION
                           markup_command_list_arguments
                           .
526 markup_command_basic_arguments:  "markup-list?"
                                    .
                                    markup_command_list_arguments
                                    markup_list
526 markup_command_basic_arguments:  "markup-list?"
                                    markup_command_list_arguments
                                    .
                                    markup_list
526 markup_command_basic_arguments:  "markup-list?"
                                    markup_command_list_arguments
                                    markup_list
                                    .
527 markup_command_basic_arguments:  "scheme?"
```

```
                                    .
                                    markup_command_list_arguments
                                    embedded_scm_closed
527 markup_command_basic_arguments:  "scheme?"
                                    markup_command_list_arguments
                                    .
                                    embedded_scm_closed
527 markup_command_basic_arguments:  "scheme?"
                                    markup_command_list_arguments
                                    embedded_scm_closed
                                    .
528 markup_command_basic_arguments:  EXPECT_NO_MORE_ARGS .
529 markup_command_list_arguments:  markup_command_basic_arguments .
530 markup_command_list_arguments:  "markup?"
                                    .
                                    markup_command_list_arguments
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530 markup_command_list_arguments:  "markup?"
                                    markup_command_list_arguments
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530 markup_command_list_arguments:  "markup?"
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531 markup_head_1_item:  MARKUP_FUNCTION
                         "markup?"
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531 markup_head_1_item:  MARKUP_FUNCTION
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531 markup_head_1_item:  MARKUP_FUNCTION
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532 markup_head_1_list:  markup_head_1_item .
533 markup_head_1_list:  markup_head_1_list .  markup_head_1_item
533 markup_head_1_list:  markup_head_1_list .  markup_head_1_item
533 markup_head_1_list:  markup_head_1_list .  markup_head_1_item
533 markup_head_1_list:  markup_head_1_list .  markup_head_1_item
533 markup_head_1_list:  markup_head_1_list markup_head_1_item .
534 simple_markup:  STRING .
536 simple_markup:  "\score" $@16 '{' .  score_body '}'
536 simple_markup:  "\score" $@16 '{' score_body '}' .
536 simple_markup:  "\score" $@16 '{' score_body .  '}'
536 simple_markup:  "\score" $@16 .  '{' score_body '}'
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  536 simple_markup:  "\score" .  $@16 '{' score_body '}'
  537 simple_markup:  MARKUP_FUNCTION . markup_command_basic_arguments
  537 simple_markup:  MARKUP_FUNCTION markup_command_basic_arguments .
  538 simple_markup:  markup_scm .  MARKUP_IDENTIFIER
  538 simple_markup:  markup_scm .  MARKUP_IDENTIFIER
  538 simple_markup:  markup_scm MARKUP_IDENTIFIER .
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  539 markup:  markup_head_1_list .  simple_markup
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  540 markup:  simple_markup .
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