

fangle

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Introduction

FANGLE is a tool for fangled literate programming. Newfangled is defined as *New and often needlessly novel* by THEFREEDICTIONARY.COM.

In this case, fangled means yet another not-so-new¹ method for literate programming.

LITERATE PROGRAMMING has a long history starting with the great DONALD KNUTH himself, whose literate programming tools seem to make use of as many escape sequences for semantic markup as T_EX (also by DONALD KNUTH).

NORMAN RAMSEY wrote the NOWEB set of tools (`notangle`, `noweave` and `noroots`) and helpfully reduced the amount of magic character sequences to pretty much just `<<`, `>>` and `@`, and in doing so brought the wonders of literate programming within my reach.

While using the L_YX editor for L^AT_EX editing I had various troubles with the noweb tools, some of which were my fault, some of which were noweb's fault and some of which were L_YX's fault.

NOWEB generally brought literate programming to the masses through removing some of the complexity of the original literate programming, but this would be of no advantage to me if the L_YX / L^AT_EX combination brought more complications in their place.

FANGLE was thus born (originally called NEWFANGLE) as an awk replacement for notangle, adding some important features, like better integration with L_YX and L^AT_EX (and later T_EX_{MACS}), multiple output format conversions, and fixing notangle bugs like indentation when using `-L` for line numbers.

Significantly, fangle is just one program which replaces various programs in NOWEB. Noweave is done away with and implemented directly as L^AT_EX macros, and noroots is implemented as a function of the untangler fangle.

Fangle is written in awk for portability reasons, awk being available for most platforms. A Python version² was considered for the benefit of L_YX but a scheme version for T_EX_{MACS} will probably materialise first; as T_EX_{MACS} macro capabilities help make edit-time and format-time rendering of fangle chunks simple enough for my weak brain.

As an extension to many literate-programming styles, Fangle permits code chunks to take parameters and thus operate somewhat like C pre-processor macros, or like C++ templates. Name parameters (or even local *variables* in the callers scope) are anticipated, as parameterized chunks — useful though they are — are hard to comprehend in the literate document.

1. but improved.

2. hasn't anyone implemented awk in python yet?

License

Fangle is licensed under the GPL 3 (or later).

This doesn't mean that sources generated by fangle must be licensed under the GPL 3.

This doesn't mean that you can't use or distribute fangle with sources of an incompatible license, but it means you must make the source of fangle available too.

As fangle is currently written in awk, an interpreted language, this should not be too hard.

4a `<gpl3-copyright[1](), lang=text>` ≡

```
1 fangle - fully featured notangle replacement in awk
2
3 Copyright (C) 2009-2010 Sam Liddicott <sam@liddicott.com>
4
5 This program is free software: you can redistribute it and/or modify
6 it under the terms of the GNU General Public License as published by
7 the Free Software Foundation, either version 3 of the License, or
8 (at your option) any later version.
9
10 This program is distributed in the hope that it will be useful,
11 but WITHOUT ANY WARRANTY; without even the implied warranty of
12 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
13 GNU General Public License for more details.
14
15 You should have received a copy of the GNU General Public License
16 along with this program. If not, see <http://www.gnu.org/licenses/>.
```

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Part I

Using Fangle

Chapter 1

Introduction to Literate Programming

Todo: Should really follow on from a part-0 explanation of what literate programming is.

Chapter 2

Running Fangle

Fangle is a replacement for NOWEB, which consists of `notangle`, `noroots` and `noweave`. Like `notangle` and `noroots`, `fangle` can read multiple named files, or from stdin.

2.1 Listing roots

The `-r` option causes `fangle` to behave like `noroots`.

```
fangle -r filename.tex
```

will print out the fangle roots of a tex file.

Unlike the `noroots` command, the printed roots are not enclosed in angle brackets e.g. `<<name>>`, unless at least one of the roots is defined using the `notangle` notation `<<name>>=`.

Also, unlike `noroots`, it prints out all roots — not just those that are not used elsewhere. I find that a root not being used doesn't make it particularly top level — and so-called top level roots could also be included in another root as well.

My convention is that top level roots to be extracted begin with `./` and have the form of a filename. `Makefile.inc`, discussed in 6, can automatically extract all such sources prefixed with `./`

2.2 Extracting roots

`notangle`'s `-R` and `-L` options are supported.

If you are using `LYX` or `LATEX`, the standard way to extract a file would be:

```
fangle -R./Makefile.inc fangle.tex > ./Makefile.inc
```

If you are using `TEXMACS`, the standard way to extract a file would similarly be:

```
fangle -R./Makefile.inc fangle.txt > ./Makefile.inc
```

`TEXMACS` users would obtain the text file with a *verbatim* export from `TEXMACS` which can be done on the command line with `texmacs -s -c fangle.tm fangle.txt -q`

Unlike the `noroots` command, the `-L` option to generate C pre-processor `#file` style line-number directives, does not break indenting of the generated file..

Also, thanks to mode tracking (described in 11) the `-L` option does not interrupt (and break) multi-line C macros either.

This does mean that sometimes the compiler might calculate the source line wrongly when generating error messages in such cases, but there isn't any other way around if multi-line macros include other chunks.

Future releases will include a mapping file so that line/character references from the C compiler can be converted to the correct part of the source document.

2.3 Formatting the document

The `noweave` replacement built into the editing and formatting environment for `TEXMACS`, `LYX` (which uses `LATEX`), and even for raw `LATEX`.

Use of `fangle` with `TEXMACS`, `LYX` and `LATEX` are explained the the next few chapters.

Chapter 3

Using Fangle with L^AT_EX

Because the `noweave` replacement is implemented in L^AT_EX, there is no processing stage required before running the L^AT_EX command. Of course, L^AT_EX may need running two or more times, so that the code chunk references can be fully calculated.

The formatting is managed by a set of macros shown in 17, and can be included with:

```
\usepackage{fangle.sty}
```

Norman Ramsay's original `noweb.sty` package is currently required as it is used for formatting the code chunk captions.

The `listings.sty` package is required, and is used for formatting the code chunks and syntax highlighting.

The `xargs.sty` package is also required, and makes writing L^AT_EX macro so much more pleasant.

To do: Add examples of use of Macros

Chapter 4

Using Fangle with LyX

LyX uses the same L^AT_EX macros shown in 17 as part of a LyX module file `fangle.module`, which automatically includes the macros in the document pre-amble provided that the fangle LyX module is used in the document.

4.1 Installing the LyX module

Copy `fangle.module` to your LyX layouts directory, which for unix users will be `~/ .lyx/layouts`. In order to make the new literate styles available, you will need to reconfigure LyX by clicking Tools->Reconfigure, and then re-start LyX.

4.2 Obtaining a decent mono font

The syntax high-lighting features of L^ST_LI^STINGS makes use of bold; however a mono-space tt font is used to typeset the listings. Obtaining a bold tt font can be impossibly difficult and amazingly easy. I spent many hours at it, following complicated instructions from those who had spend many hours over it, and was finally delivered the simple solution on the lyx mailing list.

4.2.1 txfonts

The simple way was to add this to my preamble:

```
\usepackage{txfonts}
\renewcommand{\ttdefault}{ttxtt}
```

4.2.2 ams pmb

The next simplest way was to use ams poor-mans-bold, by adding this to the pre-amble:

```
\usepackage{amsbsy}
%\renewcommand{\ttdefault}{ttxtt}
%somehow make \pmb be the command for bold, forgot how, sorry, above line not work
```

It works, but looks wretched on the dvi viewer.

4.2.3 Luximono

The lstlistings documentation suggests using Luximono.

Luximono was installed according to the instructions in Ubuntu Forums thread 1159181¹ with tips from miknight² stating that `sudo updmap --enable MixedMap ul9.map` is required. It looks fine in PDF and PS view but still looks rotten in dvi view.

4.3 Formatting your Lyx document

It is not necessary to base your literate document on any of the original LyX literate classes; so select a regular class for your document type.

Add the new module *Fangle Literate Listings* and also *Logical Markup* which is very useful.

In the drop-down style listbox you should notice a new style defined, called *Chunk*.

When you wish to insert a literate chunk, you enter it's plain name in the Chunk style, instead of the old NOWEB method that uses `<<name>>=` type tags. In the line (or paragraph) following the chunk name, you insert a listing with: Insert->Program Listing.

Inside the white listing box you can type (or paste using `shift+ctrl+V`) your listing. There is no need to use `ctrl+enter` at the end of lines as with some older LyX literate techniques — just press enter as normal.

4.3.1 Customising the listing appearance

The code is formatted using the LSTLISTINGS package. The chunk style doesn't just define the chunk name, but can also define any other chunk options supported by the lstlistings package `\lstset` command. In fact, what you type in the chunk style is raw latex. If you want to set the chunk language without having to right-click the listing, just add `,language=C` after the chunk name. (Currently the language will affect all subsequent listings, so you may need to specify `,language=` quite a lot).

To do: so fix the bug

Of course you can do this by editing the listings box advanced properties by right-clicking on the listings box, but that takes longer, and you can't see at-a-glance what the advanced settings are while editing the document; also advanced settings apply only to that box — the chunk settings apply through the rest of the document³.

To do: So make sure they only apply to chunks of that name

4.3.2 Global customisations

As lstlistings is used to set the code chunks, it's `\lstset` command can be used in the pre-amble to set some document wide settings.

If your source has many words with long sequences of capital letters, then `columns=fullflexible` may be a good idea, or the capital letters will get crowded. (I think lstlistings ought to use a slightly smaller font for captial letters so that they still fit).

The font family `\ttfamily` looks more normal for code, but has no bold (an alternate typewriter font is used).

With `\ttfamily`, I must also specify `columns=fullflexible` or the wrong letter spacing is used.

In my L^AT_EX pre-amble I usually specialise my code format with:

1. <http://ubuntuforums.org/showthread.php?t=1159181>
2. <http://miknight.blogspot.com/2005/11/how-to-install-luxi-mono-font-in.html>
3. It ought to apply only to subsequent chunks of the same name. I'll fix that later

19a `<document-preamble[1](), lang=tex> ≡`

```

1 \lstset{
2 numbers=left, stepnumber=1, numbersep=5pt,
3 breaklines=false,
4 basicstyle=\footnotesize\ttfamily,
5 numberstyle=\tiny,
6 language=C,
7 columns=fullflexible,
8 numberfirstline=true
9 }

```

4.4 Configuring the build script

You can invoke code extraction and building from the LyX menu option Document->Build Program.

First, make sure you don't have a conversion defined for Lyx->Program

From the menu Tools->Preferences, add a conversion from Latex(Plain)->Program as:

```

set -x ; fangle -Rlyx-build $$i |
  env LYX_b=$$b LYX_i=$$i LYX_o=$$o LYX_p=$$p LYX_r=$$r bash

```

(But don't cut-n-paste it from this document or you may be be pasting a multi-line string which will break your lyx preferences file).

I hope that one day, LyX will set these into the environment when calling the build script.

You may also want to consider adding options to this conversion...

```

parselog=/usr/share/lyx/scripts/listerrors

```

...but if you do you will lose your stderr⁴.

Now, a shell script chunk called `lyx-build` will be extracted and run whenever you choose the Document->Build Program menu item.

This document was originally managed using LyX and `lyx-build` script for this document is shown here for historical reference.

```

lyx -e latex fangle.lyx && \
  fangle fangle.lyx > ./autoboot

```

This looks simple enough, but as mentioned, `fangle` has to be had from somewhere before it can be extracted.

4.4.1 ...

When the `lyx-build` chunk is executed, the current directory will be a temporary directory, and `LYX_SOURCE` will refer to the `tex` file in this temporary directory. This is unfortunate as our `makefile` wants to run from the project directory where the Lyx file is kept.

We can extract the project directory from `$$r`, and derive the probable Lyx filename from the `noweb` file that Lyx generated.

19b `<lyx-build-helper[1](), lang=sh> ≡`

```

1 PROJECT_DIR="$LYX_r"
2 LYX_SRC="$PROJECT_DIR/${LYX_i%.tex}.lyx"

```

95b>

4. There is some bash plumbing to get a copy of `stderr` but this footnote is too small

```
3 TEX_DIR="$LYX_p"
4 TEX_SRC="$TEX_DIR/$LYX_i"
```

~~~~~

And then we can define a lyx-build fragment similar to the autoboot fragment

```
1 #! /bin/sh
2 <lyx-build-helper 19b>
3 cd $PROJECT_DIR || exit 1
4
5 #/usr/bin/fangle -filter ./notanglefix-filter \
6 # -R./Makefile.inc "../../noweb-lyx/noweb-lyx3.lyx" \
7 # | sed 'NOWEB_SOURCE=/s/=.*=/samba4-dfs.lyx/' \
8 # > ./Makefile.inc
9 #
10 #make -f ./Makefile.inc fangle_sources
```

~~~~~

Chapter 5

Using Fangle with $\text{T}_{\text{E}}\text{X}_{\text{MACS}}$

To do: Write this chapter

Chapter 6

Fangle with Makefiles

Here we describe a `Makefile.inc` that you can include in your own Makefiles, or glue as a recursive make to other projects.

`Makefile.inc` will cope with extracting all the other source files from this or any specified literate document and keeping them up to date.

It may also be included by a `Makefile` or `Makefile.am` defined in a literate document to automatically deal with the extraction of source files and documents during normal builds.

Thus, if `Makefile.inc` is included into a main project makefile it add rules for the source files, capable of extracting the source files from the literate document.

6.1 A word about makefiles formats

Whitespace formatting is very important in a Makefile. The first character of each action line must be a TAB.

```
target: pre-requisite
↳      action
↳      action
```

This requires that the literate programming environment have the ability to represent a TAB character in a way that fangle will generate an actual TAB character.

We also adopt a convention that code chunks whose names beginning with `./` should always be automatically extracted from the document. Code chunks whose names do not begin with `./` are for internal reference. Such chunks may be extracted directly, but will not be automatically extracted by this Makefile.

6.2 Extracting Sources

Our makefile has two parts; variables must be defined before the targets that use them.

As we progress through this chapter, explaining concepts, we will be adding lines to `<Makefile.inc-vars 23b>` and `<Makefile.inc-targets 24c>` which are included in `<./Makefile.inc 23a>` below.

23a `<./Makefile.inc[1](), lang=make> ≡`

```
1 <Makefile.inc-vars 23b>
2 <Makefile.inc-default-targets 23a>
3 <Makefile.inc-targets 24c>
```

We first define a placeholder for the tool `fangle` in case it cannot be found in the path.

23b `<Makefile.inc-vars[1](), lang=make> ≡`

```
1 FANGLE=fangle
2 AWK=awk
```

24a>

```
3 RUN_FANGLE=$(AWK -f $(FANGLE)
```

~~~~~

We also define a placeholder for `LITERATE_SOURCE` to hold the name of this document. This will normally be passed on the command line or set by the including makefile.

```
24a <Makefile.inc-vars[2]>() ↑23b, lang=> +≡ <23b 24b▽
```

```
4 #LITERATE_SOURCE=
```

~~~~~

Fangle cannot process `LyX` or `TeXMACS` documents directly, so the first stage is to convert these to more suitable text based formats¹.

6.2.1 Converting from `LyX` to `LATeX`

The first stage will always be to convert the `LyX` file to a `LATeX` file. Fangle must run on a `TeX` file because the `LyX` command `server-goto-file-line`² requires that the line number provided be a line of the `TeX` file and always maps this the line in the `LyX` document. We use `server-goto-file-line` when moving the cursor to error lines during compile failures.

The command `lyx -e literate fangle.lyx` will produce `fangle.tex`, a `TeX` file; so we define a make target to be the same as the `LyX` file but with the `.tex` extension.

The `EXTRA_DIST` is for automake support so that the `TeX` files will automatically be distributed with the source, to help those who don't have `LyX` installed.

```
24b <Makefile.inc-vars[3]>() ↑23b, lang=> +≡ Δ24a 24d▽
```

```
5 LYX_SOURCE=$(LITERATE_SOURCE) # but only the .lyx files
```

```
6 TEX_SOURCE=$(LYX_SOURCE:.lyx=.tex)
```

```
7 EXTRA_DIST+=$(TEX_SOURCE)
```

~~~~~

We then specify that the `TeX` source is to be generated from the `LyX` source.

```
24c <Makefile.inc-targets[1]>() lang=make ≡ 25a▷
```

```
1 .SUFFIXES: .tex .lyx
```

```
2 .lyx.tex:
```

```
3 ↦ lyx -e latex $<
```

```
4 clean_tex:
```

```
5 ↦ rm -f -- $(TEX_SOURCE)
```

```
6 clean: clean_tex
```

~~~~~

6.2.2 Converting from `TeXMACS`

Fangle cannot process `TeXMACS` files directly³, but must first convert them to text files.

The command `texmacs -c fangle.tm fangle.txt -q` will produce `fangle.txt`, a text file; so we define a make target to be the same as the `TeXMACS` file but with the `.txt` extension.

The `EXTRA_DIST` is for automake support so that the `TeX` files will automatically be distributed with the source, to help those who don't have `LyX` installed.

```
24d <Makefile.inc-vars[4]>() ↑23b, lang=> +≡ Δ24b 25b▷
```

```
8 TEXMACS_SOURCE=$(LITERATE_SOURCE) # but only the .tm files
```

```
9 TXT_SOURCE=$(LITERATE_SOURCE:.tm=.txt)
```

```
10 EXTRA_DIST+=$(TXT_SOURCE)
```

~~~~~

1. `LyX` and `TeXMACS` formats are text-based, but not suitable for fangle

2. The `Lyx` command `server-goto-file-line` is used to position the `Lyx` cursor at the compiler errors.

3. but this is planned when `TeXMACS` uses `xml` as it's native format

To do: Add loop around each `$<` so multiple targets can be specified

```
25a <Makefile.inc-targets[2]() ↑24c, lang=> +≡ <24c 25d∇
7 .SUFFIXES: .txt .tm
8 .tm.txt:
9 ↪      texmacs -s -c $< $@ -q
10 .PHONEY: clean_txt
11 clean_txt:
12 ↪      rm -f -- $(TXT_SOURCE)
13 clean: clean_txt
```

## 6.3 Extracting Program Source

The program source is extracted using `fangle`, which is designed to operate on text or a L<sup>A</sup>T<sub>E</sub>X documents<sup>4</sup>.

```
25b <Makefile.inc-vars[5]() ↑23b, lang=> +≡ <24d 25c∇
11 FANGLE_SOURCE=$(TXT_SOURCE)
```

The literate document can result in any number of source files, but not all of these will be changed each time the document is updated. We certainly don't want to update the timestamps of these files and cause the whole source tree to be recompiled just because the literate explanation was revised. We use `CPIF` from the *Noweb* tools to avoid updating the file if the content has not changed, but should probably write our own.

However, if a source file is not updated, then the `fangle` file will always have a newer time-stamp and the makefile would always re-attempt to extract a newer source file which would be a waste of time.

Because of this, we use a stamp file which is always updated each time the sources are fully extracted from the L<sup>A</sup>T<sub>E</sub>X document. If the stamp file is newer than the document, then we can avoid an attempt to re-extract any of the sources. Because this stamp file is only updated when extraction is complete, it is safe for the user to interrupt the build-process mid-extraction.

We use `echo` rather than `touch` to update the stamp file because the `touch` command does not work very well over an `sshfs` mount that I was using.

```
25c <Makefile.inc-vars[6]() ↑23b, lang=> +≡ Δ25b 26a∇
12 FANGLE_SOURCE_STAMP=$(FANGLE_SOURCE).stamp
```

```
25d <Makefile.inc-targets[3]() ↑24c, lang=> +≡ Δ25a 26b∇
14 $(FANGLE_SOURCE_STAMP): $(FANGLE_SOURCE) \
15 ↪      $(FANGLE_SOURCES) ; \
16 ↪      echo -n > $(FANGLE_SOURCE_STAMP)
17 clean_stamp:
18 ↪      rm -f $(FANGLE_SOURCE_STAMP)
19 clean: clean_stamp
```

## 6.4 Extracting Source Files

We compute `FANGLE_SOURCES` to hold the names of all the source files defined in the document. We compute this only once, by means of `:=` in assignment. The `sed` deletes the any `<<` and `>>` which may surround the roots names (for compatibility with *Noweb*'s `noroots` command).

4. L<sup>A</sup>T<sub>E</sub>X documents are just slightly special text documents

As we use chunk names beginning with `./` to denote top level fragments that should be extracted, we filter out all fragments that do not begin with `./`

**Note 1.** `FANGLE_PREFIX` is set to `./` by default, but whatever it may be overridden to, the prefix is replaced by a literal `./` before extraction so that files will be extracted in the current directory whatever the prefix. This helps namespace or sub-project prefixes like `documents:` for chunks like `documents:docbook/intro.xml`

To do: This doesn't work though, because it loses the full name and doesn't know what to extract!

26a `<Makefile.inc-vars[7]()`  $\uparrow$ 23b, lang= $\Rightarrow$   $\equiv$   $\triangleleft$ 25c 26e $\nabla$

```
13 FANGLE_PREFIX:=\.\./
14 FANGLE_SOURCES:=$(shell \
15   $(RUN_FANGLE) -r $(FANGLE_SOURCE) |\
16   sed -e 's/^[<][<]//;s/[>][>]$$$//;~$(FANGLE_PREFIX)/!d' \
17       -e 's/^(FANGLE_PREFIX)/\.\./')
```

The target below, `echo_fangle_sources` is a helpful debugging target and shows the names of the files that would be extracted.

26b `<Makefile.inc-targets[4]()`  $\uparrow$ 24c, lang= $\Rightarrow$   $\equiv$   $\triangleleft$ 25d 26c $\nabla$

```
20 .PHONY: echo_fangle_sources
21 echo_fangle_sources: ; @echo $(FANGLE_SOURCES)
```

We define a convenient target called `fangle_sources` so that `make -f fangle_sources` will extract the source if the literate document has been updated.

26c `<Makefile.inc-targets[5]()`  $\uparrow$ 24c, lang= $\Rightarrow$   $\equiv$   $\triangle$ 26b 26d $\nabla$

```
22 .PHONY: fangle_sources
23 fangle_sources: $(FANGLE_SOURCE_STAMP)
```

And also a convenient target to remove extracted sources.

26d `<Makefile.inc-targets[6]()`  $\uparrow$ 24c, lang= $\Rightarrow$   $\equiv$   $\triangle$ 26c 27f $\triangleright$

```
24 .PHONY: clean_fangle_sources
25 clean_fangle_sources: ; \
26   rm -f -- $(FANGLE_SOURCE_STAMP) $(FANGLE_SOURCES)
```

We now look at the extraction of the source files.

This makefile macro `if_extension` takes 4 arguments: the filename  $\$(1)$ , some extensions to match  $\$(2)$  and a shell command to return if the filename does match the extensions  $\$(3)$ , and a shell command to return if it does not match the extensions  $\$(4)$ .

26e `<Makefile.inc-vars[8]()`  $\uparrow$ 23b, lang= $\Rightarrow$   $\equiv$   $\triangle$ 26a 27a $\triangleright$

```
18 if_extension=$(if $(findstring $(suffix $(1)),$(2)),$(3)),$(4))
```

For some source files like C files, we want to output the line number and filename of the original L<sup>A</sup>T<sub>E</sub>X document from which the source came<sup>5</sup>.

To make this easier we define the file extensions for which we want to do this.

5. I plan to replace this option with a separate mapping file so as not to pollute the generated source, and also to allow a code pretty-printing reformatter like `indent` be able to re-format the file and adjust for changes through comparing the character streams.

27a `<Makefile.inc-vars[9]()`  $\uparrow$ 23b, lang=`=`) `+≡`  $\triangleleft$ 26e 27b $\triangleright$

```
19 C_EXTENSIONS=.c .h
```

~~~~~

We can then use the `if_extensions` macro to define a macro which expands out to the `-L` option if `fangle` is being invoked in a C source file, so that C compile errors will refer to the line number in the \TeX document.

27b `<Makefile.inc-vars[10]()` \uparrow 23b, lang=`=`) `+≡` \triangleleft 27a 27c \triangleright

```
20 TABS=8
21 nf_line=-L -T$(TABS)
22 fangle=$(RUN_FANGLE) $(call if_extension,$(2),$(C_EXTENSIONS),$(nf_line)) -R"$(2)" $(1)
```

~~~~~

We can use a similar trick to define an `indent` macro which takes just the filename as an argument and can return a pipeline stage calling the `indent` command. `indent` can be turned off with `make fangle_sources indent=`

27c `<Makefile.inc-vars[11]()`  $\uparrow$ 23b, lang=`=`) `+≡`  $\triangleleft$ 27b 27d $\triangleright$

```
23 indent_options=-npro -kr -i8 -ts8 -sob -l80 -ss -ncs
24 indent=$(call if_extension,$(1),$(C_EXTENSIONS), | indent $(indent_options))
```

~~~~~

We now define the pattern for extracting a file. The files are written using `noweb`'s `cpif` so that the file timestamp will not be touched if the contents haven't changed. This avoids the need to rebuild the entire project because of a typographical change in the documentation, or if none or a few C source files have changed.

27d `<Makefile.inc-vars[12]()` \uparrow 23b, lang=`=`) `+≡` \triangleleft 27c 27e \triangleright

```
25 fangle_extract=@mkdir -p $(dir $(1)) && \
26   $(call fangle,$(2),$(1)) > "$(1).tmp" && \
27   cat "$(1).tmp" $(indent) | cpif "$(1)" \
28   && rm -f -- "$(1).tmp" || \
29   (echo error fangling $(1) from $(2) ; exit 1)
```

~~~~~

We define a target which will extract or update all sources. To do this we first defined a makefile template that can do this for any source file in the  $\LaTeX$  document.

27e `<Makefile.inc-vars[13]()`  $\uparrow$ 23b, lang=`=`) `+≡`  $\triangleleft$ 27d 28b $\triangleright$

```
30 define FANGLE_template
31   $(1): $(2)
32   ↪   $$$(call fangle_extract,$(1),$(2))
33   FANGLE_TARGETS+=$(1)
34 endef
```

~~~~~

We then enumerate the discovered `FANGLE_SOURCES` to generate a makefile rule for each one using the makefile template we defined above.

27f `<Makefile.inc-targets[7]()` \uparrow 24c, lang=`=`) `+≡` \triangleleft 26d 27g \triangleright

```
27 $(foreach source,$(FANGLE_SOURCES),\
28   $(eval $(call FANGLE_template,$(source),$(FANGLE_SOURCE))) \
29   )
```

~~~~~

These will all be built with `FANGLE_SOURCE_STAMP`.

We also remove the generated sources on a `make distclean`.

27g `<Makefile.inc-targets[8]()`  $\uparrow$ 24c, lang=`=`) `+≡`  $\triangleleft$ 27f 28c $\triangleright$

```
30 _distclean: clean_fangle_sources
```

~~~~~

6.5 Extracting Documentation

We then identify the intermediate stages of the documentation and their build and clean targets.

28a `<Makefile.inc-default-targets[1](), lang=> +≡`

```
1 .PHONEY : clean_pdf
```

6.5.1 Formatting T_EX

6.5.1.1 Running pdflatex

We produce a pdf file from the tex file.

28b `<Makefile.inc-vars[14](), ↑23b, lang=> +≡` <27e 28d>

```
35 FANGLE_PDF+=$(TEX_SOURCE:.tex=.pdf)
```

```
~~~~~
```

We run pdflatex twice to be sure that the contents and aux files are up to date. We certainly are *required* to run pdflatex at least twice if these files do not exist.

28c `<Makefile.inc-targets[9](), ↑24c, lang=> +≡` <27g 28e>

```
31 .SUFFIXES: .tex .pdf
```

```
32 .tex.pdf:
```

```
33 ↪      pdflatex $< && pdflatex $<
```

```
34
```

```
35 clean_pdf_tex:
```

```
36 ↪      rm -f -- $(FANGLE_PDF) $(TEX_SOURCE:.tex=.toc) \
```

```
37 ↪      $(TEX_SOURCE:.tex=.log) $(TEX_SOURCE:.tex=.aux)
```

```
38 clean_pdf: clean_pdf_tex
```

```
~~~~~
```

6.5.2 Formatting T_EX_{MACS}

T_EX_{MACS} can produce a PDF file directly.

28d `<Makefile.inc-vars[15](), ↑23b, lang=> +≡` Δ28b 29a>

```
36 FANGLE_PDF+=$(LITERATE_SOURCE:.tm=.pdf)
```

```
~~~~~
```

To do: Outputting the PDF may not be enough to update the links and page references. I think we need to update twice, generate a pdf, update twice mode and generate a new PDF. Basically the PDF export of T_EX_{MACS} is pretty rotten and doesn't work properly from the CLI

28e `<Makefile.inc-targets[10](), ↑24c, lang=> +≡` Δ28c 29b>

```
39 .SUFFIXES: .tm .pdf
```

```
40 .tm.pdf:
```

```
41 ↪      texmacs -s -c $< $@ -q
```

```
42
```

```
43 clean_pdf_texmacs:
```

```
44 ↪      rm -f -- $(FANGLE_PDF)
```

```
45 clean_pdf: clean_pdf_texmacs
```

```
~~~~~
```

6.5.3 Building the Documentation as a Whole

Currently we only build pdf as a final format, but FANGLE_DOCS may later hold other output formats.

29a `<[Makefile.inc-vars[16]()] ↑23b, lang=)` +≡ <[28d
 37 `FANGLE_DOCS=$(FANGLE_PDF)`

We also define `fangle_docs` as a convenient phony target.

29b `<[Makefile.inc-targets[11]()] ↑24c, lang=)` +≡ <[28e 29c∇
 46 `.PHONY: fangle_docs`
 47 `fangle_docs: $(FANGLE_DOCS)`
 48 `docs: fangle_docs`

~~~~~

And define a convenient `clean_fangle_docs` which we add to the regular clean target

29c `<[Makefile.inc-targets[12]()] ↑24c, lang=)` +≡ Δ29b  
 49 `.PHONEY: clean_fangle_docs`  
 50 `clean_fangle_docs: clean_tex clean_pdf`  
 51 `clean: clean_fangle_docs`  
 52  
 53 `distclean_fangle_docs: clean_tex clean_fangle_docs`  
 54 `distclean: clean distclean_fangle_docs`

---

## 6.6 Other helpers

If `Makefile.inc` is included into `Makefile`, then extracted files can be updated with this command:

```
make fangle_sources
```

otherwise, with:

```
make -f Makefile.inc fangle_sources
```

## 6.7 Boot-strapping the extraction

As well as having the makefile extract or update the source files as part of it's operation, it also seems convenient to have the makefile re-extracted itself from *this* document.

It would also be convenient to have the code that extracts the makefile from this document to also be part of this document, however we have to start somewhere and this unfortunately requires us to type at least a few words by hand to start things off.

Therefore we will have a minimal root fragment, which, when extracted, can cope with extracting the rest of the source. This shell script fragment can do that. It's name is `*` — out of regard for NOWEB, but when extracted might better be called `autoupdate`.

To do: De-lyxify

29d `<[*[1](), lang=sh)` ≡

---

```

1  #! /bin/sh
2
3  MAKE_SRC="${1:-${NW_LYX:-../../noweb-lyx/noweb-lyx3.lyx}}"
4  MAKE_SRC=$(dirname "$MAKE_SRC"'/$(basename "$MAKE_SRC" .lyx)')
5  NOWEB_SRC="${2:-${NOWEB_SRC:-$MAKE_SRC.lyx}}"
6  lyx -e latex $MAKE_SRC
7
8  fangle -R./Makefile.inc ${MAKE_SRC}.tex \
9  | sed "/FANGLE_SOURCE=/s/~/#/;T;aNOWEB_SOURCE=$FANGLE_SRC" \
10 | cpif ./Makefile.inc
```

29d `<*[1]()`, lang=sh) ≡

```
11
12 make -f ./Makefile.inc fangle_sources
```

The general Makefile can be invoked with `./autoboot` and can also be included into any automake file to automatically re-generate the source files.

The *autoboot* can be extracted with this command:

```
lyx -e latex fangle.lyx && \
  fangle fangle.lyx > ./autoboot
```

This looks simple enough, but as mentioned, `fangle` has to be had from somewhere before it can be extracted.

On a unix system this will extract `fangle.module` and the `fangle` awk script, and run some basic tests.

To do: cross-ref to test chapter when it is a chapter all on its own

## 6.8 Incorporating Makefile.inc into existing projects

If you are writing a literate module of an existing non-literate program you may find it easier to use a slight recursive make instead of directly including `Makefile.inc` in the projects makefile.

This way there is less chance of definitions in `Makefile.inc` interfering with definitions in the main makefile, or with definitions in other `Makefile.inc` from other literate modules of the same project.

To do this we add some *glue* to the project makefile that invokes `Makefile.inc` in the right way. The glue works by adding a `.PHONY` target to call the recursive make, and adding this target as an additional pre-requisite to the existing targets.

### Example Sub-module of existing system

In this example, we are building `module.so` as a literate module of a larger project.

We will show the sort glue that can be inserted into the projects Makefile — or more likely — a regular Makefile included in or invoked by the projects Makefile.

30a `<makefile-glue[1]()`, lang=) ≡ 30b∇

```
1 module_srcdir=modules/module
2 MODULE_SOURCE=module.tm
3 MODULE_STAMP=$(MODULE_SOURCE).stamp
```

~~~~~

The existing build system may already have a build target for `module.o`, but we just add another pre-requisite to that. In this case we use `module.tm.stamp` as a pre-requisite, the stamp file's modified time indicating when all sources were extracted⁶.

30b `<makefile-glue[2]()` ↑30a, lang=make) +≡ Δ30a 30c∇

```
4 $(module_srcdir)/module.o: $(module_srcdir)/$(MODULE_STAMP)
```

~~~~~

The target for this new pre-requisite will be generated by a recursive make using `Makefile.inc` which will make sure that the source is up to date, before it is built by the main projects makefile.

30c `<makefile-glue[3]()` ↑30a, lang=) +≡ Δ30b 31a∇

```
5 $(module_srcdir)/$(MODULE_STAMP): $(module_srcdir)/$(MODULE_SOURCE)
6 ↪      $(MAKE) -C $(module_srcdir) -f Makefile.inc fangle_sources LITERATE_SOURCE=$(MODULE_SOURCE)
```

~~~~~

6. If the projects build system does not know how to build the module from the extracted sources, then just add build actions here as normal.

We can do similar glue for the docs, clean and distclean targets. In this example the main project was using a double colon for these targets, so we must use the same in our glue.

```
31a <makefile-glue[4]() ↑30a, lang=> +≡ <130c
7 docs:: docs_module
8 .PHONY: docs_module
9 docs_module:
10 ↪ $(MAKE) -C $(module_srcdir) -f Makefile.inc docs LITERATE_SOURCE=$(MODULE_SOURCE)
11
12 clean:: clean_module
13 .PHONEY: clean_module
14 clean_module:
15 ↪ $(MAKE) -C $(module_srcdir) -f Makefile.inc clean LITERATE_SOURCE=$(MODULE_SOURCE)
16
17 distclean:: distclean_module
18 .PHONY: distclean_module
19 distclean_module:
20 ↪ $(MAKE) -C $(module_srcdir) -f Makefile.inc distclean LITERATE_SOURCE=$(MODULE_SOURCE)
```

We could do similarly for install targets to install the generated docs.

Part II

Source Code

Chapter 7

Fangle Makefile

We use the copyright notice from chapter 2, and the Makefile.inc from chapter 6

35a `<./Makefile[1](), lang=make> ≡`

```
1 # <gpl3-copyright 4a>
2
3 <make-fix-make-shell 55c>
4
5 LITERATE_SOURCE=fangle.tm
6
7 all: fangle_sources
8 include Makefile.inc
9
10 fangle: test
11
12 .PHONEY: test
13 test: fangle.txt
14 ↪      $(RUN_FANGLE) -R"test:*" fangle.txt > test.sh
15 ↪      bash test.sh ; echo pass $$?
```

Chapter 8

Fangle awk source code

We use the copyright notice from chapter 2.

37a `</fangle[1]() , lang=awk> ≡` 37b▽

```
1  #!/usr/bin/awk -f
2  # <gpl3-copyright 4a>
```

~~~~~

We also use code from ARNOLD ROBBINS public domain getopt (1993 revision) defined in 85a, and naturally want to attribute this appropriately.

37b `</fangle[2]() ↑37a, lang=> +≡` △37a 37c▽

```
3  # NOTE: Arnold Robbins public domain getopt for awk is also used:
4  <getopt.awk-header 83a>
5  <getopt.awk-getopt() 83c>
6
```

~~~~~

And include the following chunks (which are explained further on) to make up the program:

37c `</fangle[3]() ↑37a, lang=> +≡` △37b 42a▷

```
7  <helper-functions 38d>
8  <mode-tracker 62b>
9  <parse_chunk_args 44a>
10 <chunk-storage-functions 81b>
11 <output_chunk_names() 75d>
12 <output_chunks() 75e>
13 <write_chunk() 76a>
14 <expand_chunk_args() 44b>
15
16 <begin 73d>
17 <recognize-chunk 65a>
18 <end 75c>
```

~~~~~

### 8.1 AWK tricks

The portable way to erase an array in awk is to split the empty string, so we define a fangle macro that can split an array, like this:

37d `<awk-delete-array[1](ARRAY), lang=awk> ≡`

```
1  split("", <ARRAY>);
```

~~~~~

For debugging it is sometimes convenient to be able to dump the contents of an array to `stderr`, and so this macro is also useful.

37e `<dump-array[1](ARRAY), lang=awk> ≡`

```
1  print "\nDump: <ARRAY>\n-----\n" > "/dev/stderr";
2  for (_x in <ARRAY>) {
```

37e `<dump-array[1](ARRAY, lang=awk) ≡`

```
3 print _x "=" <ARRAY>[_x] "\n" > "/dev/stderr";
4 }
5 print "=====\n" > "/dev/stderr";
```

8.2 Catching errors

Fatal errors are issued with the error function:

38a `<error()[1](), lang=awk) ≡` 38b▽

```
1 function error(message)
2 {
3     print "ERROR: " FILENAME ":" FNR " " message > "/dev/stderr";
4     exit 1;
5 }
```

~~~~~

and likewise for non-fatal warnings:

38b `<error()[2]() ↑38a, lang=awk) +≡` Δ38a 38c▽

```
6 function warning(message)
7 {
8     print "WARNING: " FILENAME ":" FNR " " message > "/dev/stderr";
9     warnings++;
10 }
```

~~~~~

and debug output too:

38c `<error()[3]() ↑38a, lang=awk) +≡` Δ38b

```
11 function debug_log(message)
12 {
13     print "DEBUG: " FILENAME ":" FNR " " message > "/dev/stderr";
14 }
```

To do: append=helper-functions

38d `<helper-functions[1](), lang=) ≡`

```
1 <error() 38a)
```

Chapter 9

TEX_{MACS} args

TEX_{MACS} functions with arguments¹ appear like this:

blah(argument 1 argument 3 term.
I came, I saw, I conquered `~K`, and then went home asd `~K`)
arguments

Arguments commence after the opening parenthesis. The first argument runs up till the next `~K`.

If the following character is a `,` then another argument follows. If the next character after the `,` is a space character, then it is also eaten. The fangle stylesheet emits `~K`, `space` as separators, but the fangle untangler will forgive a missing space.

If the following character is `)` then this is a terminator and there are no more arguments.

39a `<constants>[1](), lang=> ≡` 81a>

```
1 ARG_SEPARATOR=sprintf("%c", 11);
```

~~~~~

To process the text in this fashion, we split the string on `~K`

39b `<get_chunk_args>[1](), lang=> ≡`

```
1 function get_texmacs_chunk_args(text, args, a, done) {
2   split(text, args, ARG_SEPARATOR);
3
4   done=0
5   for (a=1; (a in args); a++) if (a>1) {
6     if (args[a] == "" || substr(args[a], 1, 1) == ")") done=1;
7     if (done) {
8       delete args[a];
9       break;
10    }
11
12    if (substr(args[a], 1, 2) == ", ") args[a]=substr(args[a], 3);
13    else if (substr(args[a], 1, 1) == ",") args[a]=substr(args[a], 2);
14  }
15 }
```

---

1. or function declarations with parameters



# Chapter 10

## L<sup>A</sup>T<sub>E</sub>X and lstlistings

To do: Split LyX and TeXmacs parts

For L<sup>A</sup>T<sub>E</sub>X and L<sup>A</sup>T<sub>E</sub>X, the `lstlistings` package is used to format the lines of code chunks. You may recal from chapter XXX that arguments to a chunk definition are pure L<sup>A</sup>T<sub>E</sub>X code. This means that fangle needs to be able to parse L<sup>A</sup>T<sub>E</sub>X a little.

L<sup>A</sup>T<sub>E</sub>X arguments to `lstlistings` macros are a comma separated list of key-value pairs, and values containing commas are enclosed in `{ braces }` (which is to be expected for L<sup>A</sup>T<sub>E</sub>X).

A sample expressions is:

```
name=thomas, params={a, b}, something, something-else
```

but we see that this is just a simpler form of this expression:

```
name=freddie, foo={bar=baz, quux={quirk, a=fleeg}}, etc
```

We may consider that we need a function that can parse such L<sup>A</sup>T<sub>E</sub>X expressions and assign the values to an AWK associated array, perhaps using a recursive parser into a multi-dimensional hash<sup>1</sup>, resulting in:

| key                 | value   |
|---------------------|---------|
| a[name]             | freddie |
| a[foo, bar]         | baz     |
| a[foo, quux, quirk] |         |
| a[foo, quux, a]     | fleeg   |
| a[etc]              |         |

Yet, also, on reflection it seems that sometimes such nesting is not desirable, as the braces are also used to delimit values that contain commas — we may consider that

```
name={williamson, freddie}
```

should assign `williamson, freddie` to `name`.

In fact we are not so interested in the detail so as to be bothered by this, which turns out to be a good thing for two reasons. Firstly T<sub>E</sub>X has a malleable parser with no strict syntax, and secondly whether or not `williamson` and `freddie` should count as two items will be context dependant anyway.

We need to parse this latex for only one reason; which is that we are extending `lstlistings` to add some additional arguments which will be used to express chunk parameters and other chunk options.

### 10.1 Additional lstlistings parameters

Further on we define a `\Chunk` L<sup>A</sup>T<sub>E</sub>X macro whose arguments will consist of a the chunk name, optionally followed by a comma and then a comma separated list of arguments. In fact we will just need to prefix `name=` to the arguments to in order to create valid `lstlistings` arguments.

1. as AWK doesn't have nested-hash support



`a[3]` will be either `=` or `,` and signify whether the option named in `a[1]` has a value or not (respectively).

If the option does have a value, then if the expression `substr(a[4],1,1)` returns a brace `{` it will signify that we need to recurse:

```
43a <parse-chunk-args[2]() ↑42d, lang=> +≡ <42d
4 name=a[1];
5 if (a[3] == "=") {
6   if (substr(a[4],1,1) == "{") {
7     text = get_tex_chunk_args(substr(a[4],2), values, path name SUBSEP);
8   } else {
9     values[path name]=a[5];
10    text = a[6];
11  }
12 } else {
13   values[path name]="";
14   text = a[2];
15 }
```

We can test this function like this:

```
43b <gca-test.awk[1](), lang=> ≡
1 <get_chunk_args() 42b
2 BEGIN {
3   SUBSEP=".";
4
5   print get_tex_chunk_args("name=freddie, foo={bar=baz, quux={quirk, a=fleeg}}, etc", a);
6   for (b in a) {
7     print "a[" b "]" => " a[b]";
8   }
9 }
```

which should give this output:

```
43c <gca-test.awk-results[1](), lang=> ≡
1 a[foo.quux.quirk] =>
2 a[foo.quux.a] => fleeg
3 a[foo.bar] => baz
4 a[etc] =>
5 a[name] => freddie
```

## 10.2 Parsing chunk arguments

Arguments to parameterized chunks are expressed in round brackets as a comma separated list of optional arguments. For example, a chunk that is defined with:

```
\Chunk{achunk, params=name ; address}
```

could be invoked as:

```
\chunkref{achunk}(John Jones, jones@example.com)
```

An argument list may be as simple as in `\chunkref{pull}(thing, otherthing)` or as complex as:

```
\chunkref{pull}(things[x, y], get_other_things(a, "(all)"))
```

— which for all its commas and quotes and parenthesis represents only two parameters: `things[x, y]` and `get_other_things(a, "(all)")`.

If we simply split parameter list on commas, then the comma in `things[x,y]` would split into two separate arguments: `things[x` and `y]`— neither of which make sense on their own.

One way to prevent this would be by refusing to split text between matching delimiters, such as `[, ], (, ), {, }` and most likely also `", " and ', '`. Of course this also makes it impossible to pass such mis-matched code fragments as parameters, but I think that it would be hard for readers to cope with authors who would pass such code unbalanced fragments as chunk parameters<sup>2</sup>.

Unfortunately, the full set of matching delimiters may vary from language to language. In certain C++ template contexts, `<` and `>` would count as delimiters, and yet in other contexts they would not.

This puts me in the unfortunate position of having to parse-somewhat all programming languages without knowing what they are!

However, if this universal mode-tracking is possible, then parsing the arguments would be trivial. Such a mode tracker is described in chapter 11 and used here with simplicity.

44a `<parse_chunk_args[1](), lang=>` ≡

---

```

1 function parse_chunk_args(language, text, values, mode,
2   # local vars
3   c, context, rest)
4 {
5   <new-mode-tracker(context, language, mode) 58b>
6   rest = mode_tracker(context, text, values);
7   # extract values
8   for(c=1; c <= context[0, "values"]; c++) {
9     values[c] = context[0, "values", c];
10  }
11  return rest;
12 }
```

---

### 10.3 Expanding parameters in the text

Within the body of the chunk, the parameters are referred to with: `#{name}` and `#{address}`. There is a strong case that a L<sup>A</sup>T<sub>E</sub>X style notation should be used, like `\param{name}` which would be expressed in the listing as `=<\param{name}>` and be rendered as `<name>`. Such notation would make me go blind, but I do intend to adopt it.

We therefore need a function `expand_chunk_args` which will take a block of text, a list of permitted parameters, and the arguments which must substitute for the parameters.

Here we split the text on `#{` which means that all parts except the first will begin with a parameter name which will be terminated by `}`. The split function will consume the literal `#{` in each case.

44b `<expand_chunk_args()[1](), lang=>` ≡

---

```

1 function expand_chunk_args(text, params, args,
2   p, text_array, next_text, v, t, l)
3 {
4   if (split(text, text_array, "\\#{") {
5     <substitute-chunk-args 45a>
6   }
7
8   return text;
9 }
```

---

First, we produce an associative array of substitution values indexed by parameter names. This will serve as a cache, allowing us to look up the replacement values as we extract each name.

<sup>2</sup> I know that I couldn't cope with users doing such things, and although the GPL3 license prevents me from actually forbidding anyone from trying, if they want it to work they'll have to write the code themselves and not expect any support from me.

45a `<substitute-chunk-args[1](), lang=> ≡` 45b∇

```
1 for(p in params) {
2   v[params[p]]=args[p];
3 }
```

~~~~~

We accumulate substituted text in the variable `text`. As the first part of the split function is the part before the delimiter — which is `#{` in our case — this part will never contain a parameter reference, so we assign this directly to the result kept in `$text`.

45b `<substitute-chunk-args[2]() ↑45a, lang=> +≡` Δ45a 45c∇

```
4 text=text_array[1];
```

~~~~~

We then iterate over the remaining values in the array, and substitute each reference for it's argument.

45c `<substitute-chunk-args[3]() ↑45a, lang=> +≡` Δ45b

```
5 for(t=2; t in text_array; t++) {
6   <substitute-chunk-arg 45d>
7 }
```

~~~~~

After the split on `#{` a valid parameter reference will consist of valid parameter name terminated by a close-brace `}`. A valid character name begins with the underscore or a letter, and may contain letters, digits or underscores.

A valid looking reference that is not actually the name of a parameter will be and not substituted. This is good because there is nothing to substitute anyway, and it avoids clashes when writing code for languages where `#{...}` is a valid construct — such constructs will not be interfered with unless the parameter name also matches.

45d `<substitute-chunk-arg[1](), lang=> ≡`

```
1 if (match(text_array[t], "[a-zA-Z_][a-zA-Z0-9_]*", 1) &&
2     l[1] in v)
3 {
4   text = text v[l[1]] substr(text_array[t], length(l[1])+2);
5 } else {
6   text = text "${" text_array[t];
7 }
```

~~~~~



# Chapter 11

## Language Modes & Quoting

`lstlistings` and `fangle` both recognize source languages, and perform some basic parsing and syntax highlighting in the rendered document<sup>1</sup>. `lstlistings` can detect strings and comments within a language definition and perform suitable rendering, such as italics for comments, and visible-spaces within strings.

Fangle similarly can recognize strings, and comments, etc, within a language, so that any chunks included with `\chunkref{a-chunk}` or `<a-chunk ?>` can be suitably escape or quoted.

### 11.1 Modes explanation

As an example, the C language has a few parse modes, which affect the interpretation of characters.

One parse mode is the string mode. The string mode is commenced by an un-escaped quotation mark `"` and terminated by the same. Within the string mode, only one additional mode can be commenced, it is the backslash mode `\`, which is always terminated by the following character.

Another mode is `[` which is terminated by a `]` (unless it occurs in a string).

Consider this fragment of C code:

$$\text{do\_something} \left( \overbrace{\text{things } \underbrace{[x, y]}_{2. \text{ [mode]}} , \text{ get\_other\_things} \left( \underbrace{a, \underbrace{"(all)"}_{4. \text{ "mode}}} \right)}_{3. \text{ (mode)}} \right)_{1. \text{ (mode)}}$$

Mode nesting prevents the close parenthesis in the quoted string (part 4) from terminating the parenthesis mode (part 3).

Each language has a set of modes, the default mode being the null mode. Each mode can lead to other modes.

### 11.2 Modes affect included chunks

For instance, consider this chunk with `language=perl`:

47a `<test:example-perl[1](), lang=perl> ≡`

---

```
1 print "hello world $0\n";
```

---

If it were included in a chunk with `language=sh`, like this:

47b `<test:example-sh[1](), lang=sh> ≡`

---

```
1 perl -e "<test:example-perl 47a>"
```

---



---

1. although `lstlisting` supports many more languages

we might want fangle would to generate output like this:

48a `<test:example-sh.result[1](), lang=sh> ≡`

---

```
1 perl -e "print \"hello world \\$0\\n\";"
```

---

See that the double quote `"`, back-slash `\` and `$` have been quoted with a back-slash to protect them from shell interpretation.

If that were then included in a chunk with `language=make`, like this:

48b `<test:example-makefile[1](), lang=make> ≡`

---

```
1 target: pre-req
2 ↳      (test:example-sh 47b)
```

---

We would need the output to look like this — note the `$$` as the single `$` has been makefile-quoted with another `$`.

48c `<test:example-makefile.result[1](), lang=make> ≡`

---

```
1 target: pre-req
2 ↳      perl -e "print \"hello world \\$$0\\n\";"
```

---

## 11.3 Language Mode Definitions

In order to make this work, we must define a mode-tracker supporting each language, that can detect the various quoting modes, and provide a transformation that may be applied to any included text so that included text will be interpreted correctly after any interpolation that it may be subject to at run-time.

For example, the sed transformation for text to be inserted into shell double-quoted strings would be something like:

```
s/\\/\\/\\/\\/g;s/$/\\$/g;s/"\\/\\/"/g;
```

which would protect `\ $ "`

All modes definitions are stored in a single multi-dimensional hash called `modes`:

```
modes[language, mode, properties]
```

The first index is the language, and the second index is the mode. The third indexes hold properties such as terminators, possible submodes, transformations, and so forth.

48d `<xmode:set-terminators[1](language, mode, terminators), lang=> ≡`

---

```
1 modes["<language>", "<mode>", "terminators"]="<terminators>";
```

---

48e `<xmode:set-submodes[1](language, mode, submodes), lang=> ≡`

---

```
1 modes["<language>", "<mode>", "submodes"]="<submodes>";
```

---

A useful set of mode definitions for a nameless general C-type language is shown here.

Don't be confused by the double backslash escaping needed in awk. One set of escaping is for the string, and the second set of escaping is for the regex.

To do: TODO: Add `=<\mode{>` command which will allow us to signify that a string is regex and thus fangle will quote it for us.

Sub-modes are identified by a backslash, a double or single quote, various bracket styles or a `/*` comment; specifically: `\ " ' { ( [ /*`

For each of these sub-modes modes we must also identify at a mode terminator, and any sub-modes or delimiters that may be entered<sup>2</sup>.

49a `<common-mode-definitions[1](language), lang=>`  $\equiv$  49b $\nabla$

```
1 modes[(language), "", "submodes"]="\\|'|\(|\[";
```

~~~~~

In the default mode, a comma surrounded by un-important white space is a delimiter of language items³. Delimiters are used so that fangle can parse and recognise arguments individually.

49b `<common-mode-definitions[2](language) ↑49a, lang=>` $+ \equiv$ Δ 49a 49d ∇

```
2 modes[(language), "", "delimiters"]=" *, *";
```

~~~~~

and should pass this test: To do: Why do the tests run in ?? mode and not ?? mode

49c `<test:mode-definitions[1](), lang=>`  $\equiv$  50g $\triangleright$

```
1 parse_chunk_args("c-like", "1,2,3", a, "");
2 if (a[1] != "1") e++;
3 if (a[2] != "2") e++;
4 if (a[3] != "3") e++;
5 if (length(a) != 3) e++;
6 <pca-test.awk:summary 62d>
```

```
7
8 parse_chunk_args("c-like", "joe, red", a, "");
9 if (a[1] != "joe") e++;
10 if (a[2] != "red") e++;
11 if (length(a) != 2) e++;
12 <pca-test.awk:summary 62d>
```

```
13
14 parse_chunk_args("c-like", "${colour}", a, "");
15 if (a[1] != "${colour}") e++;
16 if (length(a) != 1) e++;
17 <pca-test.awk:summary 62d>
```

~~~~~

11.3.1 Backslash

The backslash mode has no submodes or delimiters, and is terminated by any character. Note that we are not so much interested in evaluating or interpolating content as we are in delineating content. It is no matter that a double backslash (\\) may represent a single backslash while a backslash-newline may represent white space, but it does matter that the newline in a backslash newline should not be able to terminate a C pre-processor statement; and so the newline will be consumed by the backslash terminator however it may ultimately be interpreted.

49d `<common-mode-definitions[3](language) ↑49a, lang=>` $+ \equiv$ Δ 49b 50f \triangleright

```
3 modes[(language), "\\ ", "terminators"]=".";
```

~~~~~

### 11.3.2 Strings

Common languages support two kinds of strings quoting, double quotes and single quotes.

In a string we have one special mode, which is the backslash. This may escape an embedded quote and prevent us thinking that it should terminate the string.

<sup>2</sup> Because we are using the sub-mode characters as the mode identifier it means we can't currently have a mode character dependant on it's context; i.e. { can't behave differently when it is inside [.

<sup>3</sup> whatever a *language item* might be

50a `<mode:common-string[1](language, quote), lang=> ≡` 50b∇

```
1 modes[<language>, <quote>, "submodes"]="\\\\";
```

~~~~~

Otherwise, the string will be terminated by the same character that commenced it.

50b `<mode:common-string[2](language, quote) ↑50a, lang=> +≡` Δ50a 50c∇

```
2 modes[<language>, <quote>, "terminators"]=<quote>;
```

~~~~~

In C type languages, certain escape sequences exist in strings. We need to define mechanism to enclose any chunks included in this mode using those escape sequences. These are expressed in two parts, s meaning search, and r meaning replace.

The first substitution is to replace a backslash with a double backslash. We do this first as other substitutions may introduce a backslash which we would not then want to escape again here.

Note: Backslashes need double-escaping in the search pattern but not in the replacement string, hence we are replacing a literal `\` with a literal `\\`.

50c `<mode:common-string[3](language, quote) ↑50a, lang=> +≡` Δ50b 50d∇

```
3 escapes[<language>, <quote>, ++escapes[<language>, <quote>], "s"]="\\\\";
```

```
4 escapes[<language>, <quote>, escapes[<language>, <quote>], "r"]="\\\\";
```

~~~~~

If the quote character occurs in the text, it should be preceded by a backslash, otherwise it would terminate the string unexpectedly.

50d `<mode:common-string[4](language, quote) ↑50a, lang=> +≡` Δ50c 50e∇

```
5 escapes[<language>, <quote>, ++escapes[<language>, <quote>], "s"]=<quote>;
```

```
6 escapes[<language>, <quote>, escapes[<language>, <quote>], "r"]="\\" <quote>;
```

~~~~~

Any newlines in the string, must be replaced by `\n`.

50e `<mode:common-string[5](language, quote) ↑50a, lang=> +≡` Δ50d

```
7 escapes[<language>, <quote>, ++escapes[<language>, <quote>], "s"]="\n";
```

```
8 escapes[<language>, <quote>, escapes[<language>, <quote>], "r"]="\n";
```

~~~~~

For the common modes, we define this string handling for double and single quotes.

50f `<common-mode-definitions[4](language) ↑49a, lang=> +≡` <49d 51b>

```
4 <mode:common-string(<language> "\"" ) 50a)
```

```
5 <mode:common-string(<language> "'" ) 50a)
```

~~~~~

Working strings should pass this test:

50g `<test:mode-definitions[2]() ↑49c, lang=> +≡` <49c 57b>

```
18 parse_chunk_args("c-like", "say \"I said, \\\"Hello, how are you\\\".\", for me", a, "");
```

```
19 if (a[1] != "say \"I said, \\\"Hello, how are you\\\".\") e++;
```

```
20 if (a[2] != "for me") e++;
```

```
21 if (length(a) != 2) e++;
```

```
22 <pca-test.awk:summary 62d)
```

~~~~~

11.3.3 Parentheses, Braces and Brackets

Where quotes are closed by the same character, parentheses, brackets and braces are closed by an alternate character.

51h `<mode:add-hash-defines[1](language), lang=>` ≡

```
4 <mode:add-escapes(<language> "#", "\n", "\\\"") 51d
```

52a `<mode:quote-dollar-escape[1](language, quote), lang=>` ≡

```
1 escapes[<language>, <quote>, ++escapes[<language>, <quote>], "s"]="\"$";
2 escapes[<language>, <quote>, escapes[<language>, <quote>], "r"]="\"$";
```

We can add these definitions to various languages

52b `<mode:definitions[1](), lang=>` ≡

53a>

```
1 <common-mode-definitions("c-like") 49a)
2
3 <common-mode-definitions("c") 49a)
4 <mode:multi-line-comments("c") 51e)
5 <mode:single-line-slash-comments("c") 51f)
6 <mode:add-hash-defines("c") 51h)
7
8 <common-mode-definitions("awk") 49a)
9 <mode:add-hash-comments("awk") 51g)
10 <mode:add-naked-regex("awk") 52g)
```

~~~~~

The awk definitions should allow a comment block like this:

52c `<test:comment-quote[1](), lang=awk>` ≡

```
1 # Comment: <test:comment-text 52d)
```

---

52d `<test:comment-text[1](), lang=>` ≡

```
1 Now is the time for
2 the quick brown fox to bring lemonade
3 to the party
```

---

to come out like this:

52e `<test:comment-quote:result[1](), lang=>` ≡

```
1 # Comment: Now is the time for
2 #the quick brown fox to bring lemonade
3 #to the party
```

---

The C definition for such a block should have it come out like this:

52f `<test:comment-quote:C-result[1](), lang=>` ≡

```
1 # Comment: Now is the time for\
2 the quick brown fox to bring lemonade\
3 to the party
```

---

### 11.3.6 Regex

This pattern is incomplete, but meant to detect naked regular expressions in awk and perl; e.g. `/.*$/`, however required capabilities are not present.

Current it only detects regexes anchored with `^` as used in fangle.

For full regex support, modes need to be named not after their starting character, but some other more fully qualified name.

52g `<mode:add-naked-regex[1](language), lang=>` ≡

```
1 <mode:add-submode(<language> "", "/\^") 51c)
```

52g `<mode:add-naked-regex[1](language), lang=>` ≡

```
2 modes[<language>, "/^", "terminators"]=" /";
```

---

### 11.3.7 Perl

53a `<mode-definitions[2]()` ↑52b, lang=> +≡ <52b 53b▽

```
11 <common-mode-definitions("perl") 49a>
12 <mode:multi-line-comments("perl") 51e>
13 <mode:add-hash-comments("perl") 51g>
```

~~~~~

Still need to add add s/, submode /, terminate both with //. This is likely to be impossible as perl regexes can contain perl.

11.3.8 sh

Shell single-quote strings are different to other strings and have no escape characters. The only special character is the single quote ' which always closes the string. Therefore we cannot use `<common-mode-definitions("sh") 49a>` but we will invoke most of it's definition apart from single-quote strings.

53b `<mode-definitions[3]()` ↑52b, lang=awk +≡ △53a 54a>

```
14 modes["sh", "", "submodes"]="\\\\\\|' |{|\\(|\\[|\\$\\(\\(";
15 modes["sh", "\\\"", "terminators"]=".";
16
17 modes["sh", "\\\"", "submodes"]="\\\\\\|\\$\\(\\(";
18 modes["sh", "\\\"", "terminators"]="\\"";
19 escapes["sh", "\\\"", ++escapes["sh", "\\\"", "s"]="\\\\\\|";
20 escapes["sh", "\\\"", escapes["sh", "\\\"", "r"]="\\\\\\|";
21 escapes["sh", "\\\"", ++escapes["sh", "\\\"", "s"]="\\"";
22 escapes["sh", "\\\"", escapes["sh", "\\\"", "r"]="\\" \"\\"";
23 escapes["sh", "\\\"", ++escapes["sh", "\\\"", "s"]="\\n";
24 escapes["sh", "\\\"", escapes["sh", "\\\"", "r"]="\\n";
25
26 modes["sh", "'", "terminators"]="'";
27 escapes["sh", "'", ++escapes["sh", "'", "s"]="'";
28 escapes["sh", "'", escapes["sh", "'", "r"]="'\\' ' '";
29 <mode:common-brackets("sh", "$(", "\\)") 51a>
30 <mode:add-tunnel("sh", "$(", "") 53c>
31 <mode:common-brackets("sh", "{", "}") 51a>
32 <mode:common-brackets("sh", "[", "\\]") 51a>
33 <mode:common-brackets("sh", "(", "\\)") 51a>
34 <mode:add-hash-comments("sh") 51g>
35 <mode:quote-dollar-escape("sh", "\\") 52a>
```

~~~~~

The definition of add-tunnel is:

53c `<mode:add-tunnel[1](language, mode, tunnel), lang=>` ≡

```
1 escapes[<language>, <mode>, ++escapes[<language>, <mode>], "tunnel"]=<tunnel>;
```

---

### 11.3.9 Make

BUGS: makefile tab mode is terminated by newline, but chunks never end in a newline! So tab mode is never closed unless there is a trailing blank line!

For makefiles, we currently recognize 2 modes: the *null* mode and  $\mapsto$  mode, which is tabbed mode and contains the makefile recipie.

54a `<mode-definitions[4]() ↑52b, lang=awk> +≡` △53b 54b▽

```
36 modes["make", "", "submodes"]="↪      ";
```

~~~~~

In the *null* mode the only escape is `$` which must be converted to `$$`, and hash-style comments. POSIX requires that line-continuations extend hash-style comments and so fangle-style transformations to replicate the hash at the start of each line is not strictly required, however it is harmless, easier to read, and required by some implementations of `make` which do not implement POSIX requirements correctly.

54b `<mode-definitions[5]() ↑52b, lang=awk> +≡` △54a 55d>

```
37 escapes["make", "", ++escapes["make", ""], "s"]="\\$";
38 escapes["make", "", escapes["make", ""], "r"]="$$";
39 <mode:add-hash-comments("make") 51g>
```

~~~~~

Tabbed mode is harder to manage, as the GNU Make Manual says in the section on splitting lines<sup>4</sup>. There is no obvious way to escape a multi-line text that occurs as part of a makefile recipe.

Traditionally, if the newline's in the shell script all occur at points of top-level shell syntax, then we could replace them with `↪` and largely get the right effect.

54c `<test:make:1[1]() , lang=make> ≡` 54d `<test:make:1-inc[1](target) , lang=sh> ≡`

|                                                                            |                                                                                                                                                                                                        |
|----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <pre>1 all: 2 ↪      echo making 3 ↪      (test:make:1-inc(\$@) 54d)</pre> | <pre>1 if test "&lt;target&gt;" = "all" 2 then echo yes, all 3 else echo "&lt;target&gt;"   sed -e '/^\\/{ 4                               p;s/^\\.\\. / 5                               }' 6 fi</pre> |
|----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

The two chunks above could reasonably produce something like this:

?a `<test:make:1.result.bad[1]() , lang=make> ≡`

```
1 all:
2 ↪      echo making
3 ↪      if test "$@" = "all" ;\
4 ↪      then echo yes, all ;\
5 ↪      else echo "$@" | sed -e '/^\\/{
6 ↪                               p;s/^\\.\\. /
7 ↪                               }' ;\
8 ↪      fi
```

However `;\` is not a proper continuation inside a multi-line sed script. There is no simple continuation that fangle could use — and in any case it would depend on what type of quote marks were used in the bash that contained the sed.

We would prefer to use a more intuitive single backslash at the end of the line, giving these results.

54a `<test:make:1.result[1]() , lang=make> ≡`

```
1 all:
2 ↪      echo making
3 ↪      if test "$$@" = "all"\
4 ↪      then echo yes, all\
5 ↪      else echo "$$@" | sed -e '/^\\/{
6 ↪                               p;s/^\\.\\. \
7 ↪                               }'\
8 ↪      fi
```

4. <http://www.gnu.org/s/hello/manual/make/Splitting-Lines.html>

The difficulty lies in the way that `make` handles the recipe. Each line of the recipe is invoked as a separate shell command (using `$(SHELL) -c`) unless the last character of the line was a backslash. In such a case, the backslash and the newline and the nextline are handed to the shell (although the tab character that prefixes the next line is stripped).

This behaviour makes it impossible to hand a newline character to the shell unless it is prefixed by a backslash. If an included shell fragment contained strings with literal newline characters then there would be no easy way to escape these and preserve the value of the string.

A different style of makefile construction might be used — the recipe could be stored in a target specific variable<sup>5</sup> which contains the recipe with a more normal escape mechanism.

A better solution is to use a shell helper that strips the back-slash which precedes the newline character and then passes the arguments to the normal shell.

Because this is a simple operation and because `bash` is so flexible, this can be managed in a single line *within the makefile itself*.

As a newline will only exist when preceded by the backslash, and as the purpose of the backslash is to protect the newline, that is needed is to remove any backslash that is followed by a newline.

`Bash` is capable of doing this with its pattern substitution. If `A=123:=456:=789` then `${A//:=/=}` will be `123=456=789`. We don't want to just perform the substitution in a single variable but in fact in all of `$(@)`, however `bash` will repeat substitution over all members of an array, so this is done automatically.

In `bash`, `$(\012)` represents the newline character (expressed as an octal escape sequence), so this expression will replace backslash-newline with a single newline.

55a `<fix-requote-newline[1](), lang=sh> ≡`

---

```
1 "${@//\`$'\012'/$'\012'}"
```

---

We use this as part of a larger statement which will invoke such a transformed command line using any particular shell. The trailing `--` prevents any options in the command line from being interpreted as options to our `bash` command — instead they will be transformed and passed to the inner shell which is invoked with `exec` so that our `fixup-shell` does not hang around longer than is needed.

55b `<fix-make-shell[1](shell), lang=sh> ≡`

---

```
1 bash -c 'exec $(shell) <fix-requote-newline 55a>' --
```

---

We can then include a line like this in our makefiles. We should rather pass `$(SHELL)` as the chunk argument than `bash`, but currently `fangle` will not track which nested-inclusion level the argument comes from and will quote the `$` in `$(SHELL)` in the same way it quotes a `$` that may occur in the `bash` script, so this would come out as `$$$(SHELL)` and have the wrong effect.

55c `<make-fix-make-shell[1](), lang=> ≡`

---

```
1 SHELL:=$(fix-make-shell(bash) 55b)
```

---

The full escaped and quoted text with `$(SHELL)` and suitable for inclusion in a Makefile is:

```
SHELL:=bash -c 'exec $(SHELL) "$${@//\`$'\012'\`/$$'\012'\`}'" --
```

Based on this, we just need to escape newlines (in tabbed mode) with a regular backslash:

Note that `terminators` applies to literal, not included text, escapes apply to included, not literal text; also that the tab character is hard-wired into the pattern, and that the make variable `.RECIPEPREFIX` might change this to something else.

---

5. [http://www.gnu.org/s/hello/manual/make/Target\\_002dspecific.html](http://www.gnu.org/s/hello/manual/make/Target_002dspecific.html)

55e `<test:make:1.result-actual[1](), lang=make> ≡`

55d `<mode-definitions[6]() ↑52b, lang=awk> +≡`

<54b

```
40 modes["make", "↳      ", "terminators"]="\\n";
41 escapes["make", "↳      ", ++escapes["make", "↳      "], "s"]="\\n";
42 escapes["make", "↳      ", escapes["make", "↳      "], "r"]="\\n↳      ";
```

---

With this improved quoting, the test on 54c will actually produce this:

55e `<test:make:1.result-actual[1](), lang=make> ≡`

```
1 all:
2 ↳      echo making
3 ↳      if test "$$@" = "all"\<
4 ↳          then echo yes, all\<
5 ↳          else echo not all\<
6 ↳      fi
```

---

The chunk argument `$$` has been quoted (which would have been fine if we were passing the name of a shell variable), and the other shell lines are (harmlessly) indented by 1 space as part of fangle indent-matching which should have taken into account the expanded tab size, and should generally take into account the expanded prefix of the line whose indent it is trying to match, but which in this case we want to have no effect at all!

To do: The `$$` was passed from a make fragment. In what cases should it be converted to `$$$`?  
Do we need to track the language of sources of arguments?

A more ugly work-around until this problem can be solved would be to use this notation:

56a `<test:make:2[1](), lang=make> ≡`

```
1 all:
2 ↳      echo making
3 ↳      ARG="$$"; <test:make:1-inc($ARG) 54d>
```

---

which produces this output which is more useful (because it works):

56b `<test:make:2.result[1](), lang=make> ≡`

```
1 all:
2 ↳      echo making
3 ↳      ARG="$$"; if test "$$ARG" = "all"\<
4 ↳          then echo yes, all\<
5 ↳          else echo "$$ARG" | sed -e '/^\\/{\
6 ↳                                  p;s/^/..\/\
7 ↳                                  }'\
8 ↳      fi
```

---

## 11.4 Quoting scenarios

### 11.4.1 Direct quoting

He we give examples of various quoting scenarios and discuss what the expected outcome might be and how this could be obtained.

56c `<test:q:1[1](), lang=sh> ≡`

```
1 echo "$(<test:q:1-inc 56d)"
```

---

56d `<test:q:1-inc[1](), lang=sh) ≡`

---

```
1 echo "hello"
```

---

Should this examples produce `echo "$(echo "hello")"` or `echo "$(echo \"hello\")"` ?

This depends on what the author intended, but we must provide a way to express that intent.

We might argue that as both chunks have `lang=sh` the intent must have been to quote the included chunk — but consider that this might be shell script that writes shell script.

If `<test:q:1-inc 56d` had `lang=text` then it certainly would have been right to quote it, which leads us to ask: in what ways can we reduce quoting if `lang` of the included chunk is compatible with the `lang` of the including chunk?

If we take a completely nested approach then even though `$(` mode might do no quoting of it's own, `"` mode will still do it's own quoting. We need a model where the nested `$(` mode will prevent `"` from quoting.

This leads rise to the *tunneling* feature. In `bash`, the `$(` gives rise to a new top-level parsing scenario, so we need to enter the *null* mode, and also ignore any quoting and then undo-this when the `$(` mode is terminated by the corresponding close `)`.

We shall say that tunneling is when a mode in a language ignores other modes in the same language and arrives back at an earlier *null* mode of the same language.

In example `<test:q:1 56c` above, the nesting of modes is: *null*, `"`, `$(`

When mode `$(` is commenced, the stack of nest modes will be traversed. If the *null* mode can be found in the same language, without the language varying, then a tunnel will be established so that the intervening modes, `"` in this case, can be skipped when the modes are enumerated to quote the text being emitted.

In such a case, the correct result would be:

57a `<test:q:1.result[1](), lang=sh) ≡`

---

```
1 echo "$(echo "hello")"
```

---

## 11.5 Some tests

Also, the parser must return any spare text at the end that has not been processed due to a mode terminator being found.

57b `<test:mode-definitions[3]() ↑49c, lang=) +≡`

<50g 57c∇

```
23 rest = parse_chunk_args("c-like", "1, 2, 3) spare", a, "(");
24 if (a[1] != 1) e++;
25 if (a[2] != 2) e++;
26 if (a[3] != 3) e++;
27 if (length(a) != 3) e++;
28 if (rest != " spare") e++;
29 <pca-test.awk:summary 62d
```

~~~~~

We must also be able to parse the example given earlier.

57c `<test:mode-definitions[4]() ↑49c, lang=) +≡`

Δ57b

```
30 parse_chunk_args("c-like", "things[x, y], get_other_things(a, \"(all)\")", 99", a, "(");
31 if (a[1] != "things[x, y]") e++;
32 if (a[2] != "get_other_things(a, \"(all)\")") e++;
33 if (a[3] != "99") e++;
34 if (length(a) != 3) e++;
```

35 `<pca-test.awk:summary 62d>`

11.6 A non-recursive mode tracker

As each chunk is output a new mode tracker for that language is initialized in it's normal state. As text is output for that chunk the output mode is tracked. When a new chunk is included, a transformation appropriate to that mode is selected and pushed onto a stack of transformations. Any text to be output is passed through this stack of transformations.

It remains to consider if the chunk-include function should return it's generated text so that the caller can apply any transformations (and formatting), or if it should apply the stack of transformations itself.

Note that the transformed included text should have the property of not being able to change the mode in the current chunk.

To do: Note chunk parameters should probably also be transformed

11.6.1 Constructor

The mode tracker holds its state in a stack based on a numerically indexed hash. This function, when passed an empty hash, will initialize it.

58a `<new_mode_tracker()>[1](), lang=>` ≡

```
1 function new_mode_tracker(context, language, mode) {
2   context[""] = 0;
3   context[0, "language"] = language;
4   context[0, "mode"] = mode;
5 }
```

Awk functions cannot return an array, but arrays are passed by reference. Because of this we must create the array first and pass it in, so we have a fangle macro to do this:

58b `<new-mode-tracker>[1](context, language, mode), lang=awk` ≡

```
1 <awk-delete-array>(context) 37d
2 new_mode_tracker(<context>, <language>, <mode>);
```

11.6.2 Management

And for tracking modes, we dispatch to a mode-tracker action based on the current language

58c `<mode_tracker>[1](), lang=awk` ≡

58d▽

```
1 function push_mode_tracker(context, language, mode,
2   # local vars
3   top)
4 {
5   if (! (" " in context)) {
6     (new-mode-tracker(context, language, mode) 58b)
7     return;
8   } else {
9     top = context[""];
10  #   if (context[top, "language"] == language && mode=="") mode = context[top, "mode"];
11     if (context[top, "language"] == language && context[top, "mode"] == mode) return top - 1;
12     old_top = top;
13     top++;
```

58e `<mode_tracker[3]() ↑58c, lang=> +≡`

Δ58d 63a▷

```
14     context[top, "language"] = language;
15     context[top, "mode"] = mode;
16     context[""] = top;
17   }
18   return old_top;
19 }
```

58d `<mode_tracker[2]() ↑58c, lang=> +≡`

Δ58c 58e▽

```
20 function dump_mode_tracker(context,
21   c, d)
22 {
23   for(c=0; c <= context[""]; c++) {
24     printf(" %2d  %s:%s\n", c, context[c, "language"], context[c, "mode"]) > "/dev/stderr";
25     #   for(d=1; ( (c, "values", d) in context); d++) {
26     #     printf("  %2d %s\n", d, context[c, "values", d]) > "/dev/stderr";
27     #   }
28   }
29 }
```

58e `<mode_tracker[3]() ↑58c, lang=> +≡`

Δ58d 63a▷

```
30 function pop_mode_tracker(context, context_origin)
31 {
32   if ( (context_origin) && (" in context) && context[""] != (1+context_origin) && context[""] !=
context_origin) {
33     print "Context level: " context[""] ", origin: " context_origin "\n" > "/dev/stderr"
34     return 0;
35   }
36   context[""] = context_origin;
37   return 1;
38 }
```

This implies that any chunk must be syntactically whole; for instance, this is fine:

59a `<test:whole-chunk[1]() , lang=> ≡`

```
1 if (1) {
2   <test:say-hello 59b>
3 }
```

59b `<test:say-hello[1]() , lang=> ≡`

```
1 print "hello";
```

But this is not fine; the chunk `<test:hidden-else 59d>` is not properly cromulent.

59c `<test:partial-chunk[1]() , lang=> ≡`

```
1 if (1) {
2   <test:hidden-else 59d>
3 }
```

59d `<test:hidden-else[1]() , lang=> ≡`

```
1   print "I'm fine";
2 } else {
3   print "I'm not";
```

These tests will check for correct behaviour:

59e `<test:cromulence[1]() , lang=> ≡`

```
1 echo Cromulence test
2 passtest $FANGLE -Rtest:whole-chunk $TXT_SRC &>/dev/null || ( echo "Whole chunk failed" && exit 1 )
```

```
3 failtest $FANGLE -Rtest:partial-chunk $TXT_SRC &>/dev/null || ( echo "Partial chunk failed" && exit 1
)
```

11.6.3 Tracker

We must avoid recursion as a language construct because we intend to employ mode-tracking to track language mode of emitted code, and the code is emitted from a function which is itself recursive, so instead we implement psuedo-recursion using our own stack based on a hash.

59f `<mode_tracker()[1](), lang=awk> ≡` 60a▷

```
1 function mode_tracker(context, text, values,
2   # optional parameters
3   # local vars
4   mode, submodes, language,
5   cindex, c, a, part, item, name, result, new_values, new_mode,
6   delimiters, terminators)
7 {
```

~~~~~

We could be re-commencing with a valid context, so we need to setup the state according to the last context.

60a `<mode_tracker()[2]() ↑59f, lang=> +≡` ◁59f 60d▽

```
8   cindex = context[""] + 0;
9   mode = context[cindex, "mode"];
10  language = context[cindex, "language" ];
```

~~~~~

First we construct a single large regex combining the possible sub-modes for the current mode along with the terminators for the current mode.

60b `<parse_chunk_args-reset-modes[1](), lang=> ≡` 60c▽

```
1   submodes=modes[language, mode, "submodes"];
2
3   if ((language, mode, "delimiters") in modes) {
4     delimiters = modes[language, mode, "delimiters"];
5     if (length(submodes)>0) submodes = submodes "|";
6     submodes=submodes delimiters;
7   } else delimiters="";
8   if ((language, mode, "terminators") in modes) {
9     terminators = modes[language, mode, "terminators"];
10    if (length(submodes)>0) submodes = submodes "|";
11    submodes=submodes terminators;
12  } else terminators="";
```

~~~~~

If we don't find anything to match on — probably because the language is not supported — then we return the entire text without matching anything.

60c `<parse_chunk_args-reset-modes[2]() ↑60b, lang=> +≡` △60b

```
13  if (! length(submodes)) return text;
```

---

60d `<mode_tracker()[3]() ↑59f, lang=> +≡` △60a 60e▽

```
11  <parse_chunk_args-reset-modes 60b>
```

~~~~~

We then iterate the text (until there is none left) looking for sub-modes or terminators in the regex.

60e `<mode_tracker()[4]() ↑59f, lang=> +≡` △60d 60f▽

```
12  while((cindex >= 0) && length(text)) {
```

```
13     if (match(text, "(" submodes ")", a)) {
```

~~~~~

A bug that creeps in regularly during development is bad regexes of zero length which result in an infinite loop (as no text is consumed), so I catch that right away with this test.

```
60f <mode_tracker()[5]() ↑59f, lang=) +≡ Δ60e 61a>
```

```
14     if (RLENGTH<1) {
15         error(sprintf("Internal error, matched zero length submode, should be impossible - likely
regex computation error\n" \
16             "Language=%s\nmode=%s\nmatch=%s\n", language, mode, submodes));
17     }
```

~~~~~

part is defined as the text up to the sub-mode or terminator, and this is appended to item — which is the current text being gathered. If a mode has a delimiter, then item is reset each time a delimiter is found.

~~~~~

item            item  
 "hello, there", he said.  
 item            item

```
61a <mode_tracker()[6]() ↑59f, lang=) +≡ <60f 61b>
```

```
18     part = substr(text, 1, RSTART - 1);
19     item = item part;
```

~~~~~

We must now determine what was matched. If it was a terminator, then we must restore the previous mode.

```
61b <mode_tracker()[7]() ↑59f, lang=) +≡ Δ61a 61c>
```

```
20     if (match(a[1], "^" terminators "$")) {
21 #printf("%2d EXIT MODE [%s] by [%s] [%s]\n", cindex, mode, a[1], text) > "/dev/stderr"
22     context[cindex, "values", ++context[cindex, "values"]] = item;
23     delete context[cindex];
24     context[""] = --cindex;
25     if (cindex>=0) {
26         mode = context[cindex, "mode"];
27         language = context[cindex, "language"];
28         <parse_chunk_args-reset-modes 60b>
29     }
30     item = item a[1];
31     text = substr(text, 1 + length(part) + length(a[1]));
32 }
```

~~~~~

If a delimiter was matched, then we must store the current item in the parsed values array, and reset the item.

```
61c <mode_tracker()[8]() ↑59f, lang=) +≡ Δ61b 61d>
```

```
33     else if (match(a[1], "^" delimiters "$")) {
34         if (cindex==0) {
35             context[cindex, "values", ++context[cindex, "values"]] = item;
36             item = "";
37         } else {
38             item = item a[1];
39         }
40     }
41     text = substr(text, 1 + length(part) + length(a[1]));
```

~~~~~

otherwise, if a new submode is detected (all submodes have terminators), we must create a nested parse context until we find the terminator for this mode.

```
61d <mode_tracker()[9]() ↑59f, lang=) +≡ Δ61c 62a>
```

```
42     else if ((language, a[1], "terminators") in modes) {
```

```

43     #check if new_mode is defined
44     item = item a[1];
45 #printf("%2d ENTER MODE [%s] in [%s]\n", cindex, a[1], text) > "/dev/stderr"
46     text = substr(text, 1 + length(part) + length(a[1]));
47     context[""] = ++cindex;
48     context[cindex, "mode"] = a[1];
49     context[cindex, "language"] = language;
50     mode = a[1];
51     (parse_chunk_args-reset-modes 60b)
52   } else {
53     error(sprintf("Submode '%s' set unknown mode in text: %s\nLanguage %s Mode %s\n", a[1], text,
language, mode));
54     text = substr(text, 1 + length(part) + length(a[1]));
55   }
56 }

```

~~~~~

In the final case, we parsed to the end of the string. If the string was entire, then we should have no nested mode context, but if the string was just a fragment we may have a mode context which must be preserved for the next fragment. Todo: Consideration ought to be given if sub-mode strings are split over two fragments.

62a `<mode_tracker>[1](), lang=> +≡` <61d

```

57 else {
58     context[cindex, "values", ++context[cindex, "values"]] = item text;
59     text = "";
60     item = "";
61 }
62 }
63
64 context["item"] = item;
65
66 if (length(item)) context[cindex, "values", ++context[cindex, "values"]] = item;
67 return text;
68 }

```

### 11.6.3.1 One happy chunk

All the mode tracker chunks are referred to here:

62b `<mode-tracker>[1](), lang=> ≡`

```

1 <new_mode_tracker() 58a>
2 <mode_tracker() 59f>

```

### 11.6.3.2 Tests

We can test this function like this:

62c `<pca-test.awk>[1](), lang=awk ≡`

```

1 <error() 38a>
2 <mode-tracker 62b>
3 <parse_chunk_args() ?>
4 BEGIN {
5     SUBSEP=".";
6     <mode-definitions 52b>
7
8     <test:mode-definitions 49c>
9 }

```

62d `<pca-test.awk:summary>[1](), lang=awk ≡`

```

1 if (e) {

```

```

2   printf "Failed " e
3   for (b in a) {
4     print "a[" b "]" => " a[b];
5   }
6 } else {
7   print "Passed"
8 }
9 split("", a);
10 e=0;

```

---

which should give this output:

62e `<pca-test.awk-results[1](), lang=>` ≡

---

```

1 a[foo.quux.quirk] =>
2 a[foo.quux.a] => fleeg
3 a[foo.bar] => baz
4 a[etc] =>
5 a[name] => freddie

```

---

## 11.7 Escaping and Quoting

For the time being and to get around  $\text{T}_{\text{E}}\text{X}_{\text{MACS}}$  inability to export a TAB character, the right arrow  $\mapsto$  whose UTF-8 sequence is ...

To do: complete

Another special character is used, the left-arrow  $\leftarrow$  with UTF-8 sequence  $0xE2\ 0x86\ 0xA4$  is used to strip any preceding white space as a way of un-tabbing and removing indent that has been applied — this is important for bash here documents, and the like. It's a filthy hack.

To do: remove the hack

63a `<mode_tracker[4]() ↑58c, lang=>` +≡

<58e 63b∇

```

39 function untab(text) {
40   gsub("[:space:]*\xE2\x86\xA4","", text);
41   return text;
42 }

```

~~~~~

Each nested mode can optionally define a set of transforms to be applied to any text that is included from another language.

This code can perform transforms from index `c` downwards.

63b `<mode_tracker[5]() ↑58c, lang=awk` +≡

Δ63a 58c∇

```

43 function transform_escape(context, text, top,
44   c, cp, cpl, s, r)
45 {
46   for(c = top; c >= 0; c--) {
47     if ( (context[c, "language"], context[c, "mode"]) in escapes) {
48       cpl = escapes[context[c, "language"], context[c, "mode"]];
49       for (cp = 1; cp <= cpl; cp++) {
50         s = escapes[context[c, "language"], context[c, "mode"], cp, "s"];
51         r = escapes[context[c, "language"], context[c, "mode"], cp, "r"];
52         if (length(s)) {
53           gsub(s, r, text);
54         }
55       }
56       if ( (context[c, "language"], context[c, "mode"], cp, "t") in escapes ) {
57         quotes[src, "t"] = escapes[context[c, "language"], context[c, "mode"], cp, "t"];

```


Chapter 12

Recognizing Chunks

Fangle recognizes noweb chunks, but as we also want better L^AT_EX integration we will recognize any of these:

- notangle chunks matching the pattern `^<<.*?>>=`
- chunks beginning with `\begin{lstlistings}`, possibly with `\Chunk{...}` on the previous line
- an older form I have used, beginning with `\begin{Chunk}[options]` — also more suitable for plain L^AT_EX users¹.

12.1 Chunk start

The variable chunking is used to signify that we are processing a code chunk and not document. In such a state, input lines will be assigned to the current chunk; otherwise they are ignored.

12.1.1 T_EX_{MACS}

We don't handle T_EX_{MACS} files natively yet, but rather instead emit unicode character sequences to mark up the text-export file which we do process.

These hacks detect the unicode character sequences and retro-fit in the old T_EX parsing.

We convert `↩` into a tab character.

65a `<recognize-chunk[1](), lang=> ≡` 65b∇

```
1 #/\n/ {
2 #   gsub("\n*$", "");
3 #   gsub("\n", " ");
4 #}
5 #===
6 /\xE2\x86\xA6/ {
7   gsub("\xE2\x86\xA6", "\x09");
8 }
```

~~~~~

T<sub>E</sub>X<sub>MACS</sub> back-tick handling is obscure, and a cut-n-paste back-tick from a shell window comes out as a unicode sequence<sup>2</sup> that is fixed-up here.

65b `<recognize-chunk[2]() ↑65a, lang=> +≡` Δ65a 66a>

```
9
10 /\xE2\x80\x98/ {
```

1. Is there such a thing as plain L<sup>A</sup>T<sub>E</sub>X?  
2. that won't export to html, except as a NULL character (literal 0x00)

```

11  gsub("\\xE2\x80\x98", "‘");
12  }

```

~~~~~

In the $\text{T}_{\text{E}}\text{X}_{\text{MACS}}$ output, the start of a chunk will appear like this:

```
5b<example-chunk ~K [1] (arg1, ~K arg2 ~K ~K), lang=C> ≡
```

We detect the the start of a $\text{T}_{\text{E}}\text{X}_{\text{MACS}}$ chunk by detecting the ≡ symbol which occurs near the end of the line. We obtain the chunk name, the chunk parameters, and the chunk language.

```

13
14  /\xE2\x89\xA1/ {
15    if (match($0, "~*([~ ]* |)<([~ ]*)\\[[0-9]*\\] [(|(.*)[]).*, lang=( [~ ]*)>", line)) {
16      next_chunk_name=line[2];
17      get_texmacs_chunk_args(line[3], next_chunk_params);
18      gsub(ARG_SEPARATOR " ,? ?" , ";", line[3]);
19      params = "params=" line[3];
20      if ((line[4])) {
21        params = params ",language=" line[4]
22      }
23      get_tex_chunk_args(params, next_chunk_opts);
24      new_chunk(next_chunk_name, next_chunk_opts, next_chunk_params);
25      texmacs_chunking = 1;
26    } else {
27      # warning(sprintf("Unexpected chunk match: %s\n", $_))
28    }
29    next;
30  }

```

12.1.2 lstlistings

Our current scheme is to recognize the new `lstlisting` chunks, but these may be preceded by a `\Chunk` command which in $\text{L}_{\text{Y}}\text{X}$ is a more convenient way to pass the chunk name to the `\begin{lstlistings}` command, and a more visible way to specify other `lstset` settings.

The arguments to the `\Chunk` command are a name, and then a comma-separated list of key-value pairs after the manner of `\lstset`. (In fact within the $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$ `\Chunk` macro (section 17.2.1) the text `name=` is prefixed to the argument which is then literally passed to `\lstset`).

```

31  /\Chunk{/ {
32    if (match($0, "~\\Chunk{ *([~ ,]*)?(.*)}" , line)) {
33      next_chunk_name = line[1];
34      get_tex_chunk_args(line[2], next_chunk_opts);
35    }
36    next;
37  }

```

~~~~~

We also make a basic attempt to parse the name out of the `\lstlistings[name=chunk-name]` text, otherwise we fall back to the name found in the previous chunk command. This attempt is very basic and doesn't support commas or spaces or square brackets as part of the chunkname. We also recognize `\begin{Chunk}` which is convenient for some users<sup>3</sup>.

```

38  /\begin{lstlisting}|~\begin{Chunk}/ {
39    if (match($0, "~.*[[,] *name= *{? *([~ , ]*)}" , line)) {
40      new_chunk(line[1]);

```

---

3. but not yet supported in the  $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$  macros

```

41 } else {
42     new_chunk(next_chunk_name, next_chunk_opts);
43 }
44 chunking=1;
45 next;
46 }

```

~~~~~

12.2 Chunk Body

12.2.1 T_EX_{MACS}

A chunk body in T_EX_{MACS} ends with |_____... if it is the final chunklet of a chunk, or if there are further chunklets it ends with |\\/\//... which is a depiction of a jagged line of torn paper.

67a <recognize-chunk[6]() ↑65a, lang=> +≡

<66c 67b▽

```

47 /\ *|_____*/ && texmacs_chunking {
48     active_chunk="";
49     texmacs_chunking=0;
50     chunking=0;
51 }
52 /\ *|\\/\// && texmacs_chunking {
53     texmacs_chunking=0;
54     chunking=0;
55     active_chunk="";
56 }

```

~~~~~

It has been observed that not every line of output when a T<sub>E</sub>X<sub>MACS</sub> chunk is active is a line of chunk. This may no longer be true, but we set a variable `texmacs_chunk` if the current line is a chunk line.

Initially we set this to zero...

67b <recognize-chunk[7]() ↑65a, lang=> +≡

△67a 67c▽

```

57 texmacs_chunk=0;

```

~~~~~

...and then we look to see if the current line is a chunk line.

T_EX_{MACS} lines look like this: 3 | main() { so we detect the lines by leading white space, digits, more whiter space and a vertical bar followed by at least once space.

If we find such a line, we remove this line-header and set `texmacs_chunk=1` as well as `chunking=1`

67c <recognize-chunk[8]() ↑65a, lang=> +≡

△67b 67d▽

```

58 /\ *[1-9][0-9]* *| / {
59     if (texmacs_chunking) {
60         chunking=1;
61         texmacs_chunk=1;
62         gsub("^*[1-9][0-9]* *| ", "")
63     }
64 }

```

~~~~~

When T<sub>E</sub>X<sub>MACS</sub> chunking, lines that commence with \/ or \_\_ are not chunk content but visual framing, and are skipped.

67d <recognize-chunk[9]() ↑65a, lang=> +≡

△67c 68a▷

```

65 /\ *.\// && texmacs_chunking {
66     next;
67 }

```

```
68 /~ *_~*$/ && texmacs_chunking {
69   next;
70 }
```

~~~~~

Any other line when T_EX_{MACS} chunking is considered to be a line-wrapped line.

68a <recognize-chunk[10]() ↑65a, lang=) +≡

<67d 68b>

```
71 texmacs_chunking {
72   if (!texmacs_chunk) {
73     # must be a texmacs continued line
74     chunking=1;
75     texmacs_chunk=1;
76   }
77 }
```

~~~~~

This final chunklet seems bogus and probably stops L<sub>Y</sub>X working.

68b &lt;recognize-chunk[11]() ↑65a, lang=) +≡

Δ68a 68c&gt;

```
78 ! texmacs_chunk {
79 # texmacs_chunking=0;
80   chunking=0;
81 }
```

~~~~~

12.2.2 Noweb

We recognize notangle style chunks too:

68c <recognize-chunk[12]() ↑65a, lang=awk) +≡

Δ68b 68d>

```
82 /~[<[<.*[>]>=]/ {
83   if (match($0, "^[<[<(.*)[>]>= *$", line)) {
84     chunking=1;
85     notangle_mode=1;
86     new_chunk(line[1]);
87     next;
88   }
89 }
```

~~~~~

## 12.3 Chunk end

Likewise, we need to recognize when a chunk ends.

### 12.3.1 lstlistings

The e in [e]nd{lstlisting} is surrounded by square brackets so that when this document is processed, this chunk doesn't terminate early when the lstlistings package recognizes it's own end-string!<sup>4</sup>

68d &lt;recognize-chunk[13]() ↑65a, lang=) +≡

Δ68c 69a&gt;

```
90 /~\[e]nd{lstlisting}|^\\[e]nd{Chunk}/ {
91   chunking=0;
92   active_chunk="";
```

4. This doesn't make sense as the regex is anchored with ^, which this line does not begin with!

```

93     next;
94 }

```

### 12.3.2 noweb

69a &lt;recognize-chunk[14]() ↑65a, lang=&gt; +≡

&lt;68d 69b▽

```

95 /~@ *$/ {
96     chunking=0;
97     active_chunk="";
98 }

```

All other recognizers are only of effect if we are chunking; there's no point in looking at lines if they aren't part of a chunk, so we just ignore them as efficiently as we can.

69b &lt;recognize-chunk[15]() ↑65a, lang=&gt; +≡

△69a 69c▽

```

99 ! chunking { next; }

```

## 12.4 Chunk contents

Chunk contents are any lines read while `chunking` is true. Some chunk contents are special in that they refer to other chunks, and will be replaced by the contents of these chunks when the file is generated.

We add the output record separator `ORS` to the line now, because we will set `ORS` to the empty string when we generate the output<sup>5</sup>.

69c &lt;recognize-chunk[16]() ↑65a, lang=&gt; +≡

△69b

```

100 length(active_chunk) {
101     <process-chunk-tabs 69e>
102     <process-chunk 70b>
103 }

```

If a chunk just consisted of plain text, we could handle the chunk like this:

69d &lt;process-chunk-simple[1](), lang=&gt; ≡

```

1 chunk_line(active_chunk, $0 ORS);

```

but in fact a chunk can include references to other chunks. Chunk includes are traditionally written as `<<chunk-name>>` but we support other variations, some of which are more suitable for particular editing systems.

However, we also process tabs at this point. A tab at input can be replaced by a number of spaces defined by the `tabs` variable, set by the `-T` option. Of course this is poor tab behaviour, we should probably have the option to use proper counted tab-stops and process this on output.

69e &lt;process-chunk-tabs[1](), lang=&gt; ≡

```

1 if (length(tabs)) {
2     gsub("\t", tabs);
3 }

```

5. So that we can partial print lines using `print` instead of `printf`. To do: This doesn't make sense

### 12.4.1 lstlistings

If `\lstset{escapeinside={=<}{>}}` is set, then we can use `<chunk-name ?>` in listings. The sequence `=<` was chosen because:

1. it is a better mnemonic than `<<chunk-name>>` in that the `=` sign signifies equivalence or substitutability.
2. and because `=<` is not valid in C or any language I can think of.
3. and also because `lstlistings` doesn't like `>>` as an end delimiter for the `texcl` escape, so we must make do with a single `>` which is better complemented by `=<` than by `<<`.

Unfortunately the `=<...>` that we use re-enters a L<sup>A</sup>T<sub>E</sub>X parsing mode in which some characters are special, e.g. `# \` and so these cause trouble if used in arguments to `\chunkref`. At some point I must fix the L<sup>A</sup>T<sub>E</sub>X command `\chunkref` so that it can accept these literally, but until then, when writing `chunkref` arguments that need these characters, I must use the forms `\textbackslash{}` and `\#`; so I also define a hacky chunk `delatex` to be used further on whose purpose it is to remove these from any arguments parsed by fangle.

70a `<delatex[1](text), lang=>` ≡

---

```

1 # FILTHY HACK
2 gsub("\\\\#", "#", ${text});
3 gsub("\\\\textbackslash{", "\\ ", ${text});
4 gsub("\\\\\\~", "~", ${text});

```

---

As each chunk line may contain more than one chunk include, we will split out chunk includes in an iterative fashion<sup>6</sup>.

First, as long as the chunk contains a `\chunkref` command we take as much as we can up to the first `\chunkref` command.

T<sub>E</sub>X<sub>MACS</sub> text output uses `<...>` which comes out as unicode sequences `0xC2 0xAB ... 0xC2 0xBB`. Modern `awk` will interpret `[^xC2\xBB]` as a single unicode character if `LANG` is set correctly to the sub-type UTF-8, e.g. `LANG=en_GB.UTF-8`, otherwise `[^xC2\xBB]` will be treated as a two character negated match — but this should not interfere with the function.

70b `<process-chunk[1](), lang=>` ≡

70c∇

---

```

1 chunk = $0;
2 indent = 0;
3 while(match(chunk, "(\\xC2\\xAB)([\\xC2\\xBB]*) [\\xC2\\xBB]*\\xC2\\xBB", line) ||
4       match(chunk,
5             "([=]<\\\\\\\\chunkref{([>]*)}\\(\\.\\*\\\\)\\)|>|<<([a-zA-Z_][-a-zA-Z0-9_]*)>>"),
6             line) \\
7 ) {
8   chunklet = substr(chunk, 1, RSTART - 1);

```

---

We keep track of the indent count, by counting the number of literal characters found. We can then preserve this indent on each output line when multi-line chunks are expanded.

We then process this first part literal text, and set the chunk which is still to be processed to be the text after the `\chunkref` command, which we will process next as we continue around the loop.

70c `<process-chunk[2]() ↑70b, lang=>` +≡

Δ70b 71a>

---

```

9   indent += length(chunklet);
10  chunk_line(active_chunk, chunklet);
11  chunk = substr(chunk, RSTART + RLENGTH);

```

---

6. Contrary to our use of `split` when substituting parameters in chapter ?

We then consider the type of chunk command we have found, whether it is the fangle style command beginning with `=<` the older notangle style beginning with `<<`.

Fangle chunks may have parameters contained within square brackets. These will be matched in `line[3]` and are considered at this stage of processing to be part of the name of the chunk to be included.

```
71a <process-chunk[3]() ↑70b, lang=) +≡ <70c 71b▽
12   if (substr(line[1], 1, 1) == "=") {
13     # chunk name up to }
14     (delatex(line[3]) 70a)
15     chunk_include(active_chunk, line[2] line[3], indent);
16   } else if (substr(line[1], 1, 1) == "<") {
17     chunk_include(active_chunk, line[4], indent);
18   } else if (line[1] == "\xC2\xAB") {
19     chunk_include(active_chunk, line[2], indent);
20   } else {
21     error("Unknown chunk fragment: " line[1]);
22   }
```

~~~~~

The loop will continue until there are no more chunkref statements in the text, at which point we process the final part of the chunk.

```
71b <process-chunk[4]() ↑70b, lang=) +≡ Δ71a 71c▽
23   }
24   chunk_line(active_chunk, chunk);
```

~~~~~

We add the newline character as a chunklet on it's own, to make it easier to detect new lines and thus manage indentation when processing the output.

```
71c <process-chunk[5]() ↑70b, lang=) +≡ Δ71b
25   chunk_line(active_chunk, "\n");
```

---

We will also permit a chunk-part number to follow in square brackets, so that `<chunk-name[1] ?>` will refer to the first part only. This can make it easy to include a C function prototype in a header file, if the first part of the chunk is just the function prototype without the trailing semi-colon. The header file would include the prototype with the trailing semi-colon, like this:

```
<chunk-name[1] ?>
```

This is handled in section 14.1.1

We should perhaps introduce a notion of language specific chunk options; so that perhaps we could specify:

```
=<\chunkref{chunk-name[function-declaration]}
```

which applies a transform `function-declaration` to the chunk — which in this case would extract a function prototype from a function. To do: Do it



# Chapter 13

## Processing Options

At the start, first we set the default options.

73a `<default-options[1](), lang=>` ≡

---

```
1 debug=0;
2 linenos=0;
3 notangle_mode=0;
4 root="*";
5 tabs = "";
```

---

Then we use `getopt` the standard way, and null out `ARGV` afterwards in the normal AWK fashion.

73b `<read-options[1](), lang=>` ≡

---

```
1 Optind = 1 # skip ARGV[0]
2 while(getopt(ARGC, ARGV, "R:LdT:hr")!=-1) {
3     <handle-options 73c>
4 }
5 for (i=1; i<Optind; i++) { ARGV[i]=""; }
```

---

This is how we handle our options:

73c `<handle-options[1](), lang=>` ≡

---

```
1 if (Optopt == "R") root = Optarg;
2 else if (Optopt == "r") root="";
3 else if (Optopt == "L") linenos = 1;
4 else if (Optopt == "d") debug = 1;
5 else if (Optopt == "T") tabs = indent_string(Optarg+0);
6 else if (Optopt == "h") help();
7 else if (Optopt == "?") help();
```

---

We do all of this at the beginning of the program

73d `<begin[1](), lang=>` ≡

---

```
1 BEGIN {
2     <constants 39a>
3     <mode-definitions 52b>
4     <default-options 73a>
5
6     <read-options 73b>
7 }
```

---

And have a simple help function

73e `<help()[1](), lang=>` ≡

---

```
1 function help() {
2     print "Usage:"
3     print " fangle [-L] -R<rootname> [source.tex ...]"
4     print " fangle -r [source.tex ...]"
5     print " If the filename, source.tex is not specified then stdin is used"
6     print
7     print "-L causes the C statement: #line <lineno> \"filename\"" to be issued"
8     print "-R causes the named root to be written to stdout"
9     print "-r lists all roots in the file (even those used elsewhere)"
10    exit 1;
11 }
```

---



# Chapter 14

## Generating the Output

We generate output by calling `output_chunk`, or listing the chunk names.

75a `<generate-output[1](), lang=>` ≡

---

```
1 if (length(root)) output_chunk(root);
2 else output_chunk_names();
```

---

We also have some other output debugging:

75b `<debug-output[1](), lang=>` ≡

---

```
1 if (debug) {
2   print "----- chunk names "
3   output_chunk_names();
4   print "======" chunks"
5   output_chunks();
6   print "++++++ debug"
7   for (a in chunks) {
8     print a "=" chunks[a];
9   }
10 }
```

---

We do both of these at the end. We also set `ORS=""` because each chunklet is not necessarily a complete line, and we already added `ORS` to each input line in section 12.4.

75c `<end[1](), lang=>` ≡

---

```
1 END {
2   <debug-output 75b>
3   ORS="";
4   <generate-output 75a>
5 }
```

---

We write chunk names like this. If we seem to be running in notangle compatibility mode, then we enclose the name like this `<<name>>` the same way notangle does:

75d `<output_chunk_names()[1](), lang=>` ≡

---

```
1 function output_chunk_names( c, prefix, suffix)
2 {
3   if (notangle_mode) {
4     prefix="<<";
5     suffix=">>";
6   }
7   for (c in chunk_names) {
8     print prefix c suffix "\n";
9   }
10 }
```

---

This function would write out all chunks

75e `<output_chunks()[1](), lang=>` ≡

---

```
1 function output_chunks( a)
```

75e `<output_chunks()[1](), lang=>` ≡

```
2 {
3   for (a in chunk_names) {
4     output_chunk(a);
5   }
6 }
7
8 function output_chunk(chunk) {
9   newline = 1;
10  lineno_needed = linenos;
11
12  write_chunk(chunk);
13 }
14
```

---

## 14.1 Assembling the Chunks

`chunk_path` holds a string consisting of the names of all the chunks that resulted in this chunk being output. It should probably also contain the source line numbers at which each inclusion also occurred.

We first initialize the mode tracker for this chunk.

76a `<write_chunk()[1](), lang=awk` ≡

76b∇

```
1 function write_chunk(chunk_name) {
2   <awk-delete-array(context) 37d>
3   return write_chunk_r(chunk_name, context);
4 }
5
6 function write_chunk_r(chunk_name, context, indent, tail,
7   # optional vars
8   chunk_path, chunk_args,
9   # local vars
10  context_origin,
11  chunk_params, part, max_part, part_line, frag, max_frag, text,
12  chunklet, only_part, call_chunk_args, new_context)
13 {
14   if (debug) debug_log("write_chunk_r(" chunk_name ")");
```

---

### 14.1.1 Chunk Parts

As mentioned in section [?](#), a chunk name may contain a part specifier in square brackets, limiting the parts that should be emitted.

76b `<write_chunk()[2]() ↑76a, lang=>` +=

Δ76a 76c∇

```
15   if (match(chunk_name, "~(.*)\\[[([0-9]*)\\]\\$", chunk_name_parts)) {
16     chunk_name = chunk_name_parts[1];
17     only_part = chunk_name_parts[2];
18   }
```

---

We then create a mode tracker

76c `<write_chunk()[3]() ↑76a, lang=>` +=

Δ76b 77a▷

```
19   context_origin = context[""];
20   new_context = push_mode_tracker(context, chunks[chunk_name, "language"], "");
```

---

We extract into `chunk_params` the names of the parameters that this chunk accepts, whose values were (optionally) passed in `chunk_args`.

77a `<write_chunk>[4]()` ↑76a, lang=> +≡ <76c 77b▽

```
21 split(chunks[chunk_name, "params"], chunk_params, " *; *");
```

To assemble a chunk, we write out each part.

77b `<write_chunk>[5]()` ↑76a, lang=> +≡ Δ77a

```
22 if (!(chunk_name in chunk_names)) {
23     error(sprintf(_("The root module <<%s>> was not defined.\nUsed by: %s", \
24                 chunk_name, chunk_path));
25 }
26
27 max_part = chunks[chunk_name, "part"];
28 for(part = 1; part <= max_part; part++) {
29     if (! only_part || part == only_part) {
30         <write-part 77c>
31     }
32 }
33 if (! pop_mode_tracker(context, context_origin)) {
34     dump_mode_tracker(context);
35     error(sprintf(_("Module %s did not close context properly.\nUsed by: %s\n", chunk_name,
36                 chunk_path));
37 }
```

A part can either be a chunklet of lines, or an include of another chunk.

Chunks may also have parameters, specified in LaTeX style with braces after the chunk name — looking like this in the document: `chunkname{param1, param2}`. Arguments are passed in square brackets: `\chunkref{chunkname}[arg1, arg2]`.

Before we process each part, we check that the source position hasn't changed unexpectedly, so that we can know if we need to output a new file-line directive.

77c `<write-part>[1]()`, lang=> ≡

---

```
1 <check-source-jump 79d>
2
3 chunklet = chunks[chunk_name, "part", part];
4 if (chunks[chunk_name, "part", part, "type"] == part_type_chunk) {
5     <write-included-chunk 77d>
6 } else if (chunklet SUBSEP "line" in chunks) {
7     <write-chunklets 78a>
8 } else {
9     # empty last chunklet
10 }
```

---

To write an included chunk, we must detect any optional chunk arguments in parenthesis. Then we recurse calling `write_chunk()`.

77d `<write-included-chunk>[1]()`, lang=> ≡

---

```
1 if (match(chunklet, "~([^\[\(\)]*)\((.*)\)$", chunklet_parts)) {
2     chunklet = chunklet_parts[1];
3     # hack
4     gsub(sprintf("%c",11), "", chunklet);
5     gsub(sprintf("%c",11), "", chunklet_parts[2]);
6     parse_chunk_args("c-like", chunklet_parts[2], call_chunk_args, "(");
7     for (c in call_chunk_args) {
8         call_chunk_args[c] = expand_chunk_args(call_chunk_args[c], chunk_params, chunk_args);
9     }
10 } else {
11     split("", call_chunk_args);
```

77d `<write-included-chunk[1]()`, lang=`=`)  $\equiv$

```
12 }
13
14 write_chunk_r(chunklet, context,
15             chunks[chunk_name, "part", part, "indent"] indent,
16             chunks[chunk_name, "part", part, "tail"],
17             chunk_path "\n" " chunk_name,
18             call_chunk_args);
```

---

Before we output a chunklet of lines, we first emit the file and line number if we have one, and if it is safe to do so.

Chunklets are generally broken up by includes, so the start of a chunklet is a good place to do this. Then we output each line of the chunklet.

When it is not safe, such as in the middle of a multi-line macro definition, `lineno_suppressed` is set to true, and in such a case we note that we want to emit the line statement when it is next safe.

78a `<write-chunklets[1]()`, lang=`=`)  $\equiv$  78b $\nabla$

```
1 max_frag = chunks[chunklet, "line"];
2 for(frag = 1; frag <= max_frag; frag++) {
3   <write-file-line 79c>
```

---

We then extract the chunklet text and expand any arguments.

78b `<write-chunklets[2]()`  $\uparrow$ 78a, lang=`=`)  $+\equiv$   $\Delta$ 78a 78c $\nabla$

```
4
5   text = chunks[chunklet, frag];
6
7   /* check params */
8   text = expand_chunk_args(text, chunk_params, chunk_args);
```

---

If the text is a single newline (which we keep separate - see 6) then we increment the line number. In the case where this is the last line of a chunk and it is not a top-level chunk we replace the newline with an empty string — because the chunk that included this chunk will have the newline at the end of the line that included this chunk.

We also note by `newline = 1` that we have started a new line, so that indentation can be managed with the following piece of text.

78c `<write-chunklets[3]()`  $\uparrow$ 78a, lang=`=`)  $+\equiv$   $\Delta$ 78b 78d $\nabla$

```
9
10  if (text == "\n") {
11    lineno++;
12    if (part == max_part && frag == max_frag && length(chunk_path)) {
13      text = "";
14      break;
15    } else {
16      newline = 1;
17    }

```

---

If this text does not represent a newline, but we see that we are the first piece of text on a newline, then we prefix our text with the current indent.

**Note 1.** `newline` is a global output-state variable, but the `indent` is not.

78d `<write-chunklets[4]()`  $\uparrow$ 78a, lang=`=`)  $+\equiv$   $\Delta$ 78c 79a $\triangleright$

```
18 } else if (length(text) || length(tail)) {
19   if (newline) text = indent text;
20   newline = 0;
21 }
```





# Chapter 15

## Storing Chunks

Awk has pretty limited data structures, so we will use two main hashes. Uninterrupted sequences of a chunk will be stored in chunklets and the chunklets used in a chunk will be stored in `chunks`.

```
81a <constants[2]() ↑39a, lang=> +≡ <139a
2 part_type_chunk=1;
3 SUBSEP=",";
```

---

The params mentioned are not chunk parameters for parameterized chunks, as mentioned in 10.2, but the `lstlistings` style parameters used in the `\Chunk` command<sup>1</sup>.

```
81b <chunk-storage-functions[1]() , lang=> ≡ 81c∇
1 function new_chunk(chunk_name, opts, args,
2   # local vars
3   p, append )
4 {
5   # HACK WHILE WE CHANGE TO ( ) for PARAM CHUNKS
6   gsub("\\(\\)$", "", chunk_name);
7   if (! (chunk_name in chunk_names)) {
8     if (debug) print "New chunk " chunk_name;
9     chunk_names[chunk_name];
10    for (p in opts) {
11      chunks[chunk_name, p] = opts[p];
12      if (debug) print "chunks[" chunk_name "," p "] = " opts[p];
13    }
14    for (p in args) {
15      chunks[chunk_name, "params", p] = args[p];
16    }
17    if ("append" in opts) {
18      append=opts["append"];
19      if (! (append in chunk_names)) {
20        warning("Chunk " chunk_name " is appended to chunk " append " which is not defined yet");
21        new_chunk(append);
22      }
23      chunk_include(append, chunk_name);
24      chunk_line(append, ORS);
25    }
26  }
27  active_chunk = chunk_name;
28  prime_chunk(chunk_name);
29 }
```

```
~~~~~
81c <chunk-storage-functions[2]() ↑81b, lang=> +≡ Δ81b 82a>
30
31 function prime_chunk(chunk_name)
32 {
33 chunks[chunk_name, "part", ++chunks[chunk_name, "part"]] = \
34 chunk_name SUBSEP "chunklet" SUBSEP "" ++chunks[chunk_name, "chunklet"];
35 chunks[chunk_name, "part", chunks[chunk_name, "part"], "FILENAME"] = FILENAME;
36 chunks[chunk_name, "part", chunks[chunk_name, "part"], "LINENO"] = FNR + 1;
```

---

1. The `params` parameter is used to hold the parameters for parameterized chunks

```

37 }
38
39 function chunk_line(chunk_name, line){
40 chunks[chunk_name, "chunklet", chunks[chunk_name, "chunklet"],
41 ++chunks[chunk_name, "chunklet", chunks[chunk_name, "chunklet"], "line"]] = line;
42 }
43

```

~~~~~

Chunk include represents a *chunkref* statement, and stores the requirement to include another chunk. The parameter *indent* represents the quantity of literal text characters that preceded this *chunkref* statement and therefore by how much additional lines of the included chunk should be indented.

```

44 function chunk_include(chunk_name, chunk_ref, indent, tail)
45 {
46 chunks[chunk_name, "part", ++chunks[chunk_name, "part"]] = chunk_ref;
47 chunks[chunk_name, "part", chunks[chunk_name, "part"], "type"] = part_type_chunk;
48 chunks[chunk_name, "part", chunks[chunk_name, "part"], "indent"] = indent_string(indent);
49 chunks[chunk_name, "part", chunks[chunk_name, "part"], "tail"] = tail;
50 prime_chunk(chunk_name);
51 }
52

```

~~~~~

The *indent* is calculated by *indent\_string*, which may in future convert some spaces into tab characters. This function works by generating a `printf` padded format string, like `%22s` for an *indent* of 22, and then printing an empty string using that format.

```

53 function indent_string(indent) {
54 return sprintf("%" indent "s", "");
55 }

```

---

# Chapter 16

## getopt

I use Arnold Robbins public domain getopt (1993 revision). This is probably the same one that is covered in chapter 12 of *Edition 3 of GAWK: Effective AWK Programming: A User's Guide for GNU Awk* but as that is licensed under the GNU Free Documentation License, Version 1.3, which conflicts with the GPL3, I can't use it from there (or it's accompanying explanations), so I do my best to explain how it works here.

The getopt.awk header is:

83a [getopt.awk-header](#)[1](), lang=> ≡

---

```
1 # getopt.awk --- do C library getopt(3) function in awk
2 #
3 # Arnold Robbins, arnold@skeeve.com, Public Domain
4 #
5 # Initial version: March, 1991
6 # Revised: May, 1993
7
```

---

The provided explanation is:

83b [getopt.awk-notes](#)[1](), lang=> ≡

---

```
1 # External variables:
2 # Optind -- index in ARGV of first nonoption argument
3 # Optarg -- string value of argument to current option
4 # Opterr -- if nonzero, print our own diagnostic
5 # Optopt -- current option letter
6
7 # Returns:
8 # -1 at end of options
9 # ? for unrecognized option
10 # <c> a character representing the current option
11
12 # Private Data:
13 # _opti -- index in multi-flag option, e.g., -abc
14
```

---

The function follows. The final two parameters, `thisopt` and `i` are local variables and not parameters — as indicated by the multiple spaces preceding them. Awk doesn't care, the multiple spaces are a convention to help us humans.

83c [getopt.awk-getopt\(\)](#)[1](), lang=> ≡

---

```
1 function getopt(argc, argv, options, thisopt, i)
2 {
3 if (length(options) == 0) # no options given
4 return -1
5 if (argv[Optind] == "--") { # all done
6 Optind++
7 _opti = 0
8 return -1
9 } else if (argv[Optind] !~ /^[^: \t\n\f\r\v\b]/) {
10 _opti = 0
11 return -1

```

84a>

```

12 }
13 if (_opti == 0)
14 _opti = 2
15 thisopt = substr(argv[Optind], _opti, 1)
16 Optopt = thisopt
17 i = index(options, thisopt)
18 if (i == 0) {
19 if (Opterr)
20 printf("%c -- invalid option\n",
21 thisopt) > "/dev/stderr"
22 if (_opti >= length(argv[Optind])) {
23 Optind++
24 _opti = 0
25 } else
26 _opti++
27 return "?"
28 }

```

~~~~~

At this point, the option has been found and we need to know if it takes any arguments.

```

29 if (substr(options, i + 1, 1) == ":") {
30 # get option argument
31 if (length(substr(argv[Optind], _opti + 1)) > 0)
32 Optarg = substr(argv[Optind], _opti + 1)
33 else
34 Optarg = argv[++Optind]
35 _opti = 0
36 } else
37 Optarg = ""
38 if (_opti == 0 || _opti >= length(argv[Optind])) {
39 Optind++
40 _opti = 0
41 } else
42 _opti++
43 return thisopt
44 }

```

A test program is built in, too

```

1 BEGIN {
2 Opterr = 1 # default is to diagnose
3 Optind = 1 # skip ARGV[0]
4 # test program
5 if (_getopt_test) {
6 while ((_go_c = getopt(ARGC, ARGV, "ab:cd")) != -1)
7 printf("c = <%c>, optarg = <%s>\n",
8 _go_c, Optarg)
9 printf("non-option arguments:\n")
10 for (; Optind < ARGC; Optind++)
11 printf("\tARGV[%d] = <%s>\n",
12 Optind, ARGV[Optind])
13 }
14 }

```

The entire getopt.awk is made out of these chunks in order

```

1 <getopt.awk-header 83a>
2
3 <getopt.awk-notes 83b>
4 <getopt.awk-getopt() 83c>

```

84c `<getopt.awk[1](), lang=>` ≡

5 `<getopt.awk-begin 84b>`

---

Although we only want the header and function:

85a `<getopt[1](), lang=>` ≡

---

```
1 # try: locate getopt.awk for the full original file
2 # as part of your standard awk installation
3 <getopt.awk-header 83a>
4
5 <getopt.awk-getopt() 83c>
```

---



# Chapter 17

## Fangle LaTeX source code

### 17.1 fangle module

Here we define a LyX `.module` file that makes it convenient to use LyX for writing such literate programs.

This file `./fangle.module` can be installed in your personal `.lyx/layouts` folder. You will need to Tools Reconfigure so that LyX notices it. It adds a new format `Chunk`, which should precede every listing and contain the chunk name.

87a [⟨./fangle.module\[1\]\(\), lang=lyx-module⟩](#) ≡

---

```
1 #\DeclareLyXModule{Fangle Literate Listings}
2 #DescriptionBegin
3 # Fangle literate listings allow one to write
4 # literate programs after the fashion of noweb, but without having
5 # to use noweave to generate the documentation. Instead the listings
6 # package is extended in conjunction with the noweb package to implement
7 # to code formatting directly as latex.
8 # The fangle awk script
9 #DescriptionEnd
10
11 ⟨gpl3-copyright.hashcd 87b⟩
12
13 Format 11
14
15 AddToPreamble
16 ⟨./fangle.sty 88d⟩
17 EndPreamble
18
19 ⟨chunkstyle 88a⟩
20
21 ⟨chunkref 88c⟩
```

---

Because LyX modules are not yet a language supported by fangle or `lstlistings`, we resort to this fake awk chunk below in order to have each line of the GPL3 license commence with a `#`

87b [⟨gpl3-copyright.hashcd\[1\]\(\), lang=awk⟩](#) ≡

---

```
1 #(gpl3-copyright 4a)
2
```

---

#### 17.1.1 The Chunk style

The purpose of the `CHUNK` style is to make it easier for LyX users to provide the name to `lstlistings`. Normally this requires right-clicking on the listing, choosing settings, advanced, and then typing `name=chunk-name`. This has the further disadvantage that the name (and other options) are not generally visible during document editing.

The chunk style is defined as a L<sup>A</sup>T<sub>E</sub>X command, so that all text on the same line is passed to the L<sup>A</sup>T<sub>E</sub>X command `Chunk`. This makes it easy to parse using `fangle`, and easy to pass these options on to the listings package. The first word in a chunk section should be the chunk name, and will have `name=` prepended to it. Any other words are accepted arguments to `lstset`.

We set `PassThru` to 1 because the user is actually entering raw latex.

88a `<chunkstyle[1](), lang=> ≡` 88b∇

```

1 Style Chunk
2 LatexType Command
3 LatexName Chunk
4 Margin First_Dynamic
5 LeftMargin Chunk:xxx
6 LabelSep xx
7 LabelType Static
8 LabelString "Chunk:"
9 Align Left
10 PassThru 1
11
```

~~~~~

To make the label very visible we choose a larger font coloured red.

88b `<chunkstyle[2]() ↑88a, lang=> +≡` Δ88a

```

12 LabelFont
13 Family Sans
14 Size Large
15 Series Bold
16 Shape Italic
17 Color red
18 EndFont
19 End
```

### 17.1.2 The chunkref style

We also define the `Chunkref` style which can be used to express cross references to chunks.

88c `<chunkref[1](), lang=> ≡`

```

1 InsetLayout Chunkref
2 LyxType charstyle
3 LatexType Command
4 LatexName chunkref
5 PassThru 1
6 LabelFont
7 Shape Italic
8 Color red
9 EndFont
10 End
```

## 17.2 Latex Macros

We require the listings, noweb and xargs packages. As noweb defines it's own `\code` environment, we re-define the one that L<sup>y</sup>X logical markup module expects here.

88d `<./fangle.sty[1](), lang=tex> ≡` 89a∇

```

1 \usepackage{listings}%
2 \usepackage{noweb}%
```

```

3 \usepackage{xargs}%
4 \renewcommand{\code}[1]{\texttt{#1}}%

```

~~~~~

We also define a CChunk macro, for use as: `\begin{CChunk}` which will need renaming to `\begin{Chunk}` when I can do this without clashing with `\Chunk`.

89a &lt;./fangle.sty[2]() ↑88d, lang=) +≡

△88d 89b∇

```

5 \lstnewenvironment{Chunk}{\relax}{\relax}%

```

~~~~~

We also define a suitable `\lstset` of parameters that suit the literate programming style after the fashion of NOWEAVE.

89b &lt;./fangle.sty[3]() ↑88d, lang=) +≡

△89a 89c∇

```

6 \lstset{numbers=left, stepnumber=5, numbersep=5pt,
7 breaklines=false,basicstyle=\ttfamily,
8 numberstyle=\tiny, language=C}%

```

~~~~~

We also define a notangle-like mechanism for escaping to L<sup>A</sup>T<sub>E</sub>X from the listing, and by which we can refer to other listings. We declare the `=<...>` sequence to contain L<sup>A</sup>T<sub>E</sub>X code, and include another like this chunk: `<chunkname ?>`. However, because `=<...>` is already defined to contain L<sup>A</sup>T<sub>E</sub>X code for this document — this is a fangle document after all — the code fragment below effectively contains the L<sup>A</sup>T<sub>E</sub>X code: `}\`. To avoid problems with document generation, I had to declare an `lstlistings` property: `escapeinside={}` for this listing only; which in L<sub>Y</sub>X was done by right-clicking the listings inset, choosing settings->advanced. Therefore `=<` isn't interpreted literally here, in a listing when the escape sequence is already defined as shown... we need to somehow escape this representation...

89c &lt;./fangle.sty[4]() ↑88d, lang=) +≡

△89b 89d∇

```

9 \lstset{escapeinside={<}<}>}%

```

~~~~~

Although our macros will contain the @ symbol, they will be included in a `\makeatletter` section by L<sub>Y</sub>X; however we keep the commented out `\makeatletter` as a reminder. The listings package likes to centre the titles, but noweb titles are specially formatted and must be left aligned. The simplest way to do this turned out to be by removing the definition of `\lst@maketitle`. This may interact badly if other listings want a regular title or caption. We remember the old maketitle in case we need it.

89d &lt;./fangle.sty[5]() ↑88d, lang=) +≡

△89c 89e∇

```

10 %\makeatletter
11 %somehow re-defining maketitle gives us a left-aligned title
12 %which is exactly what our specially formatted title needs!
13 \global\let\fangle@lst@maketitle\lst@maketitle%
14 \global\def\lst@maketitle{}%

```

## 17.2.1 The chunk command

Our chunk command accepts one argument, and calls `\lstset`. Although `\lstset` will note the name, this is erased when the next `\lstlisting` starts, so we make a note of this in `\lst@chunkname` and restore in in `lstlistings` Init hook.

89e &lt;./fangle.sty[6]() ↑88d, lang=) +≡

△89d 90a&gt;

```

15 \def\Chunk#1{%
16 \lstset{title={\fanglecaption},name=#1}%
17 \global\edef\lst@chunkname{\lst@intname}%
18 }%

```

89e `</fangle.sty[6]() ↑88d, lang=) +≡`

`△89d 90a>`

```
19 \def\lst@chunkname{\empty}%
```

~~~~~

### 17.2.1.1 Chunk parameters

Fangle permits parameterized chunks, and requires the parameters to be specified as listings options. The fangle script uses this, and although we don't do anything with these in the L<sup>A</sup>T<sub>E</sub>X code right now, we need to stop the listings package complaining.

90a `</fangle.sty[7]() ↑88d, lang=) +≡`

`<89e 90b>`

```
20 \lst@Key{params}\relax{\def\fangle@chunk@params{#1}}%
```

~~~~~

As it is common to define a chunk which then needs appending to another chunk, and annoying to have to declare a single line chunk to manage the include, we support an `append=` option.

90b `</fangle.sty[8]() ↑88d, lang=) +≡`

`△90a 90c>`

```
21 \lst@Key{append}\relax{\def\fangle@chunk@append{#1}}%
```

~~~~~

### 17.2.2 The noweb styled caption

We define a public macro `\fanglecaption` which can be set as a regular title. By means of `\protect`, it expands to `\fangle@caption` at the appropriate time when the caption is emitted.

90c `</fangle.sty[9]() ↑88d, lang=) +≡`

`△90b 90d>`

```
\def\fanglecaption{\protect\fangle@caption}%
```

~~~~~

22c `<some-chunk 19b) ≡ + <22b 24d>`

In this example, the current chunk is 22c, and therefore the third chunk on page 22. Its name is `some-chunk`.

The first chunk with this name (19b) occurs as the second chunk on page 19.

The previous chunk (22d) with the same name is the second chunk on page 22.

The next chunk (24d) is the fourth chunk on page 24.

**Figure 1.** Noweb Heading

The general noweb output format compactly identifies the current chunk, and references to the first chunk, and the previous and next chunks that have the same name.

This means that we need to keep a counter for each chunk-name, that we use to count chunks of the same name.

### 17.2.3 The chunk counter

It would be natural to have a counter for each chunk name, but TeX would soon run out of counters<sup>1</sup>, so we have one counter which we save at the end of a chunk and restore at the beginning of a chunk.

90d `</fangle.sty[10]() ↑88d, lang=) +≡`

`△90c 91c>`

```
22 \newcounter{fangle@chunkcounter}%
```

~~~~~

---

1. ...soon did run out of counters and so I had to re-write the LaTeX macros to share a counter as described here.

We construct the name of this variable to store the counter to be the text `lst-chunk-` prefixed onto the chunks own name, and store it in `\chunkcount`.

We save the counter like this:

```
91a <save-counter[1]() (lang=) ≡

\global\expandafter\edef\csname \chunkcount\endcsname{\arabic{fangle@chunkcounter}}%
```

and restore the counter like this:

```
91b <restore-counter[1]() (lang=) ≡

\setcounter{fangle@chunkcounter}{\csname \chunkcount\endcsname}%

```

If there does not already exist a variable whose name is stored in `\chunkcount`, then we know we are the first chunk with this name, and then define a counter.

Although chunks of the same name share a common counter, they must still be distinguished. We use is the internal name of the listing, suffixed by the counter value. So the first chunk might be `something-1` and the second chunk be `something-2`, etc.

We also calculate the name of the previous chunk if we can (before we increment the chunk counter). If this is the first chunk of that name, then `\prevchunkname` is set to `\relax` which the noweb package will interpret as not existing.

```
91c <./fangle.sty[11]() (↑88d, lang=) +≡

23 \def\fangle@caption{%
24 \edef\chunkcount{lst-chunk-\lst@intname}%
25 \@ifundefined{\chunkcount}{%
26 \expandafter\gdef\csname \chunkcount\endcsname{0}%
27 \setcounter{fangle@chunkcounter}{\csname \chunkcount\endcsname}%
28 \let\prevchunkname\relax%
29 }{%
30 \setcounter{fangle@chunkcounter}{\csname \chunkcount\endcsname}%
31 \edef\prevchunkname{\lst@intname-\arabic{fangle@chunkcounter}}%
32 }%
```

After incrementing the chunk counter, we then define the name of this chunk, as well as the name of the first chunk.

```
91d <./fangle.sty[12]() (↑88d, lang=) +≡

33 \addtocounter{fangle@chunkcounter}{1}%
34 \global\expandafter\edef\csname \chunkcount\endcsname{\arabic{fangle@chunkcounter}}%
35 \edef\chunkname{\lst@intname-\arabic{fangle@chunkcounter}}%
36 \edef\firstchunkname{\lst@intname-1}%

```

We now need to calculate the name of the next chunk. We do this by temporarily skipping the counter on by one; however there may not actually be another chunk with this name! We detect this by also defining a label for each chunk based on the chunkname. If there is a next chunkname then it will define a label with that name. As labels are persistent, we can at least tell the second time L<sup>A</sup>T<sub>E</sub>X is run. If we don't find such a defined label then we define `\nextchunkname` to `\relax`.

```
91e <./fangle.sty[13]() (↑88d, lang=) +≡

37 \addtocounter{fangle@chunkcounter}{1}%
38 \edef\nextchunkname{\lst@intname-\arabic{fangle@chunkcounter}}%
39 \@ifundefined{r@label-\nextchunkname}{\let\nextchunkname\relax}{}%

```

The noweb package requires that we define a `\sublabel` for every chunk, with a unique name, which is then used to print out it's navigation hints.

We also define a regular label for this chunk, as was mentioned above when we calculated `\nextchunkname`. This requires L<sup>A</sup>T<sub>E</sub>X to be run at least twice after new chunk sections are added — but noweb required that anyway.

92a `<./fangle.sty[14]() ↑88d, lang=> +≡` △91e 92b▽

```
40 \sublabel{\chunkname}%
41 % define this label for every chunk instance, so we
42 % can tell when we are the last chunk of this name
43 \label{label-\chunkname}%
```

~~~~~

We also try and add the chunk to the list of listings, but I'm afraid we don't do very well. We want each chunk name listing once, with all of it's references.

92b `<./fangle.sty[15]() ↑88d, lang=> +≡` △92a 92c▽

```
44 \addcontentsline{lol}{lstlisting}{\lst@name~[\protect\subpageref{\chunkname}]}%
```

~~~~~

We then call the noweb output macros in the same way that noweave generates them, except that we don't need to call `\nwstartdeflinemarkup` or `\nwenddeflinemarkup` — and if we do, it messes up the output somewhat.

92c `<./fangle.sty[16]() ↑88d, lang=> +≡` △92b 92d▽

```
45 \nwmargintag{%
46 {%
47 \nwtagstyle{}%
48 \subpageref{\chunkname}%
49 }%
50 }%
51 %
52 \moddef{%
53 {\lst@name}%
54 {%
55 \nwtagstyle{}\/%
56 \@ifundefined{fangle@chunk@params}{}{%
57 (fangle@chunk@params)%
58 }%
59 [\csname \chunkcount\endcsname]~%
60 \subpageref{\firstchunkname}%
61 }%
62 \@ifundefined{fangle@chunk@append}{}{%
63 \ifx{}fangle@chunk@append{x}\else%
64 ,~add~to~fangle@chunk@append%
65 \fi%
66 }%
67 \global\def\fangle@chunk@append{}%
68 \lstset{append=x}%
69 }%
70 %
71 \ifx\relax\prevchunkname\endmoddef\else\plusendmoddef\fi%
72 % \nwstartdeflinemarkup%
73 \nwprevnextdefs{\prevchunkname}{\nextchunkname}%
74 % \nwenddeflinemarkup%
75 }%
```

~~~~~

Originally this was developed as a `listings` aspect, in the `Init` hook, but it was found easier to affect the title without using a hook — `\lst@AddToHookExe{PreSet}` is still required to set the listings name to the name passed to the `\Chunk` command, though.

92d `<./fangle.sty[17]() ↑88d, lang=> +≡` △92c 93a▷

```
76 %\lst@BeginAspect{fangle}
77 %\lst@Key{fangle}{true}[t]{\lstKV@SetIf{#1}{true}}
78 \lst@AddToHookExe{PreSet}{\global\let\lst@intname\lst@chunkname}
79 \lst@AddToHook{Init}{}%fangle@caption}
```

80 %\lst@EndAspect

~~~~~

## 17.2.4 Cross references

We define the `\chunkref` command which makes it easy to generate visual references to different code chunks, e.g.

| Macro                                        | Appearance |
|----------------------------------------------|------------|
| <code>\chunkref{preamble}</code>             |            |
| <code>\chunkref[3]{preamble}</code>          |            |
| <code>\chunkref{preamble}[arg1, arg2]</code> |            |

Chunkref can also be used within a code chunk to include another code chunk. The third optional parameter to chunkref is a comma sepatarated list of arguments, which will replace defined parameters in the chunkref.

**Note 1.** Darn it, if I have: `=<\chunkref{new-mode-tracker}[\chunks{chunk_name, "language"}],{mode}]>` the inner braces (inside `[ ]`) cause `_` to signify subscript even though we have `\lst@ReplaceIn`

93a </fangle.sty[18]() ↑88d, lang=> +≡

<92d 94a>

```

81 \def\chunkref@args#1,{%
82 \def\arg{#1}%
83 \lst@ReplaceIn\arg\lst@filenamerpl%
84 \arg%
85 \@ifnextchar{\relax}{, \chunkref@args}%
86 }%
87 \newcommand\chunkref[2][0]{%
88 \@ifnextchar(\chunkref@i{#1}{#2}){\chunkref@i{#1}{#2}()}%
89 }%
90 \def\chunkref@i#1#2(#3){%
91 \def\zero{0}%
92 \def\chunk{#2}%
93 \def\chunkno{#1}%
94 \def\chunkargs{#3}%
95 \ifx\chunkno\zero%
96 \def\chunkname{#2-1}%
97 \else%
98 \def\chunkname{#2-\chunkno}%
99 \fi%
100 \let\lst@arg\chunk%
101 \lst@ReplaceIn\chunk\lst@filenamerpl%
102 \LA{\moddef%
103 {\chunk}%
104 {%
105 \nwtagsstyle}\%/
106 \ifx\chunkno\zero%
107 \else%
108 [\chunkno]%
109 \fi%
110 \ifx\chunkargs\empty%
111 \else%
112 (\chunkref@args #3,)%
113 \fi%
114 ~\subpageref{\chunkname}%
115 }%
116 }%
117 \RA%\endmoddef%
118 }%

```

~~~~~

## 17.2.5 The end

94a `<./fangle.sty[19]() ↑88d, lang=> +≡`

`<193a`

119 `%`

120 `%\makeatother`

---

# Chapter 18

## Extracting fangle

### 18.1 Extracting from Lyx

To extract from LyX, you will need to configure LyX as explained in section ?.

And this lyx-build scrap will extract fangle for me.

95a `<lyx-build[2]()` `↑20a, lang=sh` `+``≡` <120a

```
11 #! /bin/sh
12 set -x
13
14 <lyx-build-helper 19b>
15 cd $PROJECT_DIR || exit 1
16
17 /usr/local/bin/fangle -R./fangle $TEX_SRC > ./fangle
18 /usr/local/bin/fangle -R./fangle.module $TEX_SRC > ./fangle.module
19
20 export FANGLE=./fangle
21 export TMP=${TMP:-/tmp}
22 <test:* 99a>
```

---

With a lyx-build-helper

95b `<lyx-build-helper[2]()` `↑19b, lang=sh` `+``≡` <19b

```
5 PROJECT_DIR="$LYX_r"
6 LYX_SRC="$PROJECT_DIR/${LYX_i%.tex}.lyx"
7 TEX_DIR="$LYX_p"
8 TEX_SRC="$TEX_DIR/$LYX_i"
9 TXT_SRC="$TEX_SRC"
```

---

### 18.2 Extracting documentation

95c `</gen-www[1]()`, `lang=` `≡`

```
1 #python -m elyker --css lyx.css $LYX_SRC | \
2 # iconv -c -f utf-8 -t ISO-8859-1//TRANSLIT | \
3 # sed 's/UTF-8"\(.\)"/ISO-8859-1"\1>/' > www/docs/fangle.html
4
5 python -m elyker --css lyx.css --iso885915 --html --destdirectory www/docs/fangle.e \
6 fangle.lyx > www/docs/fangle.e/fangle.html
7
8 (mkdir -p www/docs/fangle && cd www/docs/fangle && \
9 lyx -e latex ../../../../fangle.lyx && \
10 htlatex ../../../../fangle.tex "xhtml,fn-in" && \
11 sed -i -e 's/<!--1\.[0-9][0-9]* *-->/' fangle.html
12)
13
```

95c `</gen-www[1](), lang=>` ≡

```
14 (mkdir -p www/docs/literate && cd www/docs/literate && \
15 lyx -e latex ../../../../literate.lyx && \
16 htlatex ../../../../literate.tex "xhtml,fn-in" && \
17 sed -i -e 's/<!--1\.[0-9][0-9]* *-->$/g' literate.html
18)
```

---

## 18.3 Extracting from the command line

First you will need the tex output, then you can extract:

96a `<lyx-build-manual[1](), lang=sh>` ≡

```
1 lyx -e latex fangle.lyx
2 fangle -R./fangle fangle.tex > ./fangle
3 fangle -R./fangle.module fangle.tex > ./fangle.module
```

---

# Part III

## Tests



# Chapter 19

## Tests

99a `<test:*[1]()`, lang=`=`)  $\equiv$

---

```
1 #! /bin/bash
2
3 export SRC="${SRC:-./fangle.tm}"
4 export FANGLE="${FANGLE:-./fangle}"
5 export TMP="${TMP:-/tmp}"
6 export TESTDIR="$TMP/$USER/fangle.tests"
7 export TXT_SRC="${TXT_SRC:-$TESTDIR/fangle.txt}"
8 export AWK="${AWK:-awk}"
9 export RUN_FANGLE="${RUN_FANGLE:-$AWK -f}"
10
11 fangle() {
12 ${AWK} -f ${FANGLE} "$@"
13 }
14
15 mkdir -p "$TESTDIR"
16
17 tm -s -c "$SRC" "$TXT_SRC" -q
18
19 <test:helpers 99c>
20 run_tests() {
21 <test:run-tests 99b>
22 }
23
24 # test current fangle
25 echo Testing current fangle
26 run_tests
27
28 # extract new fangle
29 echo testing new fangle
30 fangle -R./fangle "$TXT_SRC" > "$TESTDIR/fangle"
31 export FANGLE="$TESTDIR/fangle"
32 run_tests
33
34 # Now check that it can extract a fangle that also passes the tests!
35 echo testing if new fangle can generate itself
36 fangle -R./fangle "$TXT_SRC" > "$TESTDIR/fangle.new"
37 passtest diff -bwu "$FANGLE" "$TESTDIR/fangle.new"
38 export FANGLE="$TESTDIR/fangle.new"
39 run_tests
```

---

99b `<test:run-tests[1]()`, lang=`=sh`)  $\equiv$

---

```
1 # run tests
2 fangle -Rpcat-test.awk $TXT_SRC | awk -f - || exit 1
3 <test:cromulence 59e>
4 <test:escapes 63c>
5 <test:test-chunk(test:example-sh) 100a>
6 <test:test-chunk(test:example-makefile) 100a>
7 <test:test-chunk(test:q:1) 100a>
8 <test:test-chunk(test:make:1) 100a>
9 <test:test-chunk(test:make:2) 100a>
10 <test:chunk-params 101e>
```

---

99c `<test:helpers[1]()>` `lang=>`  $\equiv$

99c `<test:helpers[1]()>` `lang=>`  $\equiv$

```
1 passtest() {
2 if "$@"
3 then echo "Passed $TEST"
4 else echo "Failed $TEST"
5 return 1
6 fi
7 }
8
9 failtest() {
10 if ! "$@"
11 then echo "Passed $TEST"
12 else echo "Failed $TEST"
13 return 1
14 fi
15 }
```

---

This chunk will render a named chunk and compare it to another rendered named chunk

100a `<test:test-chunk[1](chunk)>` `lang=sh`  $\equiv$

```
1 <test:test-chunk-result(<chunk> <chunk>result) 100b>
```

---

100b `<test:test-chunk-result[1](chunk, result)>` `lang=sh`  $\equiv$

```
1 TEST="<result>" passtest diff -u --label "EXPECTED: <result>" <(fangle -R<result> $TXT_SRC) \
2 --label "ACTUAL: <chunk>" <(fangle -R<chunk> $TXT_SRC)
```

---

# Chapter 20

## Chunk Parameters

### 20.1 L<sub>A</sub>T<sub>E</sub>X

101a `<test:lyx:chunk-params:sub[1](THING, colour), lang=>` ≡

```
1 I see a ${THING},
2 a ${THING} of colour ${colour},
3 and looking closer =<\chunkref{test:lyx:chunk-params:sub:sub}(${colour})>
```

101b `<test:lyx:chunk-params:sub:sub[1](colour), lang=>` ≡

```
1 a funny shade of ${colour}
```

101c `<test:lyx:chunk-params:text[1](), lang=>` ≡

```
1 What do you see? "=<\chunkref{test:lyx:chunk-params:sub}(joe, red)>"
2 Well, fancy!
```

Should generate output:

101d `<test:lyx:chunk-params:result[1](), lang=>` ≡

```
1 What do you see? "I see a joe,
2 a joe of colour red,
3 and looking closer a funny shade of red"
4 Well, fancy!
```

And this chunk will perform the test:

101e `<test:chunk-params[1](), lang=>` ≡

102b>

```
1 <test:test-chunk-result(test:lyx:chunk-params:text, test:lyx:chunk-params:result) 100b> || exit 1
```

### 20.2 T<sub>E</sub>X<sub>M</sub>A<sub>C</sub>S

101f `<test:chunk-params:sub[1](THING, colour), lang=>` ≡

```
1 I see a <THING>,
2 a <THING> of colour <colour>,
3 and looking closer <test:chunk-params:sub:sub(<colour>) 101g>
```

101g `<test:chunk-params:sub:sub[1](colour), lang=>` ≡

```
1 a funny shade of <colour>
```

101h `<test:chunk-params:text[1](), lang=>` ≡

96a>

```
1 What do you see? "<test:chunk-params:sub(joe, red) 101f>"
```

101h <test:chunk-params:text[1](), lang=> ≡

96a>

2 Well, fancy!

~~~~~

Should generate output:

102a <test:chunk-params:result[1](), lang=> ≡

---

```
1 What do you see? "I see a joe,
2 a joe of colour red,
3 and looking closer a funny shade of red"
4 Well, fancy!
```

---

And this chunk will perform the test:

102b <test:chunk-params[2]() ↑101e, lang=> +≡

<101e

---

```
2 <test:test-chunk-result(test:chunk-params:text, test:chunk-params:result) 100b) || exit 1
```

---

# Chapter 21

## Compile-log-lyx

103a [Chunk:./compile-log-lyx\[1\]\(\), lang=sh](#) ≡

---

```
1 #! /bin/sh
2 # can't use gtkdialog -i, cos it uses the "source" command which ubuntu sh doesn't have
3
4 main() {
5 errors="/tmp/compile.log.$$"
6 # if grep '[^]*:(In |[0-9][0-9]*: [^]*:)' > $errors
7 if grep '[^]*(\|[0-9][0-9]*) *:(error|warning\)' > $errors
8 then
9 sed -i -e 's/^[^]*(\|[0-9][0-9]*) *:(error|warning\)' > $errors
10 COMPILE_DIALOG='
11 <vbox>
12 <text>
13 <label>Compiler errors:</label>
14 </text>
15 <tree exported_column="0">
16 <variable>LINE</variable>
17 <height>400</height><width>800</width>
18 <label>File | Line | Message</label>
19 <action>'". $SELF ; ''lyxgoto $LINE</action>
20 <input>' "cat $errors"</input>
21 </tree>
22 <hbox>
23 <button><label>Build</label>
24 <action>lyxclient -c "LYXCMD:build-program" &</action>
25 </button>
26 <button ok></button>
27 </hbox>
28 </vbox>
29 '
30 export COMPILE_DIALOG
31 (gtkdialog --program=COMPILE_DIALOG ; rm $errors) &
32 else
33 rm $errors
34 fi
35 }
36
37 lyxgoto() {
38 file="${LINE%:*}"
39 line="${LINE##*:}"
40 extraline='cat $file | head -n $line | tac | sed '/^\\begin{lstlisting}/q' | wc -l'
41 extraline='expr $extraline - 1'
42 lyxclient -c "LYXCMD:command-sequence server-goto-file-row $file $line ; char-forward ; repeat
43 $extraline paragraph-down ; paragraph-up-select"
44 }
45 SELF="$0"
46 if test -z "$COMPILE_DIALOG"
47 then main "$0"
48 fi
```

---