A Markdown Interpreter for TEX

Vít Novotný
witiko@mail.muni.cz

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Contents

List of Figures

1 Introduction

The Markdown package[1] converts markdown[2] markup to TEX commands. The functionality is provided both as a Lua module and as plain TEX, LATEX, and ConTEXt macro packages that can be used to directly typeset TEXdocuments containing markdown markup. Unlike other convertors, the Markdown package does not require any external programs, and makes it easy to redefine how each and every markdown element is rendered. Creative abuse of the markdown syntax is encouraged. 😉

This document is a technical documentation for the Markdown package. It consists of three sections. This section introduces the package and outlines its prerequisites. Section 2 on page 6 describes the interfaces exposed by the package. Section 3 on page 58 describes the implementation of the package. The technical documentation

[1] See https://ctan.org/pkg/markdown.
[2] See https://daringfireball.net/projects/markdown/basics.

contains only a limited number of tutorials and code examples. You can find more of these in the user manual.[3]

```
local metadata = {
    version   = "$(VERSION)",
    comment   = "A module for the conversion from markdown to plain TeX",
    author    = "John MacFarlane, Hans Hagen, Vít Novotný",
    copyright = {"2009-2016 John MacFarlane, Hans Hagen",
                 "2016-2021 Vít Novotný"},
    license   = "LPPL 1.3c"
}

if not modules then modules = { } end
modules['markdown'] = metadata
```

1.1 Requirements

This section gives an overview of all resources required by the package.

1.1.1 Lua Requirements

The Lua part of the package requires that the following Lua modules are available from within the LuaTEX engine:

LPeg ⩾ 0.10 A pattern-matching library for the writing of recursive descent parsers via the Parsing Expression Grammars (PEGs). It is used by the Lunamark library to parse the markdown input. LPeg ⩾ 0.10 is included in LuaTEX ⩾ 0.72.0 (TEXLive ⩾ 2013).

```
local lpeg = require("lpeg")
```

Selene Unicode A library that provides support for the processing of wide strings. It is used by the Lunamark library to cast image, link, and footnote tags to the lower case. Selene Unicode is included in all releases of LuaTEX (TEXLive ⩾ 2008).

```
local ran_ok, unicode = pcall(require, "unicode")
```

If the Selene Unicode library is unavailable and we are using Lua ⩾ 5.3, we will use the built-in support for Unicode.

```
if not ran_ok then
  unicode = {["utf8"]={char=utf8.char}}
end
```

[3] See http://mirrors.ctan.org/macros/generic/markdown/markdown.html.

MD5 A library that provides MD5 crypto functions. It is used by the Lunamark library to compute the digest of the input for caching purposes. MD5 is included in all releases of LuaTeX (TeXLive ⩾ 2008).

```
local md5 = require("md5")
```

All the abovelisted modules are statically linked into the current version of the LuaTeX engine [1, Section 3.3]. Beside these, we also carry the following third-party Lua libraries:

api7/lua-tinyyaml A library that provides a regex-based recursive descent YAML (subset) parser that is used to read YAML metadata when the `jekyllData` option is enabled.

1.1.2 Plain TeX Requirements

The plain TeX part of the package requires that the plain TeX format (or its superset) is loaded, all the Lua prerequisites (see Section 1.1.1 on the preceding page), and the following Lua module:

Lua File System A library that provides access to the filesystem via OS-specific syscalls. It is used by the plain TeX code to create the cache directory specified by the `\markdownOptionCacheDir` macro before interfacing with the Lunamark library. Lua File System is included in all releases of LuaTeX (TeXLive ⩾ 2008).

The plain TeX code makes use of the `isdir` method that was added to the Lua File System library by the LuaTeX engine developers [1, Section 3.2].

The Lua File System module is statically linked into the LuaTeX engine [1, Section 3.3].

Unless you convert markdown documents to TeX manually using the Lua command-line interface (see Section 2.1.5 on page 19), the plain TeX part of the package will require that either the LuaTeX `\directlua` primitive or the shell access file stream 18 is available in your TeX engine. If only the shell access file stream is available in your TeX engine (as is the case with pdfTeX and XeTeX) or if you enforce the use of shell using the `\markdownMode` macro, then unless your TeX engine is globally configured to enable shell access, you will need to provide the `-shell-escape` parameter to your engine when typesetting a document.

1.1.3 LaTeX Requirements

The LaTeX part of the package requires that the LaTeX 2ε format is loaded,

```
\NeedsTeXFormat{LaTeX2e}%
```

a TeX engine that extends ε-TeX, all the plain TeX prerequisites (see Section 1.1.2), and the following LaTeX 2ε packages:

keyval A package that enables the creation of parameter sets. This package is used to provide the `\markdownSetup` macro, the package options processing, as well as the parameters of the `markdown*` LaTeX environment.

```
\RequirePackage{keyval}
```

xstring A package that provides useful macros for manipulating strings of tokens.

```
\RequirePackage{xstring}
```

The following packages are soft prerequisites. They are only used to provide default token renderer prototypes (see sections 2.2.4 on page 37 and 3.3.4 on page 175) or LaTeX themes (see Section 2.3.2.2 on page 42) and will not be loaded if the `plain` package option has been enabled (see Section 2.3.2.1 on page 42):

url A package that provides the `\url` macro for the typesetting of links.

graphicx A package that provides the `\includegraphics` macro for the typesetting of images.

paralist A package that provides the `compactitem`, `compactenum`, and `compactdesc` macros for the typesetting of tight bulleted lists, ordered lists, and definition lists.

ifthen A package that provides a concise syntax for the inspection of macro values. It is used to determine whether or not the paralist package should be loaded based on the user options, in the `witiko/dot` LaTeX theme (see Section 2.3.2.2 on page 42), and to provide default token renderer prototypes.

fancyvrb A package that provides the `\VerbatimInput` macros for the verbatim inclusion of files containing code.

csvsimple A package that provides the `\csvautotabular` macro for typesetting CSV files in the default renderer prototypes for iA Writer content blocks.

gobble A package that provides the `\@gobblethree` TeX command that is used in the default renderer prototype for citations. The package is included in TeXLive $\geqslant$ 2016.

amsmath and amssymb Packages that provide symbols used for drawing ticked and unticked boxes.

catchfile A package that catches the contents of a file and puts it in a macro. It is used in the `witiko/graphicx/http` LaTeX theme, see Section 2.3.2.2 on page 42.

grffile A package that extends the name processing of package graphics to support a larger range of file names in 2006 ⩽ TeX Live ⩽ 2019. Since TeX Live ⩾ 2020, the functionality of the package has been integrated in the LaTeX 2_ε kernel. It is used in the `witiko/dot` and `witiko/graphicx/http` LaTeX themes, see Section 2.3.2.2 on page 42.

etoolbox A package that is used to polyfill the general hook management system in the default renderer prototypes for YAML metadata, see Section 3.3.4.5.

expl3 A package that enables the expl3 language from the LaTeX3 kernel in TeX Live ⩽ 2019. It is used in the default renderer prototypes for YAML metadata, see Section 3.3.4.5.

1.1.4 ConTeXt Prerequisites

The ConTeXt part of the package requires that either the Mark II or the Mark IV format is loaded, all the plain TeX prerequisites (see Section 1.1.2 on page 3), and the following ConTeXt modules:

m-database A module that provides the default token renderer prototype for iA Writer content blocks with the CSV filename extension (see Section 2.2.4 on page 37).

1.2 Feedback

Please use the Markdown project page on GitHub[4] to report bugs and submit feature requests. If you do not want to report a bug or request a feature but are simply in need of assistance, you might want to consider posting your question to the TeX-LaTeX Stack Exchange.[5] community question answering web site under the `markdown` tag.

1.3 Acknowledgements

The Lunamark Lua module provides speedy markdown parsing for the package. I would like to thank John Macfarlane, the creator of Lunamark, for releasing Lunamark under a permissive license, which enabled its use in the Markdown package.

Extensive user documentation for the Markdown package was kindly written by Lian Tze Lim and published by Overleaf.

Funding by the the Faculty of Informatics at the Masaryk University in Brno [2] is gratefully acknowledged.

[4] See `https://github.com/witiko/markdown/issues`.
[5] See `https://tex.stackexchange.com`.

Support for content slicing (Lua options `shiftHeadings` and `slice`) and pipe tables (Lua options `pipeTables` and `tableCaptions`) was graciously sponsored by David Vins and Omedym.

The TEX implementation of the package draws inspiration from several sources including the source code of LATEX 2_ε, the minted package by Geoffrey M. Poore, which likewise tackles the issue of interfacing with an external interpreter from TEX, the filecontents package by Scott Pakin and others.

2 Interfaces

This part of the documentation describes the interfaces exposed by the package along with usage notes and examples. It is aimed at the user of the package.

Since neither TEX nor Lua provide interfaces as a language construct, the separation to interfaces and implementations is a *gentlemen's agreement*. It serves as a means of structuring this documentation and as a promise to the user that if they only access the package through the interface, the future minor versions of the package should remain backwards compatible.

Figure 1 on the following page shows the high-level structure of the Markdown package: The translation from markdown to TEX *token renderers* is exposed by the Lua layer. The plain TEX layer exposes the conversion capabilities of Lua as TEX macros. The LATEX and ConTEXt layers provide syntactic sugar on top of plain TEX macros. The user can interface with any and all layers.

2.1 Lua Interface

The Lua interface provides the conversion from UTF-8 encoded markdown to plain TEX. This interface is used by the plain TEX implementation (see Section 3.2 on page 159) and will be of interest to the developers of other packages and Lua modules.

The Lua interface is implemented by the `markdown` Lua module.

```
21 local M = {metadata = metadata}
```

2.1.1 Conversion from Markdown to Plain TEX

The Lua interface exposes the `new(options)` method. This method creates converter functions that perform the conversion from markdown to plain TEX according to the table `options` that contains options recognized by the Lua interface. (see Section 2.1.2 on the following page). The `options` parameter is optional; when unspecified, the behaviour will be the same as if `options` were an empty table.

The following example Lua code converts the markdown string `Hello *world*!` to a TEX output using the default options and prints the TEX output:

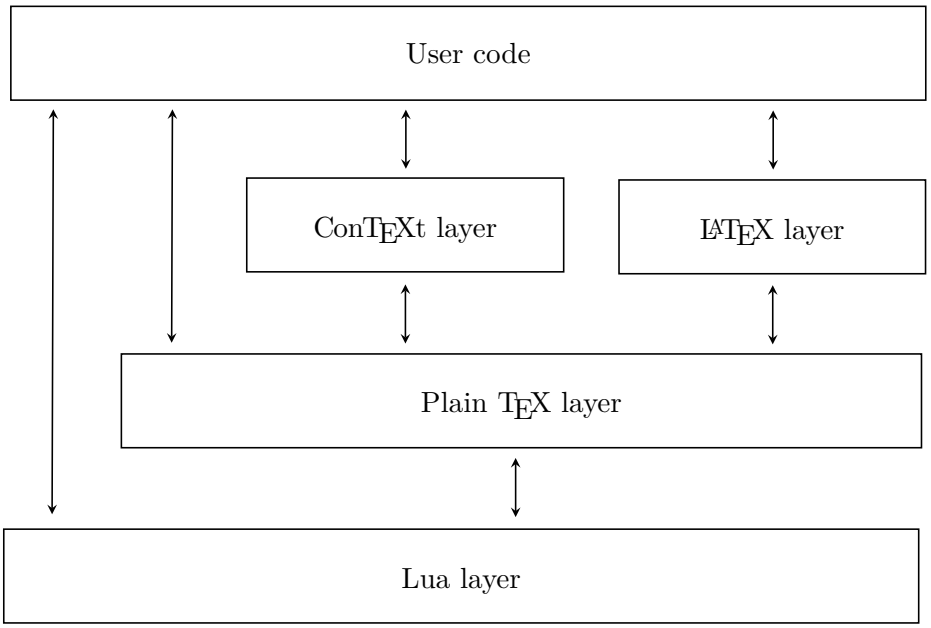

Figure 1: A block diagram of the Markdown package

```
local md = require("markdown")
local convert = md.new()
print(convert("Hello *world*!"))
```

2.1.2 Options

The Lua interface recognizes the following options. When unspecified, the value of a key is taken from the `defaultOptions` table.

```
22 local defaultOptions = {}
```

2.1.3 File and Directory Names

`cacheDir`=⟨*path*⟩ default: `.`

A path to the directory containing auxiliary cache files. If the last segment of the path does not exist, it will be created by the Lua command-line and plain TEX implementations. The Lua implementation expects that the entire path already exists.

When iteratively writing and typesetting a markdown document, the cache files are going to accumulate over time. You are advised to clean the cache directory every

now and then, or to set it to a temporary filesystem (such as `/tmp` on UN*X systems), which gets periodically emptied.

```
23 defaultOptions.cacheDir = "."
```

`frozenCacheFileName`=⟨*path*⟩ default: `frozenCache.tex`

A path to an output file (frozen cache) that will be created when the `finalizeCache` option is enabled and will contain a mapping between an enumeration of markdown documents and their auxiliary cache files.

The frozen cache makes it possible to later typeset a plain TEX document that contains markdown documents without invoking Lua using the `\markdownOptionFrozenCache` plain TEX option. As a result, the plain TEX document becomes more portable, but further changes in the order and the content of markdown documents will not be reflected.

```
24 defaultOptions.frozenCacheFileName = "frozenCache.tex"
```

2.1.4 Parser Options

`blankBeforeBlockquote`=`true`, `false` default: `false`

`true`	Require a blank line between a paragraph and the following blockquote.
`false`	Do not require a blank line between a paragraph and the following blockquote.

```
25 defaultOptions.blankBeforeBlockquote = false
```

`blankBeforeCodeFence`=`true`, `false` default: `false`

`true`	Require a blank line between a paragraph and the following fenced code block.
`false`	Do not require a blank line between a paragraph and the following fenced code block.

```
26 defaultOptions.blankBeforeCodeFence = false
```

`blankBeforeHeading`=`true`, `false` default: `false`

`true`	Require a blank line between a paragraph and the following header.
`false`	Do not require a blank line between a paragraph and the following header.

```
27 defaultOptions.blankBeforeHeading = false
```

`breakableBlockquotes`=true, false default: `false`

`true` A blank line separates block quotes.

`false` Blank lines in the middle of a block quote are ignored.

```
28 defaultOptions.breakableBlockquotes = false
```

`citationNbsps`=true, false default: `false`

`true` Replace regular spaces with non-breaking spaces inside the prenotes and postnotes of citations produced via the pandoc citation syntax extension.

`false` Do not replace regular spaces with non-breaking spaces inside the prenotes and postnotes of citations produced via the pandoc citation syntax extension.

```
29 defaultOptions.citationNbsps = true
```

`citations`=true, false default: `false`

`true` Enable the pandoc citation syntax extension:

```
Here is a simple parenthetical citation [@doe99] and here
is a string of several [see @doe99, pp. 33-35; also
@smith04, chap. 1].

A parenthetical citation can have a [prenote @doe99] and
a [@smith04 postnote]. The name of the author can be
suppressed by inserting a dash before the name of an
author as follows [-@smith04].

Here is a simple text citation @doe99 and here is
a string of several @doe99 [pp. 33-35; also @smith04,
chap. 1]. Here is one with the name of the author
suppressed -@doe99.
```

`false` Disable the pandoc citation syntax extension.

```
30 defaultOptions.citations = false
```

`codeSpans`=`true`, `false` default: `true`

`true` Enable the code span syntax:

```
Use the `printf()` function.
``There is a literal backtick (`) here.``
```

`false` Disable the code span syntax. This allows you to easily use the quotation mark ligatures in texts that do not contain code spans:

```
``This is a quote.''
```

```
31 defaultOptions.codeSpans = true
```

`contentBlocks`=`true`, `false` default: `false`

`true` Enable the iA Writer content blocks syntax extension [3]:

```
http://example.com/minard.jpg (Napoleon's
  disastrous Russian campaign of 1812)
/Flowchart.png "Engineering Flowchart"
/Savings Account.csv 'Recent Transactions'
/Example.swift
/Lorem Ipsum.txt
```

`false` Disable the iA Writer content blocks syntax extension.

```
32 defaultOptions.contentBlocks = false
```

`contentBlocksLanguageMap`=⟨*filename*⟩
default: `markdown-languages.json`

The filename of the JSON file that maps filename extensions to programming language names in the iA Writer content blocks. See Section 2.2.3.10 on page 29 for more information.

```
33 defaultOptions.contentBlocksLanguageMap = "markdown-languages.json"
```

`definitionLists`=`true`, `false` default: `false`

`true` Enable the pandoc definition list syntax extension:

```
Term 1

:   Definition 1

Term 2 with *inline markup*

:   Definition 2

        { some code, part of Definition 2 }

    Third paragraph of definition 2.
```

`false` Disable the pandoc definition list syntax extension.

```
34 defaultOptions.definitionLists = false
```

`fencedCode`=`true`, `false` default: `false`

`true` Enable the commonmark fenced code block extension:

````
~~~ js
if (a > 3) {
    moveShip(5 * gravity, DOWN);
}
~~~~~~

  ``` html
  <pre>
    <code>
      // Some comments
      line 1 of code
      line 2 of code
      line 3 of code
    </code>
  </pre>
  ```
````

`false` Disable the commonmark fenced code block extension.

```
35 defaultOptions.fencedCode = false
```

`finalizeCache`=`true`, `false` default: `false`

Whether an output file specified with the `frozenCacheFileName` option (frozen cache) that contains a mapping between an enumeration of markdown documents and their auxiliary cache files will be created.

The frozen cache makes it possible to later typeset a plain TEX document that contains markdown documents without invoking Lua using the `\markdownOptionFrozenCache` plain TEX option. As a result, the plain TEX document becomes more portable, but further changes in the order and the content of markdown documents will not be reflected.

```
36 defaultOptions.finalizeCache = false
```

`footnotes`=`true`, `false` default: `false`

`true` Enable the pandoc footnote syntax extension:

```
Here is a footnote reference,[^1] and another.[^longnote]

[^1]: Here is the footnote.

[^longnote]: Here's one with multiple blocks.

    Subsequent paragraphs are indented to show that they
belong to the previous footnote.

        { some.code }

    The whole paragraph can be indented, or just the
    first line.  In this way, multi-paragraph footnotes
    work like multi-paragraph list items.

This paragraph won't be part of the note, because it
isn't indented.
```

`false` Disable the pandoc footnote syntax extension.

```
37 defaultOptions.footnotes = false
```

`frozenCacheCounter`=⟨*number*⟩ default: `0`

The number of the current markdown document that will be stored in an output file (frozen cache) when the `finalizeCache` is enabled. When the document number is 0, then a new frozen cache will be created. Otherwise, the frozen cache will be appended.

Each frozen cache entry will define a TEX macro `\markdownFrozenCache`⟨*number*⟩ that will typeset markdown document number ⟨*number*⟩.

```
38 defaultOptions.frozenCacheCounter = 0
```

`hashEnumerators`=`true`, `false` default: `false`

`true` Enable the use of hash symbols (`#`) as ordered item list markers:

```
#. Bird
#. McHale
#. Parish
```

`false` Disable the use of hash symbols (`#`) as ordered item list markers.

```
39 defaultOptions.hashEnumerators = false
```

`headerAttributes`=`true`, `false` default: `false`

`true` Enable the assignment of HTML attributes to headings:

```
# My first heading {#foo}

## My second heading ##    {#bar .baz}

Yet another heading   {key=value}
==================
```

These HTML attributes have currently no effect other than enabling content slicing, see the `slice` option.

`false` Disable the assignment of HTML attributes to headings.

```
40 defaultOptions.headerAttributes = false
```

`html`=`true`, `false` default: `false`

`true` Enable the recognition of HTML tags, block elements, comments, HTML instructions, and entities in the input. Tags, block elements (along with contents), HTML instructions, and comments will be ignored and HTML entities will be replaced with the corresponding Unicode codepoints.

`false` Disable the recognition of HTML markup. Any HTML markup in the input will be rendered as plain text.

```
41 defaultOptions.html = false
```

`hybrid`=`true`, `false` default: `false`

`true` Disable the escaping of special plain TEX characters, which makes it possible to intersperse your markdown markup with TEX code. The intended usage is in documents prepared manually by a human author. In such documents, it can often be desirable to mix TEX and markdown markup freely.

`false` Enable the escaping of special plain TEX characters outside verbatim environments, so that they are not interpretted by TEX. This is encouraged when typesetting automatically generated content or markdown documents that were not prepared with this package in mind.

```
42 defaultOptions.hybrid = false
```

`inlineFootnotes`=`true`, `false` default: `false`

`true` Enable the pandoc inline footnote syntax extension:

```
Here is an inline note.^[Inlines notes are easier to
write, since you don't have to pick an identifier and
move down to type the note.]
```

`false` Disable the pandoc inline footnote syntax extension.

```
43 defaultOptions.inlineFootnotes = false
```

`jekyllData`=true, false default: `false`

`true` Enable the Pandoc `yaml_metadata_block` syntax extension for entering metadata in YAML:

```
---
title:  'This is the title: it contains a colon'
author:
- Author One
- Author Two
keywords: [nothing, nothingness]
abstract: |
  This is the abstract.

  It consists of two paragraphs.
---
```

`false` Disable the Pandoc `yaml_metadata_block` syntax extension for entering metadata in YAML.

```
44 defaultOptions.jekyllData = false
```

`pipeTables`=true, false default: `false`

`true` Enable the PHP Markdown table syntax extension:

```
| Right | Left | Default | Center |
|------:|:-----|---------|:------:|
|   12  |  12  |    12   |    12  |
|  123  |  123 |   123   |   123  |
|    1  |    1 |     1   |     1  |
```

`false` Disable the PHP Markdown table syntax extension.

```
45 defaultOptions.pipeTables = false
```

`preserveTabs`=true, false default: `false`

`true` Preserve tabs in code block and fenced code blocks.

`false` Convert any tabs in the input to spaces.

```
46 defaultOptions.preserveTabs = false
```

`shiftHeadings`=⟨*shift amount*⟩ default: `0`

All headings will be shifted by ⟨*shift amount*⟩, which can be both positive and negative. Headings will not be shifted beyond level 6 or below level 1. Instead, those headings will be shifted to level 6, when ⟨*shift amount*⟩ is positive, and to level 1, when ⟨*shift amount*⟩ is negative.

```
47 defaultOptions.shiftHeadings = 0
```

`slice`=⟨*the beginning and the end of a slice*⟩ default: `^ $`

Two space-separated selectors that specify the slice of a document that will be processed, whereas the remainder of the document will be ignored. The following selectors are recognized:

- The circumflex (`^`) selects the beginning of a document.
- The dollar sign (`$`) selects the end of a document.
- `^`⟨*identifier*⟩ selects the beginning of a section with the HTML attribute `#`⟨*identifier*⟩ (see the `headerAttributes` option).
- `$`⟨*identifier*⟩ selects the end of a section with the HTML attribute `#`⟨*identifier*⟩.
- ⟨*identifier*⟩ corresponds to `^`⟨*identifier*⟩ for the first selector and to `$`⟨*identifier*⟩ for the second selector.

Specifying only a single selector, ⟨*identifier*⟩, is equivalent to specifying the two selectors ⟨*identifier*⟩ ⟨*identifier*⟩, which is equivalent to `^`⟨*identifier*⟩ `$`⟨*identifier*⟩, i.e. the entire section with the HTML attribute `#`⟨*identifier*⟩ will be selected.

```
48 defaultOptions.slice = "^ $"
```

`smartEllipses`=`true`, `false` default: `false`

`true`	Convert any ellipses in the input to the `\markdownRendererEllipsis` TEX macro.
`false`	Preserve all ellipses in the input.

```
49 defaultOptions.smartEllipses = false
```

`startNumber`=`true`, `false` default: `true`

`true`	Make the number in the first item of an ordered lists significant. The item numbers will be passed to the `\markdownRendererOlItemWithNumber` TEX macro.
`false`	Ignore the numbers in the ordered list items. Each item will only produce a `\markdownRendererOlItem` TEX macro.

```
50 defaultOptions.startNumber = true
```

`stripIndent`=true, false default: `false`

`true` Strip the minimal indentation of non-blank lines from all lines in a markdown document. Requires that the `preserveTabs` Lua option is `false`:

```
\documentclass{article}
\usepackage[stripIndent]{markdown}
\begin{document}
    \begin{markdown}
        Hello *world*!
    \end{markdown}
\end{document}
```

`false` Do not strip any indentation from the lines in a markdown document.

```
defaultOptions.stripIndent = false
```

`tableCaptions`=true, false default: `false`

`true` Enable the Pandoc `table_captions` syntax extension for pipe tables (see the `pipeTables` option).

```
| Right | Left | Default | Center |
|------:|:-----|---------|:------:|
|   12  |  12  |    12   |    12  |
|  123  |  123 |   123   |   123  |
|    1  |    1 |     1   |     1  |

  : Demonstration of pipe table syntax.
```

`false` Disable the Pandoc `table_captions` syntax extension.

```
defaultOptions.tableCaptions = false
```

`taskLists`=true, false default: `false`

`true` Enable the Pandoc `task_lists` syntax extension.

```
- [ ] an unticked task list item
- [/] a half-checked task list item
- [X] a ticked task list item
```

`false` Disable the Pandoc `task_lists` syntax extension.

```
defaultOptions.taskLists = false
```

`texComments`=`true`, `false` default: `false`

`true` Strip TEX-style comments.

```
\documentclass{article}
\usepackage[texComments]{markdown}
\begin{document}
\begin{markdown}
Hello *world*!
\end{markdown}
\end{document}
```

Always enabled when `hybrid` is enabled.

`false` Do not strip TEX-style comments.

```
54 defaultOptions.texComments = false
```

`tightLists`=`true`, `false` default: `true`

`true` Lists whose bullets do not consist of multiple paragraphs will be passed to the `\markdownRendererOlBeginTight`, `\markdownRendererOlEndTight`, `\markdownRendererUlBeginTight`, `\markdownRendererUlEndTight`, `\markdownRendererDlBeginTight`, and `\markdownRendererDlEndTight` TEX macros.

`false` Lists whose bullets do not consist of multiple paragraphs will be treated the same way as lists that do consist of multiple paragraphs.

```
55 defaultOptions.tightLists = true
```

`underscores`=`true`, `false` default: `true`

`true` Both underscores and asterisks can be used to denote emphasis and strong emphasis:

```
*single asterisks*
_single underscores_
**double asterisks**
__double underscores__
```

`false` Only asterisks can be used to denote emphasis and strong emphasis. This makes it easy to write math with the `hybrid` option without the need to constantly escape subscripts.

```
56 defaultOptions.underscores = true
```

2.1.5 Command-Line Interface

The high-level operation of the Markdown package involves the communication between several programming layers: the plain TEX layer hands markdown documents to the Lua layer. Lua converts the documents to TEX, and hands the converted documents back to plain TEX layer for typesetting, see Figure 2.

This procedure has the advantage of being fully automated. However, it also has several important disadvantages: The converted TEX documents are cached on the file system, taking up increasing amount of space. Unless the TEX engine includes a Lua interpreter, the package also requires shell access, which opens the door for a malicious actor to access the system. Last, but not least, the complexity of the procedure impedes debugging.

A solution to the above problems is to decouple the conversion from the typesetting. For this reason, a command-line Lua interface for converting a markdown document to TEX is also provided, see Figure 3 on the next page.

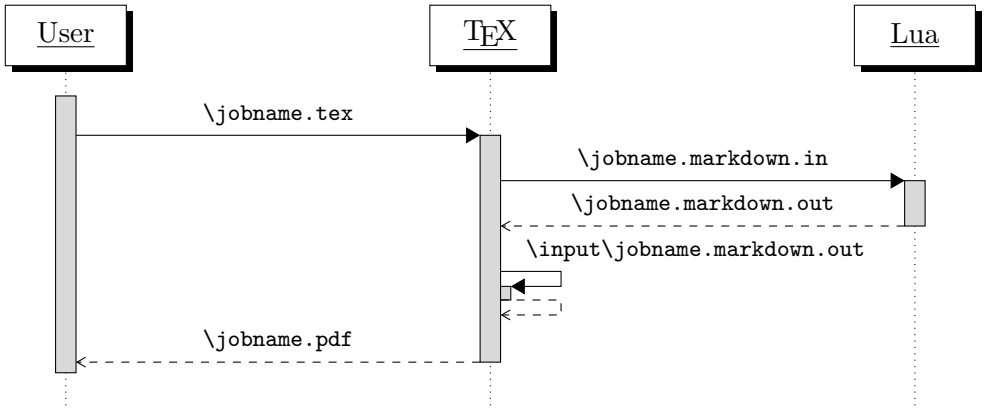

Figure 2: A sequence diagram of the Markdown package typesetting a markdown document using the TEX interface

```
57
58 HELP_STRING = [[
59 Usage: texlua ]] .. arg[0] .. [[ [OPTIONS] -- [INPUT_FILE] [OUTPUT_FILE]
60 where OPTIONS are documented in the Lua interface section of the
61 technical Markdown package documentation.
62
63 When OUTPUT_FILE is unspecified, the result of the conversion will be
64 written to the standard output. When INPUT_FILE is also unspecified, the
65 result of the conversion will be read from the standard input.
66
67 Report bugs to: witiko@mail.muni.cz
68 Markdown package home page: <https://github.com/witiko/markdown>]]
69
```

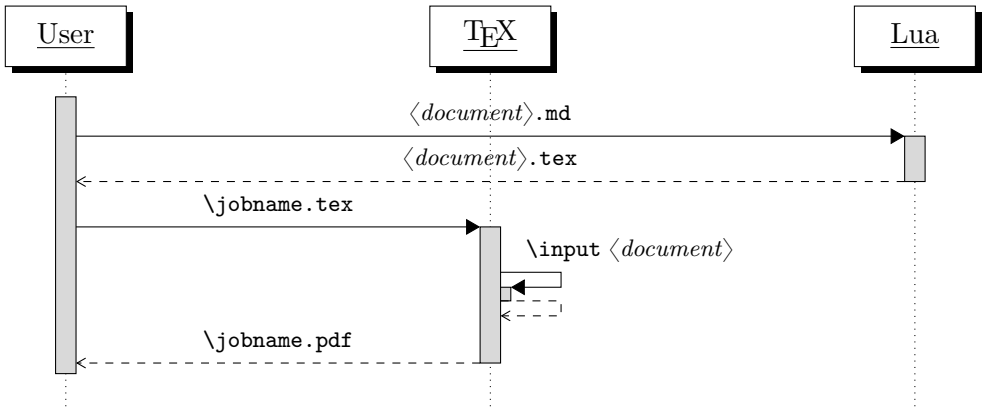

Figure 3: A sequence diagram of the Markdown package typesetting a markdown document using the Lua command-line interface

```
70 VERSION_STRING = [[
71 markdown-cli.lua (Markdown) ]] .. metadata.version .. [[
72
73 Copyright (C) ]] .. table.concat(metadata.copyright,
74                                  "\nCopyright (C) ") .. [[
75
76 License: ]] .. metadata.license
77
78 local function warn(s)
79   io.stderr:write("Warning: " .. s .. "\n") end
80
81 local function error(s)
82   io.stderr:write("Error: " .. s .. "\n")
83   os.exit(1) end
84
85 local process_options = true
86 local options = {}
87 local input_filename
88 local output_filename
89 for i = 1, #arg do
90   if process_options then
```

After the optional `--` argument has been specified, the remaining arguments are assumed to be input and output filenames. This argument is optional, but encouraged, because it helps resolve ambiguities when deciding whether an option or a filename has been specified.

```
91     if arg[i] == "--" then
92       process_options = false
93       goto continue
```

Unless the `--` argument has been specified before, an argument containing the equals sign (`=`) is assumed to be an option specification in a ⟨*key*⟩`=`⟨*value*⟩ format. The available options are listed in Section 2.1.2 on page 7.

```
    elseif arg[i]:match("=") then
      key, value = arg[i]:match("(.-)=(.*)")
```

The `defaultOptions` table is consulted to identify whether ⟨*value*⟩ should be parsed as a string or as a boolean.

```
      default_type = type(defaultOptions[key])
      if default_type == "boolean" then
        options[key] = (value == "true")
      elseif default_type == "number" then
        options[key] = tonumber(value)
      else
        if default_type ~= "string" then
          if default_type == "nil" then
            warn('Option "' .. key .. '" not recognized.')
          else
            warn('Option "' .. key .. '" type not recognized, please file ' ..
                 'a report to the package maintainer.')
          end
          warn('Parsing the ' .. 'value "' .. value ..'" of option "' ..
               key .. '" as a string.')
        end
        options[key] = value
      end
      goto continue
```

Unless the `--` argument has been specified before, an argument `--help`, or `-h` causes a brief documentation for how to invoke the program to be printed to the standard output.

```
    elseif arg[i] == "--help" or arg[i] == "-h" then
      print(HELP_STRING)
      os.exit()
```

Unless the `--` argument has been specified before, an argument `--version`, or `-v` causes the program to print information about its name, version, origin and legal status, all on standard output.

```
    elseif arg[i] == "--version" or arg[i] == "-v" then
      print(VERSION_STRING)
      os.exit()
    end
  end
```

The first argument that matches none of the above patters is assumed to be the input filename. The input filename should correspond to the Markdown document that is going to be converted to a TEX document.

```
  if input_filename == nil then
    input_filename = arg[i]
```

The first argument that matches none of the above patters is assumed to be the output filename. The output filename should correspond to the TEX document that will result from the conversion.

```
  elseif output_filename == nil then
    output_filename = arg[i]
  else
    error('Unexpected argument: "' .. arg[i] .. '".')
  end
  ::continue::
end
```

The command-line Lua interface is implemented by the `markdown-cli.lua` file that can be invoked from the command line as follows:

```
texlua /path/to/markdown-cli.lua cacheDir=. -- hello.md hello.tex
```

to convert the Markdown document `hello.md` to a TEX document `hello.tex`. After the Markdown package for our TEX format has been loaded, the converted document can be typeset as follows:

```
\input hello
```

2.2 Plain TEX Interface

The plain TEX interface provides macros for the typesetting of markdown input from within plain TEX, for setting the Lua interface options (see Section 2.1.2 on page 7) used during the conversion from markdown to plain TEX and for changing the way markdown the tokens are rendered.

```
\def\markdownLastModified{$(LAST_MODIFIED)}%
\def\markdownVersion{$(VERSION)}%
```

The plain TEX interface is implemented by the `markdown.tex` file that can be loaded as follows:

```
\input markdown
```

It is expected that the special plain TEX characters have the expected category codes, when `\input`ting the file.

2.2.1 Typesetting Markdown

The interface exposes the \markdownBegin, \markdownEnd, and \markdownInput macros.

The \markdownBegin macro marks the beginning of a markdown document fragment and the \markdownEnd macro marks its end.

```
\let\markdownBegin\relax
\let\markdownEnd\relax
```

You may prepend your own code to the \markdownBegin macro and redefine the \markdownEnd macro to produce special effects before and after the markdown block.

There are several limitations to the macros you need to be aware of. The first limitation concerns the \markdownEnd macro, which must be visible directly from the input line buffer (it may not be produced as a result of input expansion). Otherwise, it will not be recognized as the end of the markdown string. As a corrolary, the \markdownEnd string may not appear anywhere inside the markdown input.

Another limitation concerns spaces at the right end of an input line. In markdown, these are used to produce a forced line break. However, any such spaces are removed before the lines enter the input buffer of TEX [4, p. 46]. As a corrolary, the \markdownBegin macro also ignores them.

The \markdownBegin and \markdownEnd macros will also consume the rest of the lines at which they appear. In the following example plain TEX code, the characters c, e, and f will not appear in the output.

```
\input markdown
a
b \markdownBegin c
d
e \markdownEnd   f
g
\bye
```

Note that you may also not nest the \markdownBegin and \markdownEnd macros.

The following example plain TEX code showcases the usage of the \markdownBegin and \markdownEnd macros:

```
\input markdown
\markdownBegin
_Hello_ **world** ...
\markdownEnd
\bye
```

The `\markdownInput` macro accepts a single parameter containing the filename of a markdown document and expands to the result of the conversion of the input markdown document to plain TEX.

```
\let\markdownInput\relax
```

This macro is not subject to the abovelisted limitations of the `\markdownBegin` and `\markdownEnd` macros.

The following example plain TEX code showcases the usage of the `\markdownInput` macro:

```
\input markdown
\markdownInput{hello.md}
\bye
```

2.2.2 Options

The plain TEX options are represented by TEX commands. Some of them map directly to the options recognized by the Lua interface (see Section 2.1.2 on page 7), while some of them are specific to the plain TEX interface.

2.2.2.1 Finalizing and Freezing the Cache

The `\markdownOptionFinalizeCache` option corresponds to the Lua interface `finalizeCache` option, which creates an output file `\markdownOptionFrozenCacheFileName` (frozen cache) that contains a mapping between an enumeration of the markdown documents in the plain TEX document and their auxiliary files cached in the `cacheDir` directory.

```
\let\markdownOptionFinalizeCache\undefined
```

The `\markdownOptionFrozenCache` option uses the mapping previously created by the `\markdownOptionFinalizeCache` option, and uses it to typeset the plain TEX document without invoking Lua. As a result, the plain TEX document becomes more portable, but further changes in the order and the content of markdown documents will not be reflected. It defaults to `false`.

The standard usage of the above two options is as follows:

1. Remove the `cacheDir` cache directory with stale auxiliary cache files.
2. Enable the `\markdownOptionFinalizeCache` option.
4. Typeset the plain TEX document to populate and finalize the cache.
5. Enable the `\markdownOptionFrozenCache` option.
6. Publish the source code of the plain TEX document and the `cacheDir` directory.

2.2.2.2 File and Directory Names

The `\markdownOptionHelperScriptFileName` macro sets the filename of the helper Lua script file that is created during the conversion from markdown to plain TEX in TEX engines without the `\directlua`

primitive. It defaults to `\jobname.markdown.lua`, where `\jobname` is the base name of the document being typeset.

The expansion of this macro must not contain quotation marks (`"`) or backslash symbols (`\`). Mind that TEX engines tend to put quotation marks around `\jobname`, when it contains spaces.

```
\def\markdownOptionHelperScriptFileName{\jobname.markdown.lua}%
```

The `\markdownOptionInputTempFileName` macro sets the filename of the temporary input file that is created during the conversion from markdown to plain TEX in `\markdownMode` other than `2`. It defaults to `\jobname.markdown.out`. The same limitations as in the case of the `\markdownOptionHelperScriptFileName` macro apply here.

```
\def\markdownOptionInputTempFileName{\jobname.markdown.in}%
```

The `\markdownOptionOutputTempFileName` macro sets the filename of the temporary output file that is created during the conversion from markdown to plain TEX in `\markdownMode` other than `2`. It defaults to `\jobname.markdown.out`. The same limitations apply here as in the case of the `\markdownOptionHelperScriptFileName` macro.

```
\def\markdownOptionOutputTempFileName{\jobname.markdown.out}%
```

The `\markdownOptionErrorTempFileName` macro sets the filename of the temporary output file that is created when a Lua error is encountered during the conversion from markdown to plain TEX in `\markdownMode` other than `2`. It defaults to `\jobname.markdown.err`. The same limitations apply here as in the case of the `\markdownOptionHelperScriptFileName` macro.

```
\def\markdownOptionErrorTempFileName{\jobname.markdown.err}%
```

The `\markdownOptionOutputDir` macro sets the path to the directory that will contain the auxiliary cache files produced by the Lua implementation and also the auxiliary files produced by the plain TEX implementation. The option defaults to `.`.

The path must be set to the same value as the `-output-directory` option of your TEX engine for the package to function correctly. We need this macro to make the Lua implementation aware where it should store the helper files. The same limitations apply here as in the case of the `\markdownOptionHelperScriptFileName` macro.

```
\def\markdownOptionOutputDir{.}%
```

The `\markdownOptionCacheDir` macro corresponds to the Lua interface `cacheDir` option that sets the path to the directory that will contain the produced cache files. The option defaults to `_markdown_\jobname`, which is a similar naming scheme to the one used by the minted LATEX package. The same limitations apply here as in the case of the `\markdownOptionHelperScriptFileName` macro.

```
\def\markdownOptionCacheDir{\markdownOptionOutputDir/_markdown_\jobname}%
```

The `\markdownOptionFrozenCacheFileName` macro corresponds to the Lua interface `frozenCacheFileName` option that sets the path to an output file (frozen

cache) that will contain a mapping between an enumeration of the markdown documents in the plain TEX document and their auxiliary cache files. The option defaults to `frozenCache.tex`. The same limitations apply here as in the case of the `\markdownOptionHelperScriptFileName` macro.

```
\def\markdownOptionFrozenCacheFileName{\markdownOptionCacheDir/frozenCache.tex}
```

2.2.2.3 Lua Interface Options

The following macros map directly to the options recognized by the Lua interface (see Section 2.1.2 on page 7) and are not processed by the plain TEX implementation, only passed along to Lua. They are undefined, which makes them fall back to the default values provided by the Lua interface.

For the macros that correspond to the non-boolean options recognized by the Lua interface, the same limitations apply here in the case of the `\markdownOptionHelperScriptFileName` macro.

```
\let\markdownOptionBlankBeforeBlockquote\undefined
\let\markdownOptionBlankBeforeCodeFence\undefined
\let\markdownOptionBlankBeforeHeading\undefined
\let\markdownOptionBreakableBlockquotes\undefined
\let\markdownOptionCitations\undefined
\let\markdownOptionCitationNbsps\undefined
\let\markdownOptionContentBlocks\undefined
\let\markdownOptionContentBlocksLanguageMap\undefined
\let\markdownOptionDefinitionLists\undefined
\let\markdownOptionFootnotes\undefined
\let\markdownOptionFencedCode\undefined
\let\markdownOptionHashEnumerators\undefined
\let\markdownOptionHeaderAttributes\undefined
\let\markdownOptionHtml\undefined
\let\markdownOptionHybrid\undefined
\let\markdownOptionInlineFootnotes\undefined
\let\markdownOptionJekyllData\undefined
\let\markdownOptionPipeTables\undefined
\let\markdownOptionPreserveTabs\undefined
\let\markdownOptionShiftHeadings\undefined
\let\markdownOptionSlice\undefined
\let\markdownOptionSmartEllipses\undefined
\let\markdownOptionStartNumber\undefined
\let\markdownOptionStripIndent\undefined
\let\markdownOptionTableCaptions\undefined
\let\markdownOptionTaskLists\undefined
\let\markdownOptionTeXComments\undefined
\let\markdownOptionTightLists\undefined
```

2.2.2.4 Miscellaneous Options

The `\markdownOptionStripPercentSigns` macro controls whether a percent sign (`Markdown input (see Section \vref{sec:buffering}) or not`

```
\def\markdownOptionStripPercentSigns{false}%
```

2.2.3 Token Renderers

The following TEX macros may occur inside the output of the converter functions exposed by the Lua interface (see Section 2.1.1 on page 6) and represent the parsed markdown tokens. These macros are intended to be redefined by the user who is typesetting a document. By default, they point to the corresponding prototypes (see Section 2.2.4 on page 37).

2.2.3.1 Tickbox Renderers The macros named `\markdownRendererTickedBox`, `\markdownRendererHalfTickedBox`, and `\markdownRendererUntickedBox` represent ticked and unticked boxes, respectively. These macros will either be produced, when the `taskLists` option is enabled, or when the Ballot Box with X (☒, U+2612), Hourglass (⊡, U+231B) or Ballot Box (▫, U+2610) Unicode characters are encountered in the markdown input, respectively.

```
\def\markdownRendererTickedBox{%
  \markdownRendererTickedBoxPrototype}%
\def\markdownRendererHalfTickedBox{%
  \markdownRendererHalfTickedBoxPrototype}%
\def\markdownRendererUntickedBox{%
  \markdownRendererUntickedBoxPrototype}%
```

2.2.3.2 Interblock Separator Renderer The `\markdownRendererInterblockSeparator` macro represents a separator between two markdown block elements. The macro receives no arguments.

```
\def\markdownRendererInterblockSeparator{%
  \markdownRendererInterblockSeparatorPrototype}%
```

2.2.3.3 Line Break Renderer The `\markdownRendererLineBreak` macro represents a forced line break. The macro receives no arguments.

```
\def\markdownRendererLineBreak{%
  \markdownRendererLineBreakPrototype}%
```

2.2.3.4 Ellipsis Renderer The `\markdownRendererEllipsis` macro replaces any occurance of ASCII ellipses in the input text. This macro will only be produced, when the `smartEllipses` option is enabled. The macro receives no arguments.

```
\def\markdownRendererEllipsis{%
  \markdownRendererEllipsisPrototype}%
```

2.2.3.5 Non-Breaking Space Renderer

The `\markdownRendererNbsp` macro represents a non-breaking space.

```
\def\markdownRendererNbsp{%
  \markdownRendererNbspPrototype}%
```

2.2.3.6 Special Character Renderers

The following macros replace any special plain TEX characters, including the active pipe character (`|`) of ConTEXt, in the input text. These macros will only be produced, when the `hybrid` option is `false`.

```
\def\markdownRendererLeftBrace{%
  \markdownRendererLeftBracePrototype}%
\def\markdownRendererRightBrace{%
  \markdownRendererRightBracePrototype}%
\def\markdownRendererDollarSign{%
  \markdownRendererDollarSignPrototype}%
\def\markdownRendererPercentSign{%
  \markdownRendererPercentSignPrototype}%
\def\markdownRendererAmpersand{%
  \markdownRendererAmpersandPrototype}%
\def\markdownRendererUnderscore{%
  \markdownRendererUnderscorePrototype}%
\def\markdownRendererHash{%
  \markdownRendererHashPrototype}%
\def\markdownRendererCircumflex{%
  \markdownRendererCircumflexPrototype}%
\def\markdownRendererBackslash{%
  \markdownRendererBackslashPrototype}%
\def\markdownRendererTilde{%
  \markdownRendererTildePrototype}%
\def\markdownRendererPipe{%
  \markdownRendererPipePrototype}%
```

2.2.3.7 Code Span Renderer

The `\markdownRendererCodeSpan` macro represents inlined code span in the input text. It receives a single argument that corresponds to the inlined code span.

```
\def\markdownRendererCodeSpan{%
  \markdownRendererCodeSpanPrototype}%
```

2.2.3.8 Link Renderer

The `\markdownRendererLink` macro represents a hyperlink. It receives four arguments: the label, the fully escaped URI that can be directly typeset, the raw URI that can be used outside typesetting, and the title of the link.

```
\def\markdownRendererLink{%
  \markdownRendererLinkPrototype}%
```

2.2.3.9 Image Renderer

The `\markdownRendererImage` macro represents an image. It receives four arguments: the label, the fully escaped URI that can be directly typeset, the raw URI that can be used outside typesetting, and the title of the link.

```
\def\markdownRendererImage{%
  \markdownRendererImagePrototype}%
```

2.2.3.10 Content Block Renderers

The `\markdownRendererContentBlock` macro represents an iA Writer content block. It receives four arguments: the local file or online image filename extension cast to the lower case, the fully escaped URI that can be directly typeset, the raw URI that can be used outside typesetting, and the title of the content block.

```
\def\markdownRendererContentBlock{%
  \markdownRendererContentBlockPrototype}%
```

The `\markdownRendererContentBlockOnlineImage` macro represents an iA Writer online image content block. The macro receives the same arguments as `\markdownRendererContentBlock`.

```
\def\markdownRendererContentBlockOnlineImage{%
  \markdownRendererContentBlockOnlineImagePrototype}%
```

The `\markdownRendererContentBlockCode` macro represents an iA Writer content block that was recognized as a file in a known programming language by its filename extension s. If any `markdown-languages.json` file found by kpathsea[6] contains a record (k, v), then a non-online-image content block with the filename extension s, `s:lower()` $= k$ is considered to be in a known programming language v. The macro receives five arguments: the local file name extension s cast to the lower case, the language v, the fully escaped URI that can be directly typeset, the raw URI that can be used outside typesetting, and the title of the content block.

Note that you will need to place place a `markdown-languages.json` file inside your working directory or inside your local TEX directory structure. In this file, you will define a mapping between filename extensions and the language names recognized by your favorite syntax highlighter; there may exist other creative uses beside syntax highlighting. The `Languages.json` file provided by Sotkov [3] is a good starting point.

```
\def\markdownRendererContentBlockCode{%
  \markdownRendererContentBlockCodePrototype}%
```

2.2.3.11 Bullet List Renderers

The `\markdownRendererUlBegin` macro represents the beginning of a bulleted list that contains an item with several paragraphs of text (the list is not tight). The macro receives no arguments.

[6] Local files take precedence. Filenames other than `markdown-languages.json` may be specified using the `contentBlocksLanguageMap` Lua option.

```
\def\markdownRendererUlBegin{%
  \markdownRendererUlBeginPrototype}%
```

The `\markdownRendererUlBeginTight` macro represents the beginning of a bulleted list that contains no item with several paragraphs of text (the list is tight). This macro will only be produced, when the `tightLists` option is `false`. The macro receives no arguments.

```
\def\markdownRendererUlBeginTight{%
  \markdownRendererUlBeginTightPrototype}%
```

The `\markdownRendererUlItem` macro represents an item in a bulleted list. The macro receives no arguments.

```
\def\markdownRendererUlItem{%
  \markdownRendererUlItemPrototype}%
```

The `\markdownRendererUlItemEnd` macro represents the end of an item in a bulleted list. The macro receives no arguments.

```
\def\markdownRendererUlItemEnd{%
  \markdownRendererUlItemEndPrototype}%
```

The `\markdownRendererUlEnd` macro represents the end of a bulleted list that contains an item with several paragraphs of text (the list is not tight). The macro receives no arguments.

```
\def\markdownRendererUlEnd{%
  \markdownRendererUlEndPrototype}%
```

The `\markdownRendererUlEndTight` macro represents the end of a bulleted list that contains no item with several paragraphs of text (the list is tight). This macro will only be produced, when the `tightLists` option is `false`. The macro receives no arguments.

```
\def\markdownRendererUlEndTight{%
  \markdownRendererUlEndTightPrototype}%
```

2.2.3.12 Ordered List Renderers

The `\markdownRendererOlBegin` macro represents the beginning of an ordered list that contains an item with several paragraphs of text (the list is not tight). The macro receives no arguments.

```
\def\markdownRendererOlBegin{%
  \markdownRendererOlBeginPrototype}%
```

The `\markdownRendererOlBeginTight` macro represents the beginning of an ordered list that contains no item with several paragraphs of text (the list is tight). This macro will only be produced, when the `tightLists` option is `false`. The macro receives no arguments.

```
\def\markdownRendererOlBeginTight{%
  \markdownRendererOlBeginTightPrototype}%
```

The `\markdownRendererOlItem` macro represents an item in an ordered list. This macro will only be produced, when the `startNumber` option is `false`. The macro receives no arguments.

```
\def\markdownRendererOlItem{%
  \markdownRendererOlItemPrototype}%
```

The `\markdownRendererOlItemEnd` macro represents the end of an item in an ordered list. The macro receives no arguments.

```
\def\markdownRendererOlItemEnd{%
  \markdownRendererOlItemEndPrototype}%
```

The `\markdownRendererOlItemWithNumber` macro represents an item in an ordered list. This macro will only be produced, when the `startNumber` option is enabled. The macro receives a single numeric argument that corresponds to the item number.

```
\def\markdownRendererOlItemWithNumber{%
  \markdownRendererOlItemWithNumberPrototype}%
```

The `\markdownRendererOlEnd` macro represents the end of an ordered list that contains an item with several paragraphs of text (the list is not tight). The macro receives no arguments.

```
\def\markdownRendererOlEnd{%
  \markdownRendererOlEndPrototype}%
```

The `\markdownRendererOlEndTight` macro represents the end of an ordered list that contains no item with several paragraphs of text (the list is tight). This macro will only be produced, when the `tightLists` option is `false`. The macro receives no arguments.

```
\def\markdownRendererOlEndTight{%
  \markdownRendererOlEndTightPrototype}%
```

2.2.3.13 Definition List Renderers

The following macros are only produced, when the `definitionLists` option is enabled.

The `\markdownRendererDlBegin` macro represents the beginning of a definition list that contains an item with several paragraphs of text (the list is not tight). The macro receives no arguments.

```
\def\markdownRendererDlBegin{%
  \markdownRendererDlBeginPrototype}%
```

The `\markdownRendererDlBeginTight` macro represents the beginning of a definition list that contains an item with several paragraphs of text (the list is not tight). This macro will only be produced, when the `tightLists` option is `false`. The macro receives no arguments.

```
\def\markdownRendererDlBeginTight{%
  \markdownRendererDlBeginTightPrototype}%
```

The `\markdownRendererDlItem` macro represents a term in a definition list. The macro receives a single argument that corresponds to the term being defined.

```
\def\markdownRendererDlItem{%
  \markdownRendererDlItemPrototype}%
```

The `\markdownRendererDlItemEnd` macro represents the end of a list of definitions for a single term.

```
\def\markdownRendererDlItemEnd{%
  \markdownRendererDlItemEndPrototype}%
```

The `\markdownRendererDlDefinitionBegin` macro represents the beginning of a definition in a definition list. There can be several definitions for a single term.

```
\def\markdownRendererDlDefinitionBegin{%
  \markdownRendererDlDefinitionBeginPrototype}%
```

The `\markdownRendererDlDefinitionEnd` macro represents the end of a definition in a definition list. There can be several definitions for a single term.

```
\def\markdownRendererDlDefinitionEnd{%
  \markdownRendererDlDefinitionEndPrototype}%
```

The `\markdownRendererDlEnd` macro represents the end of a definition list that contains an item with several paragraphs of text (the list is not tight). The macro receives no arguments.

```
\def\markdownRendererDlEnd{%
  \markdownRendererDlEndPrototype}%
```

The `\markdownRendererDlEndTight` macro represents the end of a definition list that contains no item with several paragraphs of text (the list is tight). This macro will only be produced, when the `tightLists` option is `false`. The macro receives no arguments.

```
\def\markdownRendererDlEndTight{%
  \markdownRendererDlEndTightPrototype}%
```

2.2.3.14 Emphasis Renderers

The `\markdownRendererEmphasis` macro represents an emphasized span of text. The macro receives a single argument that corresponds to the emphasized span of text.

```
\def\markdownRendererEmphasis{%
  \markdownRendererEmphasisPrototype}%
```

The \markdownRendererStrongEmphasis macro represents a strongly emphasized span of text. The macro receives a single argument that corresponds to the emphasized span of text.

```
\def\markdownRendererStrongEmphasis{%
  \markdownRendererStrongEmphasisPrototype}%
```

2.2.3.15 Block Quote Renderers

The \markdownRendererBlockQuoteBegin macro represents the beginning of a block quote. The macro receives no arguments.

```
\def\markdownRendererBlockQuoteBegin{%
  \markdownRendererBlockQuoteBeginPrototype}%
```

The \markdownRendererBlockQuoteEnd macro represents the end of a block quote. The macro receives no arguments.

```
\def\markdownRendererBlockQuoteEnd{%
  \markdownRendererBlockQuoteEndPrototype}%
```

2.2.3.16 Code Block Renderers

The \markdownRendererInputVerbatim macro represents a code block. The macro receives a single argument that corresponds to the filename of a file contaning the code block contents.

```
\def\markdownRendererInputVerbatim{%
  \markdownRendererInputVerbatimPrototype}%
```

The \markdownRendererInputFencedCode macro represents a fenced code block. This macro will only be produced, when the fencedCode option is enabled. The macro receives two arguments that correspond to the filename of a file contaning the code block contents and to the code fence infostring.

```
\def\markdownRendererInputFencedCode{%
  \markdownRendererInputFencedCodePrototype}%
```

2.2.3.17 YAML Metadata Renderers

The \markdownRendererJekyllDataBegin macro represents the beginning of a YAML document. This macro will only be produced when the jekyllData option is enabled. The macro receives no arguments.

```
\def\markdownRendererJekyllDataBegin{%
  \markdownRendererJekyllDataBeginPrototype}%
```

The \markdownRendererJekyllDataEnd macro represents the end of a YAML document. This macro will only be produced when the jekyllData option is enabled. The macro receives no arguments.

```
\def\markdownRendererJekyllDataEnd{%
  \markdownRendererJekyllDataEndPrototype}%
```

The \markdownRendererJekyllDataMappingBegin macro represents the beginning of a mapping in a YAML document. This macro will only be produced when the jekyllData option is enabled. The macro receives two arguments: the scalar key in the parent structure, cast to a string following YAML serialization rules, and the number of items in the mapping.

```
\def\markdownRendererJekyllDataMappingBegin{%
  \markdownRendererJekyllDataMappingBeginPrototype}%
```

The \markdownRendererJekyllDataMappingEnd macro represents the end of a mapping in a YAML document. This macro will only be produced when the jekyllData option is enabled. The macro receives no arguments.

```
\def\markdownRendererJekyllDataMappingEnd{%
  \markdownRendererJekyllDataMappingEndPrototype}%
```

The \markdownRendererJekyllDataSequenceBegin macro represents the beginning of a sequence in a YAML document. This macro will only be produced when the jekyllData option is enabled. The macro receives two arguments: the scalar key in the parent structure, cast to a string following YAML serialization rules, and the number of items in the sequence.

```
\def\markdownRendererJekyllDataSequenceBegin{%
  \markdownRendererJekyllDataSequenceBeginPrototype}%
```

The \markdownRendererJekyllDataBoolean macro represents a boolean scalar value in a YAML document. This macro will only be produced when the jekyllData option is enabled. The macro receives two arguments: the scalar key in the parent structure, and the scalar value, both cast to a string following YAML serialization rules.

```
\def\markdownRendererJekyllDataBoolean{%
  \markdownRendererJekyllDataBooleanPrototype}%
```

The \markdownRendererJekyllDataNumber macro represents a numeric scalar value in a YAML document. This macro will only be produced when the jekyllData option is enabled. The macro receives two arguments: the scalar key in the parent structure, and the scalar value, both cast to a string following YAML serialization rules.

```
\def\markdownRendererJekyllDataNumber{%
  \markdownRendererJekyllDataNumberPrototype}%
```

The \markdownRendererJekyllDataString macro represents a string scalar value in a YAML document. This macro will only be produced when the jekyllData option is enabled. The macro receives two arguments: the scalar key in the parent structure, cast to a string following YAML serialization rules, and the scalar value.

```
\def\markdownRendererJekyllDataString{%
  \markdownRendererJekyllDataStringPrototype}%
```

The \markdownRendererJekyllDataEmpty macro represents an empty scalar value in a YAML document. This macro will only be produced when the jekyllData option is enabled. The macro receives one argument: the scalar key in the parent structure, cast to a string following YAML serialization rules.

```
\def\markdownRendererJekyllDataEmpty{%
  \markdownRendererJekyllDataEmptyPrototype}%
```

2.2.3.18 Heading Renderers

The \markdownRendererHeadingOne macro represents a first level heading. The macro receives a single argument that corresponds to the heading text.

```
\def\markdownRendererHeadingOne{%
  \markdownRendererHeadingOnePrototype}%
```

The \markdownRendererHeadingTwo macro represents a second level heading. The macro receives a single argument that corresponds to the heading text.

```
\def\markdownRendererHeadingTwo{%
  \markdownRendererHeadingTwoPrototype}%
```

The \markdownRendererHeadingThree macro represents a third level heading. The macro receives a single argument that corresponds to the heading text.

```
\def\markdownRendererHeadingThree{%
  \markdownRendererHeadingThreePrototype}%
```

The \markdownRendererHeadingFour macro represents a fourth level heading. The macro receives a single argument that corresponds to the heading text.

```
\def\markdownRendererHeadingFour{%
  \markdownRendererHeadingFourPrototype}%
```

The \markdownRendererHeadingFive macro represents a fifth level heading. The macro receives a single argument that corresponds to the heading text.

```
\def\markdownRendererHeadingFive{%
  \markdownRendererHeadingFivePrototype}%
```

The \markdownRendererHeadingSix macro represents a sixth level heading. The macro receives a single argument that corresponds to the heading text.

```
\def\markdownRendererHeadingSix{%
  \markdownRendererHeadingSixPrototype}%
```

2.2.3.19 Horizontal Rule Renderer

The \markdownRendererHorizontalRule macro represents a horizontal rule. The macro receives no arguments.

```
\def\markdownRendererHorizontalRule{%
  \markdownRendererHorizontalRulePrototype}%
```

2.2.3.20 Footnote Renderer

The `\markdownRendererFootnote` macro represents a footnote. This macro will only be produced, when the `footnotes` option is enabled. The macro receives a single argument that corresponds to the footnote text.

```
\def\markdownRendererFootnote{%
  \markdownRendererFootnotePrototype}%
```

2.2.3.21 Parenthesized Citations Renderer

The `\markdownRendererCite` macro represents a string of one or more parenthetical citations. This macro will only be produced, when the `citations` option is enabled. The macro receives the parameter `{`⟨*number of citations*⟩`}` followed by ⟨*suppress author*⟩ `{`⟨*prenote*⟩`}{`⟨*postnote*⟩`}{`⟨*name*⟩`}` repeated ⟨*number of citations*⟩ times. The ⟨*suppress author*⟩ parameter is either the token `-`, when the author's name is to be suppressed, or `+` otherwise.

```
\def\markdownRendererCite{%
  \markdownRendererCitePrototype}%
```

2.2.3.22 Text Citations Renderer

The `\markdownRendererTextCite` macro represents a string of one or more text citations. This macro will only be produced, when the `citations` option is enabled. The macro receives parameters in the same format as the `\markdownRendererCite` macro.

```
\def\markdownRendererTextCite{%
  \markdownRendererTextCitePrototype}%
```

2.2.3.23 Table Renderer

The `\markdownRendererTable` macro represents a table. This macro will only be produced, when the `pipeTables` option is enabled. The macro receives the parameters `{`⟨*caption*⟩`}{`⟨*number of rows*⟩`}{`⟨*number of columns*⟩`}` followed by `{`⟨*alignments*⟩`}` and then by `{`⟨*row*⟩`}` repeated ⟨*number of rows*⟩ times, where ⟨*row*⟩ is `{`⟨*column*⟩`}` repeated ⟨*number of columns*⟩ times, ⟨*alignments*⟩ is ⟨*alignment*⟩ repeated ⟨*number of columns*⟩ times, and ⟨*alignment*⟩ is one of the following:

- `d` – The corresponding column has an unspecified (default) alignment.
- `l` – The corresponding column is left-aligned.
- `c` – The corresponding column is centered.
- `r` – The corresponding column is right-aligned.

```
\def\markdownRendererTable{%
  \markdownRendererTablePrototype}%
```

2.2.3.24 Inline HTML Comment Renderer

The `\markdownRendererInlineHtmlComment` macro represents the contents of an inline HTML comment. This macro will only be

produced, when the `html` option is enabled. The macro receives a single argument that corresponds to the contents of the HTML comment.

```
\def\markdownRendererInlineHtmlComment{%
  \markdownRendererInlineHtmlCommentPrototype}%
```

2.2.4 Token Renderer Prototypes

The following TEX macros provide definitions for the token renderers (see Section 2.2.3 on page 27) that have not been redefined by the user. These macros are intended to be redefined by macro package authors who wish to provide sensible default token renderers. They are also redefined by the LATEX and ConTEXt implementations (see sections 3.3 on page 171 and 3.4 on page 190).

```
\def\markdownRendererInterblockSeparatorPrototype{}%
\def\markdownRendererLineBreakPrototype{}%
\def\markdownRendererEllipsisPrototype{}%
\def\markdownRendererNbspPrototype{}%
\def\markdownRendererLeftBracePrototype{}%
\def\markdownRendererRightBracePrototype{}%
\def\markdownRendererDollarSignPrototype{}%
\def\markdownRendererPercentSignPrototype{}%
\def\markdownRendererAmpersandPrototype{}%
\def\markdownRendererUnderscorePrototype{}%
\def\markdownRendererHashPrototype{}%
\def\markdownRendererCircumflexPrototype{}%
\def\markdownRendererBackslashPrototype{}%
\def\markdownRendererTildePrototype{}%
\def\markdownRendererPipePrototype{}%
\def\markdownRendererCodeSpanPrototype#1{}%
\def\markdownRendererLinkPrototype#1#2#3#4{}%
\def\markdownRendererImagePrototype#1#2#3#4{}%
\def\markdownRendererContentBlockPrototype#1#2#3#4{}%
\def\markdownRendererContentBlockOnlineImagePrototype#1#2#3#4{}%
\def\markdownRendererContentBlockCodePrototype#1#2#3#4#5{}%
\def\markdownRendererUlBeginPrototype{}%
\def\markdownRendererUlBeginTightPrototype{}%
\def\markdownRendererUlItemPrototype{}%
\def\markdownRendererUlItemEndPrototype{}%
\def\markdownRendererUlEndPrototype{}%
\def\markdownRendererUlEndTightPrototype{}%
\def\markdownRendererOlBeginPrototype{}%
\def\markdownRendererOlBeginTightPrototype{}%
\def\markdownRendererOlItemPrototype{}%
\def\markdownRendererOlItemWithNumberPrototype#1{}%
\def\markdownRendererOlItemEndPrototype{}%
\def\markdownRendererOlEndPrototype{}%
\def\markdownRendererOlEndTightPrototype{}%
```

```
\def\markdownRendererDlBeginPrototype{}%
\def\markdownRendererDlBeginTightPrototype{}%
\def\markdownRendererDlItemPrototype#1{}%
\def\markdownRendererDlItemEndPrototype{}%
\def\markdownRendererDlDefinitionBeginPrototype{}%
\def\markdownRendererDlDefinitionEndPrototype{}%
\def\markdownRendererDlEndPrototype{}%
\def\markdownRendererDlEndTightPrototype{}%
\def\markdownRendererEmphasisPrototype#1{}%
\def\markdownRendererStrongEmphasisPrototype#1{}%
\def\markdownRendererBlockQuoteBeginPrototype{}%
\def\markdownRendererBlockQuoteEndPrototype{}%
\def\markdownRendererInputVerbatimPrototype#1{}%
\def\markdownRendererInputFencedCodePrototype#1#2{}%
\def\markdownRendererJekyllDataBooleanPrototype#1#2{}%
\def\markdownRendererJekyllDataEmptyPrototype#1{}%
\def\markdownRendererJekyllDataNumberPrototype#1#2{}%
\def\markdownRendererJekyllDataStringPrototype#1#2{}%
\def\markdownRendererJekyllDataBeginPrototype{}%
\def\markdownRendererJekyllDataEndPrototype{}%
\def\markdownRendererJekyllDataSequenceBeginPrototype#1#2{}%
\def\markdownRendererJekyllDataSequenceEndPrototype{}%
\def\markdownRendererJekyllDataMappingBeginPrototype#1#2{}%
\def\markdownRendererJekyllDataMappingEndPrototype{}%
\def\markdownRendererHeadingOnePrototype#1{}%
\def\markdownRendererHeadingTwoPrototype#1{}%
\def\markdownRendererHeadingThreePrototype#1{}%
\def\markdownRendererHeadingFourPrototype#1{}%
\def\markdownRendererHeadingFivePrototype#1{}%
\def\markdownRendererHeadingSixPrototype#1{}%
\def\markdownRendererHorizontalRulePrototype{}%
\def\markdownRendererFootnotePrototype#1{}%
\def\markdownRendererCitePrototype#1{}%
\def\markdownRendererTextCitePrototype#1{}%
\def\markdownRendererTablePrototype#1#2#3{}%
\def\markdownRendererInlineHtmlCommentPrototype#1{}%
\def\markdownRendererTickedBoxPrototype{}%
\def\markdownRendererHalfTickedBoxPrototype{}%
\def\markdownRendererUntickedBoxPrototype{}%
```

2.2.5 Logging Facilities

The `\markdownInfo`, `\markdownWarning`, and `\markdownError` macros perform logging for the Markdown package. Their first argument specifies the text of the info, warning, or error message. The `\markdownError` macro receives a second argument that provides a help text. You may redefine these macros to redirect and process the info, warning, and error messages.

2.2.6 Miscellanea

The `\markdownMakeOther` macro is used by the package, when a TEX engine that does not support direct Lua access is starting to buffer a text. The plain TEX implementation changes the category code of plain TEX special characters to other, but there may be other active characters that may break the output. This macro should temporarily change the category of these to *other*.

```
\let\markdownMakeOther\relax
```

The `\markdownReadAndConvert` macro implements the `\markdownBegin` macro. The first argument specifies the token sequence that will terminate the markdown input (`\markdownEnd` in the instance of the `\markdownBegin` macro) when the plain TEX special characters have had their category changed to *other*. The second argument specifies the token sequence that will actually be inserted into the document, when the ending token sequence has been found.

```
\let\markdownReadAndConvert\relax
\begingroup
```

Locally swap the category code of the backslash symbol (`\`) with the pipe symbol (`|`). This is required in order that all the special symbols in the first argument of the `markdownReadAndConvert` macro have the category code *other*.

```
  \catcode`\|=0\catcode`\\=12%
  |gdef|markdownBegin{%
    |markdownReadAndConvert{\markdownEnd}%
                           {|markdownEnd}}%
|endgroup
```

The macro is exposed in the interface, so that the user can create their own markdown environments. Due to the way the arguments are passed to Lua (see Section 3.2.7 on page 169), the first argument may not contain the string `]]` (regardless of the category code of the bracket symbol (`]`)).

The `\markdownMode` macro specifies how the plain TEX implementation interfaces with the Lua interface. The valid values and their meaning are as follows:

- `0` – Shell escape via the 18 output file stream
- `1` – Shell escape via the Lua `os.execute` method
- `2` – Direct Lua access

By defining the macro, the user can coerce the package to use a specific mode. If the user does not define the macro prior to loading the plain TEX implementation, the correct value will be automatically detected. The outcome of changing the value of `\markdownMode` after the implementation has been loaded is undefined.

```
\ifx\markdownMode\undefined
  \ifx\directlua\undefined
    \def\markdownMode{0}%
  \else
    \def\markdownMode{2}%
```

```
  \fi
\fi
```

The following macros are no longer a part of the plain TEX interface and are only defined for backwards compatibility:

```
\def\markdownLuaRegisterIBCallback#1{\relax}%
\def\markdownLuaUnregisterIBCallback#1{\relax}%
```

2.3 LATEX Interface

The LATEX interface provides LATEX environments for the typesetting of markdown input from within LATEX, facilities for setting Lua interface options (see Section 2.1.2 on page 7) used during the conversion from markdown to plain TEX, and facilities for changing the way markdown tokens are rendered. The rest of the interface is inherited from the plain TEX interface (see Section 2.2 on page 22).

The LATEX interface is implemented by the `markdown.sty` file, which can be loaded from the LATEX document preamble as follows:

```
\usepackage[⟨options⟩]{markdown}
```

where ⟨*options*⟩ are the LATEX interface options (see Section 2.3.2 on the following page). Note that ⟨*options*⟩ inside the `\usepackage` macro may not set the `markdownRenderers` (see Section 2.3.2.5 on page 50) and `markdownRendererPrototypes` (see Section 2.3.2.6 on page 54) keys. This limitation is due to the way LATEX 2$_\varepsilon$ parses package options.

2.3.1 Typesetting Markdown

The interface exposes the `markdown` and `markdown*` LATEX environments, and redefines the `\markdownInput` command.

The `markdown` and `markdown*` LATEX environments are used to typeset markdown document fragments. The starred version of the `markdown` environment accepts LATEX interface options (see Section 2.3.2 on the next page) as its only argument. These options will only influence this markdown document fragment.

```
\newenvironment{markdown}\relax\relax
\newenvironment{markdown*}[1]\relax\relax
```

You may prepend your own code to the `\markdown` macro and append your own code to the `\endmarkdown` macro to produce special effects before and after the `markdown` LATEX environment (and likewise for the starred version).

Note that the `markdown` and `markdown*` LATEX environments are subject to the same limitations as the `\markdownBegin` and `\markdownEnd` macros exposed by the plain TEX interface.

The following example LATEX code showcases the usage of the `markdown` and `markdown*` environments:

```
\documentclass{article}
\usepackage{markdown}
\begin{document}
\begin{markdown}
_Hello_ **world** ...
\end{markdown}
\end{document}
```

```
\documentclass{article}
\usepackage{markdown}
\begin{document}
\begin{markdown*}{smartEllipses}
_Hello_ **world** ...
\end{markdown*}
\end{document}
```

The `\markdownInput` macro accepts a single mandatory parameter containing the filename of a markdown document and expands to the result of the conversion of the input markdown document to plain TEX. Unlike the `\markdownInput` macro provided by the plain TEX interface, this macro also accepts LATEX interface options (see Section 2.3.2) as its optional argument. These options will only influnce this markdown document.

The following example LATEX code showcases the usage of the `\markdownInput` macro:

```
\documentclass{article}
\usepackage{markdown}
\begin{document}
\markdownInput[smartEllipses]{hello.md}
\end{document}
```

2.3.2 Options

The LATEX options are represented by a comma-delimited list of ⟨*key*⟩=⟨*value*⟩ pairs. For boolean options, the =⟨*value*⟩ part is optional, and ⟨*key*⟩ will be interpreted as ⟨*key*⟩=`true` if the =⟨*value*⟩ part has been omitted.

Except for the `plain` option described in Section 2.3.2.1 on the next page, and the LATEX themes described in Section 2.3.2.2 on the following page, and the LATEX setup snippets described in Section 2.3.2.3 on page 47, LATEX options map directly to the options recognized by the plain TEX interface (see Section 2.2.2 on page 24) and to the markdown token renderers and their prototypes recognized by the plain TEX interface (see Sections 2.2.3 on page 27 and 2.2.4 on page 37).

The LATEX options may be specified when loading the LATEX package, when using the `markdown*` LATEX environment or the `\markdownInput` macro (see Section 2.3 on the previous page), or via the `\markdownSetup` macro. The `\markdownSetup` macro receives the options to set up as its only argument:

```
\newcommand\markdownSetup[1]{%
  \setkeys{markdownOptions}{#1}%
```

We may also store LaTeX options as *setup snippets* and invoke them later using the `\markdownSetupSnippet` macro. The `\markdownSetupSnippet` macro receives two arguments: the name of the setup snippet and the options to store:

```
\newcommand\markdownSetupSnippet[2]{%
  \@ifundefined
    {markdownLaTeXSetupSnippet\markdownLaTeXThemeName#1}{%
      \newtoks\next
        \next={#2}%
      \expandafter\let\csname markdownLaTeXSetupSnippet%
        \markdownLaTeXThemeName#1\endcsname=\next
    }{%
      \markdownWarning
        {Redefined setup snippet \markdownLaTeXThemeName#1}%
      \csname markdownLaTeXSetupSnippet%
        \markdownLaTeXThemeName#1\endcsname={#2}%
    }}%
```

See Section 2.3.2.2 for information on interactions between setup snippets and LaTeX themes. See Section 2.3.2.3 on page 47 for information about invoking the stored setup snippets.

2.3.2.1 No default token renderer prototypes

Default token renderer prototypes require LaTeX packages that may clash with other packages used in a document. Additionally, if we redefine token renderers and renderer prototypes ourselves, the default definitions will bring no benefit to us. Using the `plain` package option, we can keep the default definitions from the plain TeX implementation (see Section 3.2.3 on page 160) and prevent the soft LaTeX prerequisites in Section 1.1.3 on page 3 from being loaded:

```
\usepackage[plain]{markdown}
```

```
\newif\ifmarkdownLaTeXPlain
  \markdownLaTeXPlainfalse
\define@key{markdownOptions}{plain}[true]{%
  \ifmarkdownLaTeXLoaded
    \markdownWarning
      {The plain option must be specified when loading the package}%
  \else
    \markdownLaTeXPlaintrue
  \fi}
```

2.3.2.2 LaTeX themes

User-contributed LaTeX themes for the Markdown package provide a domain-specific interpretation of some Markdown tokens. Similarly to LaTeX packages,

themes allow the authors to achieve a specific look and other high-level goals without low-level programming.

The LaTeX option with key `theme` loads a LaTeX package (further referred to as *a theme*) named `markdowntheme`⟨*munged theme name*⟩`.sty`, where the *munged theme name* is the *theme name* after a substitution of all forward slashes (`/`) for an underscore (`_`), the theme name is a value that is *qualified* and contains no underscores, and a value is qualified if and only if it contains at least one forward slash. Themes are inspired by the Beamer LaTeX package, which provides similar functionality with its `\usetheme` macro [5, Section 15.1].

Theme names must be qualified to minimize naming conflicts between different themes intended for a single LaTeX document class or for a single LaTeX package. The preferred format of a theme name is ⟨*theme author*⟩`/`⟨*target LaTeX document class or package*⟩`/`⟨*private naming scheme*⟩, where the *private naming scheme* may contain additional forward slashes. For example, a theme by a user `witiko` for the MU theme of the Beamer document class may have the name `witiko/beamer/MU`.

Theme names are munged, because LaTeX packages are identified only by their filenames, not by their pathnames. [6] Therefore, we can't store the qualified theme names directly using directories, but we must encode the individual segments of the qualified theme in the filename. For example, loading a theme named `witiko/beamer/MU` would load a LaTeX package named `markdownthemewitiko_beamer_MU.sty`.

If the LaTeX option with key `theme` is (repeatedly) specified in the `\usepackage` macro, the loading of the theme(s) will be postponed in first-in-first-out order until after the Markdown LaTeX package has been loaded. Otherwise, the theme(s) will be loaded immediately. For example, there is a theme named `witiko/dot`, which typesets fenced code blocks with the `dot` infostring as images of directed graphs rendered by the Graphviz tools. The following code would first load the Markdown package, then the `markdownthemewitiko_beamer_MU.sty` LaTeX package, and finally the `markdownthemewitiko_dot.sty` LaTeX package:

```
\usepackage[
  theme = witiko/beamer/MU,
  theme = witiko/dot,
]{markdown}
```

```
\newif\ifmarkdownLaTeXLoaded
  \markdownLaTeXLoadedfalse
\AtEndOfPackage{\markdownLaTeXLoadedtrue}%
\define@key{markdownOptions}{theme}{%
  \IfSubStr{#1}{/}{}{%
    \markdownError
      {Won't load theme with unqualified name #1}%
```

```
      {Theme names must contain at least one forward slash}}%
  \StrSubstitute{#1}{/}{_}[\markdownLaTeXThemePackageName]%
  \edef\markdownLaTeXThemePackageName{%
    markdowntheme\markdownLaTeXThemePackageName}%
  \expandafter\markdownLaTeXThemeLoad\expandafter{%
    \markdownLaTeXThemePackageName}{#1/}}%
\newcommand\markdownLaTeXThemeName{}%
\newcommand\markdownLaTeXThemeLoad[2]{%
  \ifmarkdownLaTeXLoaded
    \def\markdownLaTeXThemeName{#2}%
    \RequirePackage{#1}%
    \def\markdownLaTeXThemeName{}%
  \else
    \AtEndOfPackage{%
      \def\markdownLaTeXThemeName{#2}%
      \RequirePackage{#1}%
      \def\markdownLaTeXThemeName{}}%
  \fi}%
```

The LaTeX themes have a useful synergy with the setup snippets (see Section 2.3.2 on page 41): To make it less likely that different themes will define setup snippets with the same name, we will prepend ⟨*theme name*⟩`/` before the snippet name and use the result as the snippet name. For example, if the `witiko/dot` theme defines the `product` setup snippet, the setup snippet will be available under the name `witiko/dot/product`.Due to limitations of LaTeX, themes may not be loaded after the beginning of a LaTeX document.

```
\@onlypreamble\KV@markdownOptions@theme
```

Example themes provided with the Markdown package include:

witiko/dot A theme that typesets fenced code blocks with the `dot …` infostring as images of directed graphs rendered by the Graphviz tools. The right tail of the infostring is used as the image title.

```
\documentclass{article}
\usepackage[theme=witiko/dot]{markdown}
\setkeys{Gin}{
  width = \columnwidth,
  height = 0.65\paperheight,
  keepaspectratio}
\begin{document}
\begin{markdown}
``` dot Various formats of mathemathical formulae
digraph tree {
  margin = 0;
  rankdir = "LR";
```
```

```
  latex -> pmml;
  latex -> cmml;
  pmml -> slt;
  cmml -> opt;
  cmml -> prefix;
  cmml -> infix;
  pmml -> mterms [style=dashed];
  cmml -> mterms;

  latex [label = "LaTeX"];
  pmml [label = "Presentation MathML"];
  cmml [label = "Content MathML"];
  slt [label = "Symbol Layout Tree"];
  opt [label = "Operator Tree"];
  prefix [label = "Prefix"];
  infix [label = "Infix"];
  mterms [label = "M-Terms"];
}
```
\end{markdown}
\end{document}
```

Typesetting the above document produces the output shown in Figure 4.

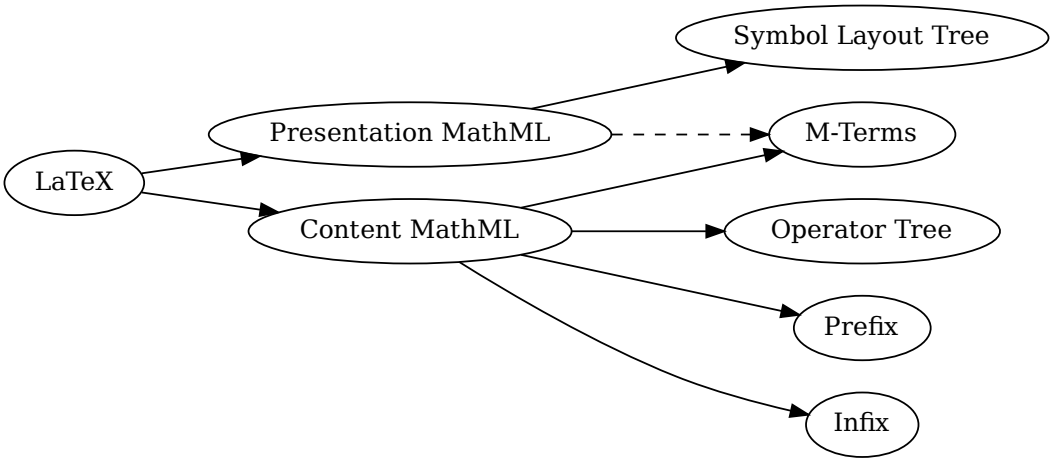


**Figure 4: Various formats of mathemathical formulae**
```

The theme requires a Unix-like operating system with GNU Diffutils and Graphviz installed. The theme also requires shell access unless the `\markdownOptionFrozenCache` plain TEX option is enabled.

```
460 \ProvidesPackage{markdownthemewitiko_dot}[2021/03/09]%
```

witiko/graphicx/http A theme that adds support for downloading images whose URL has the http or https protocol.

```
\documentclass{article}
\usepackage[theme=witiko/graphicx/http]{markdown}
\begin{document}
\begin{markdown}
![img](https://github.com/witiko/markdown/raw/main/markdown.png
       "The banner of the Markdown package")
\end{markdown}
\end{document}
```

Typesetting the above document produces the output shown in Figure 5. The

```
\documentclass{book}
\usepackage{markdown}
\markdownSetup{pipeTables,tableCaptions}
\begin{document}
\begin{markdown}
Introduction
============
## Section
### Subsection
Hello *Markdown*!

| Right | Left | Default | Center |
|------:|:-----|---------|:------:|
|   12  |  12  |    12   |    12  |
|  123  |  123 |   123   |   123  |
|    1  |    1 |     1   |     1  |

: Table
\end{markdown}
\end{document}
```

Chapter 1

Introduction

1.1 Section

1.1.1 Subsection

Hello *Markdown*!

Right	Left	Default	Center
12	12	12	12
123	123	123	123
1	1	1	1

Table 1.1: Table

Figure 5: The banner of the Markdown package

theme requires the catchfile LATEX package and a Unix-like operating system with GNU Coreutils `md5sum` and either GNU Wget or cURL installed. The

theme also requires shell access unless the `\markdownOptionFrozenCache` plain TEX option is enabled.

```
\ProvidesPackage{markdownthemewitiko_graphicx_http}[2021/03/22]%
```

witiko/tilde A theme that makes tilde (`~`) always typeset the non-breaking space even when the `hybrid` Lua option is `false`.

```
\documentclass{article}
\usepackage[theme=witiko/tilde]{markdown}
\begin{document}
\begin{markdown}
Bartel~Leendert van~der~Waerden
\end{markdown}
\end{document}
```

Typesetting the above document produces the following text: “Bartel Leendert van der Waerden”.

```
\ProvidesPackage{markdownthemewitiko_tilde}[2021/03/22]%
```

Please, see Section 3.3.3.1 on page 172 for implementation details of the example themes.

2.3.2.3 LaTeX setup snippets

The LaTeX option with key `snippet` invokes a snippet named ⟨*value*⟩:

```
\define@key{markdownOptions}{snippet}{%
  \expandafter\markdownSetup\expandafter{%
    \the\csname markdownLaTeXSetupSnippet#1\endcsname}}%
```

Here is how we can use setup snippets to store options and invoke them later:

```
\markdownSetupSnippet{romanNumerals}{
  renderers = {
      olItemWithNumber = {\item[\romannumeral#1\relax.]},
  },
}
\begin{markdown}

The following ordered list will be preceded by arabic numerals:

1. wahid
2. aithnayn
```

```
\end{markdown}
\begin{markdown*}{snippet=romanNumerals}

The following ordered list will be preceded by roman numerals:

3. tres
4. quattuor

\end{markdown*}
```

2.3.2.4 Plain TEX Interface Options

The following options map directly to the option macros exposed by the plain TEX interface (see Section 2.2.2 on page 24).

```
\define@key{markdownOptions}{helperScriptFileName}{%
  \def\markdownOptionHelperScriptFileName{#1}}%
\define@key{markdownOptions}{inputTempFileName}{%
  \def\markdownOptionInputTempFileName{#1}}%
\define@key{markdownOptions}{outputTempFileName}{%
  \def\markdownOptionOutputTempFileName{#1}}%
\define@key{markdownOptions}{errorTempFileName}{%
  \def\markdownOptionErrorTempFileName{#1}}%
\define@key{markdownOptions}{cacheDir}{%
  \def\markdownOptionCacheDir{#1}}%
\define@key{markdownOptions}{outputDir}{%
  \def\markdownOptionOutputDir{#1}}%
\define@key{markdownOptions}{blankBeforeBlockquote}[true]{%
  \def\markdownOptionBlankBeforeBlockquote{#1}}%
\define@key{markdownOptions}{blankBeforeCodeFence}[true]{%
  \def\markdownOptionBlankBeforeCodeFence{#1}}%
\define@key{markdownOptions}{blankBeforeHeading}[true]{%
  \def\markdownOptionBlankBeforeHeading{#1}}%
\define@key{markdownOptions}{breakableBlockquotes}[true]{%
  \def\markdownOptionBreakableBlockquotes{#1}}%
\define@key{markdownOptions}{citations}[true]{%
  \def\markdownOptionCitations{#1}}%
\define@key{markdownOptions}{citationNbsps}[true]{%
  \def\markdownOptionCitationNbsps{#1}}%
\define@key{markdownOptions}{contentBlocks}[true]{%
  \def\markdownOptionContentBlocks{#1}}%
\define@key{markdownOptions}{codeSpans}[true]{%
  \def\markdownOptionCodeSpans{#1}}%
\define@key{markdownOptions}{contentBlocksLanguageMap}{%
  \def\markdownOptionContentBlocksLanguageMap{#1}}%
\define@key{markdownOptions}{definitionLists}[true]{%
  \def\markdownOptionDefinitionLists{#1}}%
\define@key{markdownOptions}{footnotes}[true]{%
```

```
  \def\markdownOptionFootnotes{#1}%
\define@key{markdownOptions}{fencedCode}[true]{%
  \def\markdownOptionFencedCode{#1}%
\define@key{markdownOptions}{jekyllData}[true]{%
  \def\markdownOptionJekyllData{#1}%
\define@key{markdownOptions}{hashEnumerators}[true]{%
  \def\markdownOptionHashEnumerators{#1}%
\define@key{markdownOptions}{headerAttributes}[true]{%
  \def\markdownOptionHeaderAttributes{#1}%
\define@key{markdownOptions}{html}[true]{%
  \def\markdownOptionHtml{#1}%
\define@key{markdownOptions}{hybrid}[true]{%
  \def\markdownOptionHybrid{#1}%
\define@key{markdownOptions}{inlineFootnotes}[true]{%
  \def\markdownOptionInlineFootnotes{#1}%
\define@key{markdownOptions}{pipeTables}[true]{%
  \def\markdownOptionPipeTables{#1}%
\define@key{markdownOptions}{preserveTabs}[true]{%
  \def\markdownOptionPreserveTabs{#1}%
\define@key{markdownOptions}{smartEllipses}[true]{%
  \def\markdownOptionSmartEllipses{#1}%
\define@key{markdownOptions}{shiftHeadings}{%
  \def\markdownOptionShiftHeadings{#1}%
\define@key{markdownOptions}{slice}{%
  \def\markdownOptionSlice{#1}%
\define@key{markdownOptions}{startNumber}[true]{%
  \def\markdownOptionStartNumber{#1}%
\define@key{markdownOptions}{stripIndent}[true]{%
  \def\markdownOptionStripIndent{#1}%
\define@key{markdownOptions}{tableCaptions}[true]{%
  \def\markdownOptionTableCaptions{#1}%
\define@key{markdownOptions}{taskLists}[true]{%
  \def\markdownOptionTaskLists{#1}%
\define@key{markdownOptions}{texComments}[true]{%
  \def\markdownOptionTeXComments{#1}%
\define@key{markdownOptions}{tightLists}[true]{%
  \def\markdownOptionTightLists{#1}%
\define@key{markdownOptions}{underscores}[true]{%
  \def\markdownOptionUnderscores{#1}%
\define@key{markdownOptions}{stripPercentSigns}[true]{%
  \def\markdownOptionStripPercentSigns{#1}%
```

The `\markdownOptionFinalizeCache` and `\markdownOptionFrozenCache` plain TEX options are exposed through LATEX options with keys `finalizeCache` and `frozenCache`.

To ensure compatibility with the `minted` package [7, Section 5.1], which supports the `finalizecache` and `frozencache` package options with similar semantics, the

Markdown package also recognizes these as aliases and recognizes them as document class options. By passing `finalizecache` and `frozencache` as document class options, you may conveniently control the behavior of both packages at once:

```
\documentclass[frozencache]{article}
\usepackage{markdown,minted}
\begin{document}
\end{document}
```

We hope that other packages will support the `finalizecache` and `frozencache` package options in the future, so that they can become a standard interface for preparing LaTeX document sources for distribution.

```
\define@key{markdownOptions}{finalizeCache}[true]{%
  \def\markdownOptionFinalizeCache{#1}}%
\DeclareOption{finalizecache}{\markdownSetup{finalizeCache}}
\define@key{markdownOptions}{frozenCache}[true]{%
  \def\markdownOptionFrozenCache{#1}}%
\DeclareOption{frozencache}{\markdownSetup{frozenCache}}
\define@key{markdownOptions}{frozenCacheFileName}{%
  \def\markdownOptionFrozenCacheFileName{#1}}%
```

The following example LaTeX code showcases a possible configuration of plain TeX interface options `\markdownOptionHybrid`, `\markdownOptionSmartEllipses`, and `\markdownOptionCacheDir`.

```
\markdownSetup{
  hybrid,
  smartEllipses,
  cacheDir = /tmp,
}
```

2.3.2.5 Plain TeX Markdown Token Renderers

The LaTeX interface recognizes an option with the `renderers` key, whose value must be a list of options that map directly to the markdown token renderer macros exposed by the plain TeX interface (see Section 2.2.3 on page 27).

```
\define@key{markdownRenderers}{interblockSeparator}{%
  \renewcommand\markdownRendererInterblockSeparator{#1}}%
\define@key{markdownRenderers}{lineBreak}{%
  \renewcommand\markdownRendererLineBreak{#1}}%
\define@key{markdownRenderers}{ellipsis}{%
  \renewcommand\markdownRendererEllipsis{#1}}%
\define@key{markdownRenderers}{nbsp}{%
  \renewcommand\markdownRendererNbsp{#1}}%
```

```
\define@key{markdownRenderers}{leftBrace}{%
  \renewcommand\markdownRendererLeftBrace{#1}}%
\define@key{markdownRenderers}{rightBrace}{%
  \renewcommand\markdownRendererRightBrace{#1}}%
\define@key{markdownRenderers}{dollarSign}{%
  \renewcommand\markdownRendererDollarSign{#1}}%
\define@key{markdownRenderers}{percentSign}{%
  \renewcommand\markdownRendererPercentSign{#1}}%
\define@key{markdownRenderers}{ampersand}{%
  \renewcommand\markdownRendererAmpersand{#1}}%
\define@key{markdownRenderers}{underscore}{%
  \renewcommand\markdownRendererUnderscore{#1}}%
\define@key{markdownRenderers}{hash}{%
  \renewcommand\markdownRendererHash{#1}}%
\define@key{markdownRenderers}{circumflex}{%
  \renewcommand\markdownRendererCircumflex{#1}}%
\define@key{markdownRenderers}{backslash}{%
  \renewcommand\markdownRendererBackslash{#1}}%
\define@key{markdownRenderers}{tilde}{%
  \renewcommand\markdownRendererTilde{#1}}%
\define@key{markdownRenderers}{pipe}{%
  \renewcommand\markdownRendererPipe{#1}}%
\define@key{markdownRenderers}{codeSpan}{%
  \renewcommand\markdownRendererCodeSpan[1]{#1}}%
\define@key{markdownRenderers}{link}{%
  \renewcommand\markdownRendererLink[4]{#1}}%
\define@key{markdownRenderers}{contentBlock}{%
  \renewcommand\markdownRendererContentBlock[4]{#1}}%
\define@key{markdownRenderers}{contentBlockOnlineImage}{%
  \renewcommand\markdownRendererContentBlockOnlineImage[4]{#1}}%
\define@key{markdownRenderers}{contentBlockCode}{%
  \renewcommand\markdownRendererContentBlockCode[5]{#1}}%
\define@key{markdownRenderers}{image}{%
  \renewcommand\markdownRendererImage[4]{#1}}%
\define@key{markdownRenderers}{ulBegin}{%
  \renewcommand\markdownRendererUlBegin{#1}}%
\define@key{markdownRenderers}{ulBeginTight}{%
  \renewcommand\markdownRendererUlBeginTight{#1}}%
\define@key{markdownRenderers}{ulItem}{%
  \renewcommand\markdownRendererUlItem{#1}}%
\define@key{markdownRenderers}{ulItemEnd}{%
  \renewcommand\markdownRendererUlItemEnd{#1}}%
\define@key{markdownRenderers}{ulEnd}{%
  \renewcommand\markdownRendererUlEnd{#1}}%
\define@key{markdownRenderers}{ulEndTight}{%
  \renewcommand\markdownRendererUlEndTight{#1}}%
\define@key{markdownRenderers}{olBegin}{%
```

```
  \renewcommand\markdownRendererOlBegin{#1}}%
\define@key{markdownRenderers}{olBeginTight}{%
  \renewcommand\markdownRendererOlBeginTight{#1}}%
\define@key{markdownRenderers}{olItem}{%
  \renewcommand\markdownRendererOlItem{#1}}%
\define@key{markdownRenderers}{olItemWithNumber}{%
  \renewcommand\markdownRendererOlItemWithNumber[1]{#1}}%
\define@key{markdownRenderers}{olItemEnd}{%
  \renewcommand\markdownRendererOlItemEnd{#1}}%
\define@key{markdownRenderers}{olEnd}{%
  \renewcommand\markdownRendererOlEnd{#1}}%
\define@key{markdownRenderers}{olEndTight}{%
  \renewcommand\markdownRendererOlEndTight{#1}}%
\define@key{markdownRenderers}{dlBegin}{%
  \renewcommand\markdownRendererDlBegin{#1}}%
\define@key{markdownRenderers}{dlBeginTight}{%
  \renewcommand\markdownRendererDlBeginTight{#1}}%
\define@key{markdownRenderers}{dlItem}{%
  \renewcommand\markdownRendererDlItem[1]{#1}}%
\define@key{markdownRenderers}{dlItemEnd}{%
  \renewcommand\markdownRendererDlItemEnd{#1}}%
\define@key{markdownRenderers}{dlDefinitionBegin}{%
  \renewcommand\markdownRendererDlDefinitionBegin{#1}}%
\define@key{markdownRenderers}{dlDefinitionEnd}{%
  \renewcommand\markdownRendererDlDefinitionEnd{#1}}%
\define@key{markdownRenderers}{dlEnd}{%
  \renewcommand\markdownRendererDlEnd{#1}}%
\define@key{markdownRenderers}{dlEndTight}{%
  \renewcommand\markdownRendererDlEndTight{#1}}%
\define@key{markdownRenderers}{emphasis}{%
  \renewcommand\markdownRendererEmphasis[1]{#1}}%
\define@key{markdownRenderers}{strongEmphasis}{%
  \renewcommand\markdownRendererStrongEmphasis[1]{#1}}%
\define@key{markdownRenderers}{blockQuoteBegin}{%
  \renewcommand\markdownRendererBlockQuoteBegin{#1}}%
\define@key{markdownRenderers}{blockQuoteEnd}{%
  \renewcommand\markdownRendererBlockQuoteEnd{#1}}%
\define@key{markdownRenderers}{inputVerbatim}{%
  \renewcommand\markdownRendererInputVerbatim[1]{#1}}%
\define@key{markdownRenderers}{inputFencedCode}{%
  \renewcommand\markdownRendererInputFencedCode[2]{#1}}%
\define@key{markdownRenderers}{jekyllDataBoolean}{%
  \renewcommand\markdownRendererJekyllDataBoolean[2]{#1}}%
\define@key{markdownRenderers}{jekyllDataEmpty}{%
  \renewcommand\markdownRendererJekyllDataEmpty[1]{#1}}%
\define@key{markdownRenderers}{jekyllDataNumber}{%
  \renewcommand\markdownRendererJekyllDataNumber[2]{#1}}%
```

```
\define@key{markdownRenderers}{jekyllDataString}{%
  \renewcommand\markdownRendererJekyllDataString[2]{#1}}%
\define@key{markdownRenderers}{jekyllDataBegin}{%
  \renewcommand\markdownRendererJekyllDataBegin{#1}}%
\define@key{markdownRenderers}{jekyllDataEnd}{%
  \renewcommand\markdownRendererJekyllDataEnd{#1}}%
\define@key{markdownRenderers}{jekyllDataSequenceBegin}{%
  \renewcommand\markdownRendererJekyllDataSequenceBegin[2]{#1}}%
\define@key{markdownRenderers}{jekyllDataSequenceEnd}{%
  \renewcommand\markdownRendererJekyllDataSequenceEnd{#1}}%
\define@key{markdownRenderers}{jekyllDataMappingBegin}{%
  \renewcommand\markdownRendererJekyllDataMappingBegin[2]{#1}}%
\define@key{markdownRenderers}{jekyllDataMappingEnd}{%
  \renewcommand\markdownRendererJekyllDataMappingEnd{#1}}%
\define@key{markdownRenderers}{headingOne}{%
  \renewcommand\markdownRendererHeadingOne[1]{#1}}%
\define@key{markdownRenderers}{headingTwo}{%
  \renewcommand\markdownRendererHeadingTwo[1]{#1}}%
\define@key{markdownRenderers}{headingThree}{%
  \renewcommand\markdownRendererHeadingThree[1]{#1}}%
\define@key{markdownRenderers}{headingFour}{%
  \renewcommand\markdownRendererHeadingFour[1]{#1}}%
\define@key{markdownRenderers}{headingFive}{%
  \renewcommand\markdownRendererHeadingFive[1]{#1}}%
\define@key{markdownRenderers}{headingSix}{%
  \renewcommand\markdownRendererHeadingSix[1]{#1}}%
\define@key{markdownRenderers}{horizontalRule}{%
  \renewcommand\markdownRendererHorizontalRule{#1}}%
\define@key{markdownRenderers}{footnote}{%
  \renewcommand\markdownRendererFootnote[1]{#1}}%
\define@key{markdownRenderers}{cite}{%
  \renewcommand\markdownRendererCite[1]{#1}}%
\define@key{markdownRenderers}{textCite}{%
  \renewcommand\markdownRendererTextCite[1]{#1}}%
\define@key{markdownRenderers}{table}{%
  \renewcommand\markdownRendererTable[3]{#1}}%
\define@key{markdownRenderers}{inlineHtmlComment}{%
  \renewcommand\markdownRendererInlineHtmlComment[1]{#1}}%
\define@key{markdownRenderers}{tickedBox}{%
  \renewcommand\markdownRendererTickedBox{#1}}%
\define@key{markdownRenderers}{halfTickedBox}{%
  \renewcommand\markdownRendererHalfTickedBox{#1}}%
\define@key{markdownRenderers}{untickedBox}{%
  \renewcommand\markdownRendererUntickedBox{#1}}%
```

The following example LaTeX code showcases a possible configuration of the

`\markdownRendererLink` and `\markdownRendererEmphasis` markdown token renderers.

```
\markdownSetup{
  renderers = {
    link = {#4},                    emphasis = {\emph{#1}},    }
}
```

2.3.2.6 Plain TEX Markdown Token Renderer Prototypes

The LATEX interface recognizes an option with the `rendererPrototypes` key, whose value must be a list of options that map directly to the markdown token renderer prototype macros exposed by the plain TEX interface (see Section 2.2.4 on page 37).

```
\define@key{markdownRendererPrototypes}{interblockSeparator}{%
  \renewcommand\markdownRendererInterblockSeparatorPrototype{#1}}%
\define@key{markdownRendererPrototypes}{lineBreak}{%
  \renewcommand\markdownRendererLineBreakPrototype{#1}}%
\define@key{markdownRendererPrototypes}{ellipsis}{%
  \renewcommand\markdownRendererEllipsisPrototype{#1}}%
\define@key{markdownRendererPrototypes}{nbsp}{%
  \renewcommand\markdownRendererNbspPrototype{#1}}%
\define@key{markdownRendererPrototypes}{leftBrace}{%
  \renewcommand\markdownRendererLeftBracePrototype{#1}}%
\define@key{markdownRendererPrototypes}{rightBrace}{%
  \renewcommand\markdownRendererRightBracePrototype{#1}}%
\define@key{markdownRendererPrototypes}{dollarSign}{%
  \renewcommand\markdownRendererDollarSignPrototype{#1}}%
\define@key{markdownRendererPrototypes}{percentSign}{%
  \renewcommand\markdownRendererPercentSignPrototype{#1}}%
\define@key{markdownRendererPrototypes}{ampersand}{%
  \renewcommand\markdownRendererAmpersandPrototype{#1}}%
\define@key{markdownRendererPrototypes}{underscore}{%
  \renewcommand\markdownRendererUnderscorePrototype{#1}}%
\define@key{markdownRendererPrototypes}{hash}{%
  \renewcommand\markdownRendererHashPrototype{#1}}%
\define@key{markdownRendererPrototypes}{circumflex}{%
  \renewcommand\markdownRendererCircumflexPrototype{#1}}%
\define@key{markdownRendererPrototypes}{backslash}{%
  \renewcommand\markdownRendererBackslashPrototype{#1}}%
\define@key{markdownRendererPrototypes}{tilde}{%
  \renewcommand\markdownRendererTildePrototype{#1}}%
\define@key{markdownRendererPrototypes}{pipe}{%
  \renewcommand\markdownRendererPipePrototype{#1}}%
\define@key{markdownRendererPrototypes}{codeSpan}{%
  \renewcommand\markdownRendererCodeSpanPrototype[1]{#1}}%
\define@key{markdownRendererPrototypes}{link}{%
```

```
    \renewcommand\markdownRendererLinkPrototype[4]{#1}}%
  \define@key{markdownRendererPrototypes}{contentBlock}{%
    \renewcommand\markdownRendererContentBlockPrototype[4]{#1}}%
  \define@key{markdownRendererPrototypes}{contentBlockOnlineImage}{%
    \renewcommand\markdownRendererContentBlockOnlineImagePrototype[4]{#1}}%
  \define@key{markdownRendererPrototypes}{contentBlockCode}{%
    \renewcommand\markdownRendererContentBlockCodePrototype[5]{#1}}%
  \define@key{markdownRendererPrototypes}{image}{%
    \renewcommand\markdownRendererImagePrototype[4]{#1}}%
  \define@key{markdownRendererPrototypes}{ulBegin}{%
    \renewcommand\markdownRendererUlBeginPrototype{#1}}%
  \define@key{markdownRendererPrototypes}{ulBeginTight}{%
    \renewcommand\markdownRendererUlBeginTightPrototype{#1}}%
  \define@key{markdownRendererPrototypes}{ulItem}{%
    \renewcommand\markdownRendererUlItemPrototype{#1}}%
  \define@key{markdownRendererPrototypes}{ulItemEnd}{%
    \renewcommand\markdownRendererUlItemEndPrototype{#1}}%
  \define@key{markdownRendererPrototypes}{ulEnd}{%
    \renewcommand\markdownRendererUlEndPrototype{#1}}%
  \define@key{markdownRendererPrototypes}{ulEndTight}{%
    \renewcommand\markdownRendererUlEndTightPrototype{#1}}%
  \define@key{markdownRendererPrototypes}{olBegin}{%
    \renewcommand\markdownRendererOlBeginPrototype{#1}}%
  \define@key{markdownRendererPrototypes}{olBeginTight}{%
    \renewcommand\markdownRendererOlBeginTightPrototype{#1}}%
  \define@key{markdownRendererPrototypes}{olItem}{%
    \renewcommand\markdownRendererOlItemPrototype{#1}}%
  \define@key{markdownRendererPrototypes}{olItemWithNumber}{%
    \renewcommand\markdownRendererOlItemWithNumberPrototype[1]{#1}}%
  \define@key{markdownRendererPrototypes}{olItemEnd}{%
    \renewcommand\markdownRendererOlItemEndPrototype{#1}}%
  \define@key{markdownRendererPrototypes}{olEnd}{%
    \renewcommand\markdownRendererOlEndPrototype{#1}}%
  \define@key{markdownRendererPrototypes}{olEndTight}{%
    \renewcommand\markdownRendererOlEndTightPrototype{#1}}%
  \define@key{markdownRendererPrototypes}{dlBegin}{%
    \renewcommand\markdownRendererDlBeginPrototype{#1}}%
  \define@key{markdownRendererPrototypes}{dlBeginTight}{%
    \renewcommand\markdownRendererDlBeginTightPrototype{#1}}%
  \define@key{markdownRendererPrototypes}{dlItem}{%
    \renewcommand\markdownRendererDlItemPrototype[1]{#1}}%
  \define@key{markdownRendererPrototypes}{dlItemEnd}{%
    \renewcommand\markdownRendererDlItemEndPrototype{#1}}%
  \define@key{markdownRendererPrototypes}{dlDefinitionBegin}{%
    \renewcommand\markdownRendererDlDefinitionBeginPrototype{#1}}%
  \define@key{markdownRendererPrototypes}{dlDefinitionEnd}{%
    \renewcommand\markdownRendererDlDefinitionEndPrototype{#1}}%
```

```
\define@key{markdownRendererPrototypes}{dlEnd}{%
  \renewcommand\markdownRendererDlEndPrototype{#1}}%
\define@key{markdownRendererPrototypes}{dlEndTight}{%
  \renewcommand\markdownRendererDlEndTightPrototype{#1}}%
\define@key{markdownRendererPrototypes}{emphasis}{%
  \renewcommand\markdownRendererEmphasisPrototype[1]{#1}}%
\define@key{markdownRendererPrototypes}{strongEmphasis}{%
  \renewcommand\markdownRendererStrongEmphasisPrototype[1]{#1}}%
\define@key{markdownRendererPrototypes}{blockQuoteBegin}{%
  \renewcommand\markdownRendererBlockQuoteBeginPrototype{#1}}%
\define@key{markdownRendererPrototypes}{blockQuoteEnd}{%
  \renewcommand\markdownRendererBlockQuoteEndPrototype{#1}}%
\define@key{markdownRendererPrototypes}{inputVerbatim}{%
  \renewcommand\markdownRendererInputVerbatimPrototype[1]{#1}}%
\define@key{markdownRendererPrototypes}{inputFencedCode}{%
  \renewcommand\markdownRendererInputFencedCodePrototype[2]{#1}}%
\define@key{markdownRendererPrototypes}{jekyllDataBoolean}{%
  \renewcommand\markdownRendererJekyllDataBooleanPrototype[2]{#1}}%
\define@key{markdownRendererPrototypes}{jekyllDataEmpty}{%
  \renewcommand\markdownRendererJekyllDataEmptyPrototype[1]{#1}}%
\define@key{markdownRendererPrototypes}{jekyllDataNumber}{%
  \renewcommand\markdownRendererJekyllDataNumberPrototype[2]{#1}}%
\define@key{markdownRendererPrototypes}{jekyllDataString}{%
  \renewcommand\markdownRendererJekyllDataStringPrototype[2]{#1}}%
\define@key{markdownRendererPrototypes}{jekyllDataBegin}{%
  \renewcommand\markdownRendererJekyllDataBeginPrototype{#1}}%
\define@key{markdownRendererPrototypes}{jekyllDataEnd}{%
  \renewcommand\markdownRendererJekyllDataEndPrototype{#1}}%
\define@key{markdownRendererPrototypes}{jekyllDataSequenceBegin}{%
  \renewcommand\markdownRendererJekyllDataSequenceBeginPrototype[2]{#1}}%
\define@key{markdownRendererPrototypes}{jekyllDataSequenceEnd}{%
  \renewcommand\markdownRendererJekyllDataSequenceEndPrototype{#1}}%
\define@key{markdownRendererPrototypes}{jekyllDataMappingBegin}{%
  \renewcommand\markdownRendererJekyllDataMappingBeginPrototype[2]{#1}}%
\define@key{markdownRendererPrototypes}{jekyllDataMappingEnd}{%
  \renewcommand\markdownRendererJekyllDataMappingEndPrototype{#1}}%
\define@key{markdownRendererPrototypes}{headingOne}{%
  \renewcommand\markdownRendererHeadingOnePrototype[1]{#1}}%
\define@key{markdownRendererPrototypes}{headingTwo}{%
  \renewcommand\markdownRendererHeadingTwoPrototype[1]{#1}}%
\define@key{markdownRendererPrototypes}{headingThree}{%
  \renewcommand\markdownRendererHeadingThreePrototype[1]{#1}}%
\define@key{markdownRendererPrototypes}{headingFour}{%
  \renewcommand\markdownRendererHeadingFourPrototype[1]{#1}}%
\define@key{markdownRendererPrototypes}{headingFive}{%
  \renewcommand\markdownRendererHeadingFivePrototype[1]{#1}}%
\define@key{markdownRendererPrototypes}{headingSix}{%
```

```
  \renewcommand\markdownRendererHeadingSixPrototype[1]{#1}%
\define@key{markdownRendererPrototypes}{horizontalRule}{%
  \renewcommand\markdownRendererHorizontalRulePrototype{#1}}%
\define@key{markdownRendererPrototypes}{footnote}{%
  \renewcommand\markdownRendererFootnotePrototype[1]{#1}}%
\define@key{markdownRendererPrototypes}{cite}{%
  \renewcommand\markdownRendererCitePrototype[1]{#1}}%
\define@key{markdownRendererPrototypes}{textCite}{%
  \renewcommand\markdownRendererTextCitePrototype[1]{#1}}%
\define@key{markdownRendererPrototypes}{table}{%
  \renewcommand\markdownRendererTablePrototype[3]{#1}}%
\define@key{markdownRendererPrototypes}{inlineHtmlComment}{%
  \renewcommand\markdownRendererInlineHtmlCommentPrototype[1]{#1}}%
\define@key{markdownRendererPrototypes}{tickedBox}{%
  \renewcommand\markdownRendererTickedBoxPrototype{#1}}%
\define@key{markdownRendererPrototypes}{halfTickedBox}{%
  \renewcommand\markdownRendererHalfTickedBoxPrototype{#1}}%
\define@key{markdownRendererPrototypes}{untickedBox}{%
  \renewcommand\markdownRendererUntickedBoxPrototype{#1}}%
```

The following example LaTeX code showcases a possible configuration of the `\markdownRendererImagePrototype` and `\markdownRendererCodeSpanPrototype` markdown token renderer prototypes.

```
\markdownSetup{
  rendererPrototypes = {
    image = {\includegraphics{#2}},
    codeSpan = {\texttt{#1}},    }
}
```

2.4 ConTeXt Interface

The ConTeXt interface provides a start-stop macro pair for the typesetting of markdown input from within ConTeXt. The rest of the interface is inherited from the plain TeX interface (see Section 2.2 on page 22).

```
\writestatus{loading}{ConTeXt User Module / markdown}%
\startmodule[markdown]
\unprotect
```

The ConTeXt interface is implemented by the `t-markdown.tex` ConTeXt module file that can be loaded as follows:

```
\usemodule[t][markdown]
```

It is expected that the special plain TeX characters have the expected category codes, when `\input`ting the file.

2.4.1 Typesetting Markdown

The interface exposes the `\startmarkdown` and `\stopmarkdown` macro pair for the typesetting of a markdown document fragment.

```
\let\startmarkdown\relax
\let\stopmarkdown\relax
```

You may prepend your own code to the `\startmarkdown` macro and redefine the `\stopmarkdown` macro to produce special effects before and after the markdown block.

Note that the `\startmarkdown` and `\stopmarkdown` macros are subject to the same limitations as the `\markdownBegin` and `\markdownEnd` macros exposed by the plain TeX interface.

The following example ConTeXt code showcases the usage of the `\startmarkdown` and `\stopmarkdown` macros:

```
\usemodule[t][markdown]
\starttext
\startmarkdown
_Hello_ **world** ...
\stopmarkdown
\stoptext
```

3 Implementation

This part of the documentation describes the implementation of the interfaces exposed by the package (see Section 2 on page 6) and is aimed at the developers of the package, as well as the curious users.

Figure 1 on page 7 shows the high-level structure of the Markdown package: The translation from markdown to TeX *token renderers* is performed by the Lua layer. The plain TeX layer provides default definitions for the token renderers. The LaTeX and ConTeXt layers correct idiosyncrasies of the respective TeX formats, and provide format-specific default definitions for the token renderers.

3.1 Lua Implementation

The Lua implementation implements `writer` and `reader` objects that provide the conversion from markdown to plain TeX.

The Lunamark Lua module implements writers for the conversion to various other formats, such as DocBook, Groff, or HTML. These were stripped from the module and the remaining markdown reader and plain TeX writer were hidden behind the converter functions exposed by the Lua interface (see Section 2.1 on page 6).

```
local upper, gsub, format, length =
  string.upper, string.gsub, string.format, string.len
local concat = table.concat
local P, R, S, V, C, Cg, Cb, Cmt, Cc, Ct, B, Cs, any =
  lpeg.P, lpeg.R, lpeg.S, lpeg.V, lpeg.C, lpeg.Cg, lpeg.Cb,
  lpeg.Cmt, lpeg.Cc, lpeg.Ct, lpeg.B, lpeg.Cs, lpeg.P(1)
```

3.1.1 Utility Functions

This section documents the utility functions used by the plain TEX writer and the markdown reader. These functions are encapsulated in the `util` object. The functions were originally located in the `lunamark/util.lua` file in the Lunamark Lua module.

```
local util = {}
```

The `util.err` method prints an error message `msg` and exits. If `exit_code` is provided, it specifies the exit code. Otherwise, the exit code will be 1.

```
function util.err(msg, exit_code)
  io.stderr:write("markdown.lua: " .. msg .. "\n")
  os.exit(exit_code or 1)
end
```

The `util.cache` method computes the digest of `string` and `salt`, adds the `suffix` and looks into the directory `dir`, whether a file with such a name exists. If it does not, it gets created with `transform(string)` as its content. The filename is then returned.

```
function util.cache(dir, string, salt, transform, suffix)
  local digest = md5.sumhexa(string .. (salt or ""))
  local name = util.pathname(dir, digest .. suffix)
  local file = io.open(name, "r")
  if file == nil then -- If no cache entry exists, then create a new one.
    local file = assert(io.open(name, "w"),
      [[could not open file "]] .. name .. [[" for writing]])
    local result = string
    if transform ~= nil then
      result = transform(result)
    end
    assert(file:write(result))
    assert(file:close())
  end
  return name
end
```

The `util.table_copy` method creates a shallow copy of a table `t` and its metatable.

```
function util.table_copy(t)
  local u = { }
  for k, v in pairs(t) do u[k] = v end
```

```
875   return setmetatable(u, getmetatable(t))
876 end
```

The `util.expand_tabs_in_line` expands tabs in string `s`. If `tabstop` is specified, it is used as the tab stop width. Otherwise, the tab stop width of 4 characters is used. The method is a copy of the tab expansion algorithm from Ierusalimschy [8, Chapter 21].

```
877 function util.expand_tabs_in_line(s, tabstop)
878   local tab = tabstop or 4
879   local corr = 0
880   return (s:gsub("()\t", function(p)
881             local sp = tab - (p - 1 + corr) % tab
882             corr = corr - 1 + sp
883             return string.rep(" ", sp)
884           end))
885 end
```

The `util.walk` method walks a rope `t`, applying a function `f` to each leaf element in order. A rope is an array whose elements may be ropes, strings, numbers, or functions. If a leaf element is a function, call it and get the return value before proceeding.

```
886 function util.walk(t, f)
887   local typ = type(t)
888   if typ == "string" then
889     f(t)
890   elseif typ == "table" then
891     local i = 1
892     local n
893     n = t[i]
894     while n do
895       util.walk(n, f)
896       i = i + 1
897       n = t[i]
898     end
899   elseif typ == "function" then
900     local ok, val = pcall(t)
901     if ok then
902       util.walk(val,f)
903     end
904   else
905     f(tostring(t))
906   end
907 end
```

The `util.flatten` method flattens an array `ary` that does not contain cycles and returns the result.

```
908 function util.flatten(ary)
```

```
  local new = {}
  for _,v in ipairs(ary) do
    if type(v) == "table" then
      for _,w in ipairs(util.flatten(v)) do
        new[#new + 1] = w
      end
    else
      new[#new + 1] = v
    end
  end
  return new
end
```

The `util.rope_to_string` method converts a rope `rope` to a string and returns it. For the definition of a rope, see the definition of the `util.walk` method.

```
function util.rope_to_string(rope)
  local buffer = {}
  util.walk(rope, function(x) buffer[#buffer + 1] = x end)
  return table.concat(buffer)
end
```

The `util.rope_last` method retrieves the last item in a rope. For the definition of a rope, see the definition of the `util.walk` method.

```
function util.rope_last(rope)
  if #rope == 0 then
    return nil
  else
    local l = rope[#rope]
    if type(l) == "table" then
      return util.rope_last(l)
    else
      return l
    end
  end
end
```

Given an array `ary` and a string `x`, the `util.intersperse` method returns an array `new`, such that `ary[i] == new[2*(i-1)+1]` and `new[2*i] == x` for all $1 \leqslant$ `i` $\leqslant$ `#ary`.

```
function util.intersperse(ary, x)
  local new = {}
  local l = #ary
  for i,v in ipairs(ary) do
    local n = #new
    new[n + 1] = v
    if i ~= l then
      new[n + 2] = x
    end
```

```
947   end
948   return new
949 end
```

Given an array `ary` and a function `f`, the `util.map` method returns an array `new`, such that `new[i] == f(ary[i])` for all $1 \leqslant$ `i` $\leqslant$ `#ary`.

```
950 function util.map(ary, f)
951   local new = {}
952   for i,v in ipairs(ary) do
953     new[i] = f(v)
954   end
955   return new
956 end
```

Given a table `char_escapes` mapping escapable characters to escaped strings and optionally a table `string_escapes` mapping escapable strings to escaped strings, the `util.escaper` method returns an escaper function that escapes all occurances of escapable strings and characters (in this order).

The method uses LPeg, which is faster than the Lua `string.gsub` built-in method.

```
957 function util.escaper(char_escapes, string_escapes)
```

Build a string of escapable characters.

```
958   local char_escapes_list = ""
959   for i,_ in pairs(char_escapes) do
960     char_escapes_list = char_escapes_list .. i
961   end
```

Create an LPeg capture `escapable` that produces the escaped string corresponding to the matched escapable character.

```
962   local escapable = S(char_escapes_list) / char_escapes
```

If `string_escapes` is provided, turn `escapable` into the

$$\sum_{\texttt{(k,v)}\in\texttt{string\_escapes}} \texttt{P(k) / v} + \texttt{escapable}$$

capture that replaces any occurance of the string `k` with the string `v` for each $(\texttt{k}, \texttt{v}) \in \texttt{string\_escapes}$. Note that the pattern summation is not commutative and its operands are inspected in the summation order during the matching. As a corrolary, the strings always take precedence over the characters.

```
963   if string_escapes then
964     for k,v in pairs(string_escapes) do
965       escapable = P(k) / v + escapable
966     end
967   end
```

Create an LPeg capture `escape_string` that captures anything `escapable` does and matches any other unmatched characters.

```
968   local escape_string = Cs((escapable + any)^0)
```

Return a function that matches the input string `s` against the `escape_string` capture.

```
  return function(s)
    return lpeg.match(escape_string, s)
  end
end
```

The `util.pathname` method produces a pathname out of a directory name `dir` and a filename `file` and returns it.

```
function util.pathname(dir, file)
  if #dir == 0 then
    return file
  else
    return dir .. "/" .. file
  end
end
```

3.1.2 HTML Entities

This section documents the HTML entities recognized by the markdown reader. These functions are encapsulated in the `entities` object. The functions were originally located in the `lunamark/entities.lua` file in the Lunamark Lua module.

```
local entities = {}

local character_entities = {
  ["Tab"] = 9,
  ["NewLine"] = 10,
  ["excl"] = 33,
  ["quot"] = 34,
  ["QUOT"] = 34,
  ["num"] = 35,
  ["dollar"] = 36,
  ["percnt"] = 37,
  ["amp"] = 38,
  ["AMP"] = 38,
  ["apos"] = 39,
  ["lpar"] = 40,
  ["rpar"] = 41,
  ["ast"] = 42,
  ["midast"] = 42,
  ["plus"] = 43,
  ["comma"] = 44,
  ["period"] = 46,
  ["sol"] = 47,
  ["colon"] = 58,
  ["semi"] = 59,
```

```
["lt"] = 60,
["LT"] = 60,
["equals"] = 61,
["gt"] = 62,
["GT"] = 62,
["quest"] = 63,
["commat"] = 64,
["lsqb"] = 91,
["lbrack"] = 91,
["bsol"] = 92,
["rsqb"] = 93,
["rbrack"] = 93,
["Hat"] = 94,
["lowbar"] = 95,
["grave"] = 96,
["DiacriticalGrave"] = 96,
["lcub"] = 123,
["lbrace"] = 123,
["verbar"] = 124,
["vert"] = 124,
["VerticalLine"] = 124,
["rcub"] = 125,
["rbrace"] = 125,
["nbsp"] = 160,
["NonBreakingSpace"] = 160,
["iexcl"] = 161,
["cent"] = 162,
["pound"] = 163,
["curren"] = 164,
["yen"] = 165,
["brvbar"] = 166,
["sect"] = 167,
["Dot"] = 168,
["die"] = 168,
["DoubleDot"] = 168,
["uml"] = 168,
["copy"] = 169,
["COPY"] = 169,
["ordf"] = 170,
["laquo"] = 171,
["not"] = 172,
["shy"] = 173,
["reg"] = 174,
["circledR"] = 174,
["REG"] = 174,
["macr"] = 175,
["OverBar"] = 175,
```

```
1051    ["strns"] = 175,
1052    ["deg"] = 176,
1053    ["plusmn"] = 177,
1054    ["pm"] = 177,
1055    ["PlusMinus"] = 177,
1056    ["sup2"] = 178,
1057    ["sup3"] = 179,
1058    ["acute"] = 180,
1059    ["DiacriticalAcute"] = 180,
1060    ["micro"] = 181,
1061    ["para"] = 182,
1062    ["middot"] = 183,
1063    ["centerdot"] = 183,
1064    ["CenterDot"] = 183,
1065    ["cedil"] = 184,
1066    ["Cedilla"] = 184,
1067    ["sup1"] = 185,
1068    ["ordm"] = 186,
1069    ["raquo"] = 187,
1070    ["frac14"] = 188,
1071    ["frac12"] = 189,
1072    ["half"] = 189,
1073    ["frac34"] = 190,
1074    ["iquest"] = 191,
1075    ["Agrave"] = 192,
1076    ["Aacute"] = 193,
1077    ["Acirc"] = 194,
1078    ["Atilde"] = 195,
1079    ["Auml"] = 196,
1080    ["Aring"] = 197,
1081    ["AElig"] = 198,
1082    ["Ccedil"] = 199,
1083    ["Egrave"] = 200,
1084    ["Eacute"] = 201,
1085    ["Ecirc"] = 202,
1086    ["Euml"] = 203,
1087    ["Igrave"] = 204,
1088    ["Iacute"] = 205,
1089    ["Icirc"] = 206,
1090    ["Iuml"] = 207,
1091    ["ETH"] = 208,
1092    ["Ntilde"] = 209,
1093    ["Ograve"] = 210,
1094    ["Oacute"] = 211,
1095    ["Ocirc"] = 212,
1096    ["Otilde"] = 213,
1097    ["Ouml"] = 214,
```

```
1098    ["times"] = 215,
1099    ["Oslash"] = 216,
1100    ["Ugrave"] = 217,
1101    ["Uacute"] = 218,
1102    ["Ucirc"] = 219,
1103    ["Uuml"] = 220,
1104    ["Yacute"] = 221,
1105    ["THORN"] = 222,
1106    ["szlig"] = 223,
1107    ["agrave"] = 224,
1108    ["aacute"] = 225,
1109    ["acirc"] = 226,
1110    ["atilde"] = 227,
1111    ["auml"] = 228,
1112    ["aring"] = 229,
1113    ["aelig"] = 230,
1114    ["ccedil"] = 231,
1115    ["egrave"] = 232,
1116    ["eacute"] = 233,
1117    ["ecirc"] = 234,
1118    ["euml"] = 235,
1119    ["igrave"] = 236,
1120    ["iacute"] = 237,
1121    ["icirc"] = 238,
1122    ["iuml"] = 239,
1123    ["eth"] = 240,
1124    ["ntilde"] = 241,
1125    ["ograve"] = 242,
1126    ["oacute"] = 243,
1127    ["ocirc"] = 244,
1128    ["otilde"] = 245,
1129    ["ouml"] = 246,
1130    ["divide"] = 247,
1131    ["div"] = 247,
1132    ["oslash"] = 248,
1133    ["ugrave"] = 249,
1134    ["uacute"] = 250,
1135    ["ucirc"] = 251,
1136    ["uuml"] = 252,
1137    ["yacute"] = 253,
1138    ["thorn"] = 254,
1139    ["yuml"] = 255,
1140    ["Amacr"] = 256,
1141    ["amacr"] = 257,
1142    ["Abreve"] = 258,
1143    ["abreve"] = 259,
1144    ["Aogon"] = 260,
```

```
1145    ["aogon"] = 261,
1146    ["Cacute"] = 262,
1147    ["cacute"] = 263,
1148    ["Ccirc"] = 264,
1149    ["ccirc"] = 265,
1150    ["Cdot"] = 266,
1151    ["cdot"] = 267,
1152    ["Ccaron"] = 268,
1153    ["ccaron"] = 269,
1154    ["Dcaron"] = 270,
1155    ["dcaron"] = 271,
1156    ["Dstrok"] = 272,
1157    ["dstrok"] = 273,
1158    ["Emacr"] = 274,
1159    ["emacr"] = 275,
1160    ["Edot"] = 278,
1161    ["edot"] = 279,
1162    ["Eogon"] = 280,
1163    ["eogon"] = 281,
1164    ["Ecaron"] = 282,
1165    ["ecaron"] = 283,
1166    ["Gcirc"] = 284,
1167    ["gcirc"] = 285,
1168    ["Gbreve"] = 286,
1169    ["gbreve"] = 287,
1170    ["Gdot"] = 288,
1171    ["gdot"] = 289,
1172    ["Gcedil"] = 290,
1173    ["Hcirc"] = 292,
1174    ["hcirc"] = 293,
1175    ["Hstrok"] = 294,
1176    ["hstrok"] = 295,
1177    ["Itilde"] = 296,
1178    ["itilde"] = 297,
1179    ["Imacr"] = 298,
1180    ["imacr"] = 299,
1181    ["Iogon"] = 302,
1182    ["iogon"] = 303,
1183    ["Idot"] = 304,
1184    ["imath"] = 305,
1185    ["inodot"] = 305,
1186    ["IJlig"] = 306,
1187    ["ijlig"] = 307,
1188    ["Jcirc"] = 308,
1189    ["jcirc"] = 309,
1190    ["Kcedil"] = 310,
1191    ["kcedil"] = 311,
```

```
1192  ["kgreen"] = 312,
1193  ["Lacute"] = 313,
1194  ["lacute"] = 314,
1195  ["Lcedil"] = 315,
1196  ["lcedil"] = 316,
1197  ["Lcaron"] = 317,
1198  ["lcaron"] = 318,
1199  ["Lmidot"] = 319,
1200  ["lmidot"] = 320,
1201  ["Lstrok"] = 321,
1202  ["lstrok"] = 322,
1203  ["Nacute"] = 323,
1204  ["nacute"] = 324,
1205  ["Ncedil"] = 325,
1206  ["ncedil"] = 326,
1207  ["Ncaron"] = 327,
1208  ["ncaron"] = 328,
1209  ["napos"] = 329,
1210  ["ENG"] = 330,
1211  ["eng"] = 331,
1212  ["Omacr"] = 332,
1213  ["omacr"] = 333,
1214  ["Odblac"] = 336,
1215  ["odblac"] = 337,
1216  ["OElig"] = 338,
1217  ["oelig"] = 339,
1218  ["Racute"] = 340,
1219  ["racute"] = 341,
1220  ["Rcedil"] = 342,
1221  ["rcedil"] = 343,
1222  ["Rcaron"] = 344,
1223  ["rcaron"] = 345,
1224  ["Sacute"] = 346,
1225  ["sacute"] = 347,
1226  ["Scirc"] = 348,
1227  ["scirc"] = 349,
1228  ["Scedil"] = 350,
1229  ["scedil"] = 351,
1230  ["Scaron"] = 352,
1231  ["scaron"] = 353,
1232  ["Tcedil"] = 354,
1233  ["tcedil"] = 355,
1234  ["Tcaron"] = 356,
1235  ["tcaron"] = 357,
1236  ["Tstrok"] = 358,
1237  ["tstrok"] = 359,
1238  ["Utilde"] = 360,
```

```
1239  ["utilde"] = 361,
1240  ["Umacr"] = 362,
1241  ["umacr"] = 363,
1242  ["Ubreve"] = 364,
1243  ["ubreve"] = 365,
1244  ["Uring"] = 366,
1245  ["uring"] = 367,
1246  ["Udblac"] = 368,
1247  ["udblac"] = 369,
1248  ["Uogon"] = 370,
1249  ["uogon"] = 371,
1250  ["Wcirc"] = 372,
1251  ["wcirc"] = 373,
1252  ["Ycirc"] = 374,
1253  ["ycirc"] = 375,
1254  ["Yuml"] = 376,
1255  ["Zacute"] = 377,
1256  ["zacute"] = 378,
1257  ["Zdot"] = 379,
1258  ["zdot"] = 380,
1259  ["Zcaron"] = 381,
1260  ["zcaron"] = 382,
1261  ["fnof"] = 402,
1262  ["imped"] = 437,
1263  ["gacute"] = 501,
1264  ["jmath"] = 567,
1265  ["circ"] = 710,
1266  ["caron"] = 711,
1267  ["Hacek"] = 711,
1268  ["breve"] = 728,
1269  ["Breve"] = 728,
1270  ["dot"] = 729,
1271  ["DiacriticalDot"] = 729,
1272  ["ring"] = 730,
1273  ["ogon"] = 731,
1274  ["tilde"] = 732,
1275  ["DiacriticalTilde"] = 732,
1276  ["dblac"] = 733,
1277  ["DiacriticalDoubleAcute"] = 733,
1278  ["DownBreve"] = 785,
1279  ["UnderBar"] = 818,
1280  ["Alpha"] = 913,
1281  ["Beta"] = 914,
1282  ["Gamma"] = 915,
1283  ["Delta"] = 916,
1284  ["Epsilon"] = 917,
1285  ["Zeta"] = 918,
```

```
1286  ["Eta"] = 919,
1287  ["Theta"] = 920,
1288  ["Iota"] = 921,
1289  ["Kappa"] = 922,
1290  ["Lambda"] = 923,
1291  ["Mu"] = 924,
1292  ["Nu"] = 925,
1293  ["Xi"] = 926,
1294  ["Omicron"] = 927,
1295  ["Pi"] = 928,
1296  ["Rho"] = 929,
1297  ["Sigma"] = 931,
1298  ["Tau"] = 932,
1299  ["Upsilon"] = 933,
1300  ["Phi"] = 934,
1301  ["Chi"] = 935,
1302  ["Psi"] = 936,
1303  ["Omega"] = 937,
1304  ["alpha"] = 945,
1305  ["beta"] = 946,
1306  ["gamma"] = 947,
1307  ["delta"] = 948,
1308  ["epsiv"] = 949,
1309  ["varepsilon"] = 949,
1310  ["epsilon"] = 949,
1311  ["zeta"] = 950,
1312  ["eta"] = 951,
1313  ["theta"] = 952,
1314  ["iota"] = 953,
1315  ["kappa"] = 954,
1316  ["lambda"] = 955,
1317  ["mu"] = 956,
1318  ["nu"] = 957,
1319  ["xi"] = 958,
1320  ["omicron"] = 959,
1321  ["pi"] = 960,
1322  ["rho"] = 961,
1323  ["sigmav"] = 962,
1324  ["varsigma"] = 962,
1325  ["sigmaf"] = 962,
1326  ["sigma"] = 963,
1327  ["tau"] = 964,
1328  ["upsi"] = 965,
1329  ["upsilon"] = 965,
1330  ["phi"] = 966,
1331  ["phiv"] = 966,
1332  ["varphi"] = 966,
```

```
  ["chi"] = 967,
  ["psi"] = 968,
  ["omega"] = 969,
  ["thetav"] = 977,
  ["vartheta"] = 977,
  ["thetasym"] = 977,
  ["Upsi"] = 978,
  ["upsih"] = 978,
  ["straightphi"] = 981,
  ["piv"] = 982,
  ["varpi"] = 982,
  ["Gammad"] = 988,
  ["gammad"] = 989,
  ["digamma"] = 989,
  ["kappav"] = 1008,
  ["varkappa"] = 1008,
  ["rhov"] = 1009,
  ["varrho"] = 1009,
  ["epsi"] = 1013,
  ["straightepsilon"] = 1013,
  ["bepsi"] = 1014,
  ["backepsilon"] = 1014,
  ["IOcy"] = 1025,
  ["DJcy"] = 1026,
  ["GJcy"] = 1027,
  ["Jukcy"] = 1028,
  ["DScy"] = 1029,
  ["Iukcy"] = 1030,
  ["YIcy"] = 1031,
  ["Jsercy"] = 1032,
  ["LJcy"] = 1033,
  ["NJcy"] = 1034,
  ["TSHcy"] = 1035,
  ["KJcy"] = 1036,
  ["Ubrcy"] = 1038,
  ["DZcy"] = 1039,
  ["Acy"] = 1040,
  ["Bcy"] = 1041,
  ["Vcy"] = 1042,
  ["Gcy"] = 1043,
  ["Dcy"] = 1044,
  ["IEcy"] = 1045,
  ["ZHcy"] = 1046,
  ["Zcy"] = 1047,
  ["Icy"] = 1048,
  ["Jcy"] = 1049,
  ["Kcy"] = 1050,
```

```
1380  ["Lcy"] = 1051,
1381  ["Mcy"] = 1052,
1382  ["Ncy"] = 1053,
1383  ["Ocy"] = 1054,
1384  ["Pcy"] = 1055,
1385  ["Rcy"] = 1056,
1386  ["Scy"] = 1057,
1387  ["Tcy"] = 1058,
1388  ["Ucy"] = 1059,
1389  ["Fcy"] = 1060,
1390  ["KHcy"] = 1061,
1391  ["TScy"] = 1062,
1392  ["CHcy"] = 1063,
1393  ["SHcy"] = 1064,
1394  ["SHCHcy"] = 1065,
1395  ["HARDcy"] = 1066,
1396  ["Ycy"] = 1067,
1397  ["SOFTcy"] = 1068,
1398  ["Ecy"] = 1069,
1399  ["YUcy"] = 1070,
1400  ["YAcy"] = 1071,
1401  ["acy"] = 1072,
1402  ["bcy"] = 1073,
1403  ["vcy"] = 1074,
1404  ["gcy"] = 1075,
1405  ["dcy"] = 1076,
1406  ["iecy"] = 1077,
1407  ["zhcy"] = 1078,
1408  ["zcy"] = 1079,
1409  ["icy"] = 1080,
1410  ["jcy"] = 1081,
1411  ["kcy"] = 1082,
1412  ["lcy"] = 1083,
1413  ["mcy"] = 1084,
1414  ["ncy"] = 1085,
1415  ["ocy"] = 1086,
1416  ["pcy"] = 1087,
1417  ["rcy"] = 1088,
1418  ["scy"] = 1089,
1419  ["tcy"] = 1090,
1420  ["ucy"] = 1091,
1421  ["fcy"] = 1092,
1422  ["khcy"] = 1093,
1423  ["tscy"] = 1094,
1424  ["chcy"] = 1095,
1425  ["shcy"] = 1096,
1426  ["shchcy"] = 1097,
```

```
1427  ["hardcy"] = 1098,
1428  ["ycy"] = 1099,
1429  ["softcy"] = 1100,
1430  ["ecy"] = 1101,
1431  ["yucy"] = 1102,
1432  ["yacy"] = 1103,
1433  ["iocy"] = 1105,
1434  ["djcy"] = 1106,
1435  ["gjcy"] = 1107,
1436  ["jukcy"] = 1108,
1437  ["dscy"] = 1109,
1438  ["iukcy"] = 1110,
1439  ["yicy"] = 1111,
1440  ["jsercy"] = 1112,
1441  ["ljcy"] = 1113,
1442  ["njcy"] = 1114,
1443  ["tshcy"] = 1115,
1444  ["kjcy"] = 1116,
1445  ["ubrcy"] = 1118,
1446  ["dzcy"] = 1119,
1447  ["ensp"] = 8194,
1448  ["emsp"] = 8195,
1449  ["emsp13"] = 8196,
1450  ["emsp14"] = 8197,
1451  ["numsp"] = 8199,
1452  ["puncsp"] = 8200,
1453  ["thinsp"] = 8201,
1454  ["ThinSpace"] = 8201,
1455  ["hairsp"] = 8202,
1456  ["VeryThinSpace"] = 8202,
1457  ["ZeroWidthSpace"] = 8203,
1458  ["NegativeVeryThinSpace"] = 8203,
1459  ["NegativeThinSpace"] = 8203,
1460  ["NegativeMediumSpace"] = 8203,
1461  ["NegativeThickSpace"] = 8203,
1462  ["zwnj"] = 8204,
1463  ["zwj"] = 8205,
1464  ["lrm"] = 8206,
1465  ["rlm"] = 8207,
1466  ["hyphen"] = 8208,
1467  ["dash"] = 8208,
1468  ["ndash"] = 8211,
1469  ["mdash"] = 8212,
1470  ["horbar"] = 8213,
1471  ["Verbar"] = 8214,
1472  ["Vert"] = 8214,
1473  ["lsquo"] = 8216,
```

```
["OpenCurlyQuote"] = 8216,
["rsquo"] = 8217,
["rsquor"] = 8217,
["CloseCurlyQuote"] = 8217,
["lsquor"] = 8218,
["sbquo"] = 8218,
["ldquo"] = 8220,
["OpenCurlyDoubleQuote"] = 8220,
["rdquo"] = 8221,
["rdquor"] = 8221,
["CloseCurlyDoubleQuote"] = 8221,
["ldquor"] = 8222,
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```

```
2931    ["Mfr"] = 120080,
2932    ["Nfr"] = 120081,
2933    ["Ofr"] = 120082,
2934    ["Pfr"] = 120083,
2935    ["Qfr"] = 120084,
2936    ["Sfr"] = 120086,
2937    ["Tfr"] = 120087,
2938    ["Ufr"] = 120088,
2939    ["Vfr"] = 120089,
2940    ["Wfr"] = 120090,
2941    ["Xfr"] = 120091,
2942    ["Yfr"] = 120092,
2943    ["afr"] = 120094,
2944    ["bfr"] = 120095,
2945    ["cfr"] = 120096,
2946    ["dfr"] = 120097,
2947    ["efr"] = 120098,
2948    ["ffr"] = 120099,
2949    ["gfr"] = 120100,
2950    ["hfr"] = 120101,
2951    ["ifr"] = 120102,
2952    ["jfr"] = 120103,
2953    ["kfr"] = 120104,
2954    ["lfr"] = 120105,
2955    ["mfr"] = 120106,
2956    ["nfr"] = 120107,
2957    ["ofr"] = 120108,
2958    ["pfr"] = 120109,
2959    ["qfr"] = 120110,
2960    ["rfr"] = 120111,
2961    ["sfr"] = 120112,
2962    ["tfr"] = 120113,
2963    ["ufr"] = 120114,
2964    ["vfr"] = 120115,
2965    ["wfr"] = 120116,
2966    ["xfr"] = 120117,
2967    ["yfr"] = 120118,
2968    ["zfr"] = 120119,
2969    ["Aopf"] = 120120,
2970    ["Bopf"] = 120121,
2971    ["Dopf"] = 120123,
2972    ["Eopf"] = 120124,
2973    ["Fopf"] = 120125,
2974    ["Gopf"] = 120126,
2975    ["Iopf"] = 120128,
2976    ["Jopf"] = 120129,
2977    ["Kopf"] = 120130,
```

```
  ["Lopf"] = 120131,
  ["Mopf"] = 120132,
  ["Oopf"] = 120134,
  ["Sopf"] = 120138,
  ["Topf"] = 120139,
  ["Uopf"] = 120140,
  ["Vopf"] = 120141,
  ["Wopf"] = 120142,
  ["Xopf"] = 120143,
  ["Yopf"] = 120144,
  ["aopf"] = 120146,
  ["bopf"] = 120147,
  ["copf"] = 120148,
  ["dopf"] = 120149,
  ["eopf"] = 120150,
  ["fopf"] = 120151,
  ["gopf"] = 120152,
  ["hopf"] = 120153,
  ["iopf"] = 120154,
  ["jopf"] = 120155,
  ["kopf"] = 120156,
  ["lopf"] = 120157,
  ["mopf"] = 120158,
  ["nopf"] = 120159,
  ["oopf"] = 120160,
  ["popf"] = 120161,
  ["qopf"] = 120162,
  ["ropf"] = 120163,
  ["sopf"] = 120164,
  ["topf"] = 120165,
  ["uopf"] = 120166,
  ["vopf"] = 120167,
  ["wopf"] = 120168,
  ["xopf"] = 120169,
  ["yopf"] = 120170,
  ["zopf"] = 120171,
}
```

Given a string `s` of decimal digits, the `entities.dec_entity` returns the corresponding UTF8-encoded Unicode codepoint.

```
function entities.dec_entity(s)
  return unicode.utf8.char(tonumber(s))
end
```

Given a string `s` of hexadecimal digits, the `entities.hex_entity` returns the corresponding UTF8-encoded Unicode codepoint.

```
function entities.hex_entity(s)
  return unicode.utf8.char(tonumber("0x"..s))
```

```
end
```

Given a character entity name `s` (like `ouml`), the `entities.char_entity` returns the corresponding UTF8-encoded Unicode codepoint.

```
function entities.char_entity(s)
  local n = character_entities[s]
  if n == nil then
    return "&" .. s .. ";"
  end
  return unicode.utf8.char(n)
end
```

3.1.3 Plain TEX Writer

This section documents the `writer` object, which implements the routines for producing the TEX output. The object is an amalgamate of the generic, TEX, LATEX writer objects that were located in the `lunamark/writer/generic.lua`, `lunamark/writer/tex.lua`, and `lunamark/writer/latex.lua` files in the Lunamark Lua module.

Although not specified in the Lua interface (see Section 2.1 on page 6), the `writer` object is exported, so that the curious user could easily tinker with the methods of the objects produced by the `writer.new` method described below. The user should be aware, however, that the implementation may change in a future revision.

```
M.writer = {}
```

The `writer.new` method creates and returns a new TEX writer object associated with the Lua interface options (see Section 2.1.2 on page 7) `options`. When `options` are unspecified, it is assumed that an empty table was passed to the method.

The objects produced by the `writer.new` method expose instance methods and variables of their own. As a convention, I will refer to these ⟨*member*⟩s as `writer->`⟨*member*⟩. All member variables are immutable unless explicitly stated otherwise.

```
function M.writer.new(options)
  local self = {}
  options = options or {}
```

Make the `options` table inherit from the `defaultOptions` table.

```
  setmetatable(options, { __index = function (_, key)
    return defaultOptions[key] end })
```

Parse the `slice` option and define `writer->slice_begin` `writer->slice_end`, and `writer->is_writing`. The `writer->is_writing` member variable is mutable.

```
  local slice_specifiers = {}
  for specifier in options.slice:gmatch("[^%s]+") do
    table.insert(slice_specifiers, specifier)
  end
```

```
3038
3039  if #slice_specifiers == 2 then
3040    self.slice_begin, self.slice_end = table.unpack(slice_specifiers)
3041    local slice_begin_type = self.slice_begin:sub(1, 1)
3042    if slice_begin_type ~= "^" and slice_begin_type ~= "$" then
3043      self.slice_begin = "^" .. self.slice_begin
3044    end
3045    local slice_end_type = self.slice_end:sub(1, 1)
3046    if slice_end_type ~= "^" and slice_end_type ~= "$" then
3047      self.slice_end = "$" .. self.slice_end
3048    end
3049  elseif #slice_specifiers == 1 then
3050    self.slice_begin = "^" .. slice_specifiers[1]
3051    self.slice_end = "$" .. slice_specifiers[1]
3052  end
3053
3054  if self.slice_begin == "^" and self.slice_end ~= "^" then
3055    self.is_writing = true
3056  else
3057    self.is_writing = false
3058  end
```

Define `writer->suffix` as the suffix of the produced cache files.

```
3059  self.suffix = ".tex"
```

Define `writer->space` as the output format of a space character.

```
3060  self.space = " "
```

Define `writer->nbsp` as the output format of a non-breaking space character.

```
3061  self.nbsp = "\\markdownRendererNbsp{}"
```

Define `writer->plain` as a function that will transform an input plain text block `s` to the output format.

```
3062  function self.plain(s)
3063    return s
3064  end
```

Define `writer->paragraph` as a function that will transform an input paragraph `s` to the output format.

```
3065  function self.paragraph(s)
3066    if not self.is_writing then return "" end
3067    return s
3068  end
```

Define `writer->pack` as a function that will take the filename `name` of the output file prepared by the reader and transform it to the output format.

```
3069  function self.pack(name)
3070    return [[\input ]] .. name .. [[\relax{}]]
3071  end
```

Define `writer->interblocksep` as the output format of a block element separator.

```
  function self.interblocksep()
    if not self.is_writing then return "" end
    return "\\markdownRendererInterblockSeparator\n{}"
  end
```

Define `writer->eof` as the end of file marker in the output format.

```
  self.eof = [[\relax]]
```

Define `writer->linebreak` as the output format of a forced line break.

```
  self.linebreak = "\\markdownRendererLineBreak\n{}"
```

Define `writer->ellipsis` as the output format of an ellipsis.

```
  self.ellipsis = "\\markdownRendererEllipsis{}"
```

Define `writer->hrule` as the output format of a horizontal rule.

```
  function self.hrule()
    if not self.is_writing then return "" end
    return "\\markdownRendererHorizontalRule{}"
  end
```

Define tables `escaped_uri_chars`, `escaped_citation_chars`, and `escaped_minimal_strings` containing the mapping from special plain characters and character strings that always need to be escaped.

```
  local escaped_uri_chars = {
    ["{"] = "\\markdownRendererLeftBrace{}",
    ["}"] = "\\markdownRendererRightBrace{}",
    ["%"] = "\\markdownRendererPercentSign{}",
    ["\\"] = "\\markdownRendererBackslash{}",
  }
  local escaped_citation_chars = {
    ["{"] = "\\markdownRendererLeftBrace{}",
    ["}"] = "\\markdownRendererRightBrace{}",
    ["%"] = "\\markdownRendererPercentSign{}",
    ["\\"] = "\\markdownRendererBackslash{}",
    ["#"] = "\\markdownRendererHash{}",
  }
  local escaped_minimal_strings = {
    ["^^"] = "\\markdownRendererCircumflex\\markdownRendererCircumflex ",
    ["☒"] = "\\markdownRendererTickedBox{}",
    ["⊡"] = "\\markdownRendererHalfTickedBox{}",
    ["▫"] = "\\markdownRendererUntickedBox{}",
  }
```

Define a table `escaped_chars` containing the mapping from special plain TEX characters (including the active pipe character (`|`) of ConTEXt) that need to be escaped for typeset content.

```
  local escaped_chars = {
    ["{"] = "\\markdownRendererLeftBrace{}",
```

```
    ["}"] = "\\markdownRendererRightBrace{}",
    ["%"] = "\\markdownRendererPercentSign{}",
    ["\\"] = "\\markdownRendererBackslash{}",
    ["#"] = "\\markdownRendererHash{}",
    ["$"] = "\\markdownRendererDollarSign{}",
    ["&"] = "\\markdownRendererAmpersand{}",
    ["_"] = "\\markdownRendererUnderscore{}",
    ["^"] = "\\markdownRendererCircumflex{}",
    ["~"] = "\\markdownRendererTilde{}",
    ["|"] = "\\markdownRendererPipe{}",
  }
```

Use the `escaped_chars`, `escaped_uri_chars`, `escaped_citation_chars`, and `escaped_minimal_strings` tables to create the `escape`, `escape_citation`, `escape_uri`, and `escape_minimal` escaper functions.

```
  local escape = util.escaper(escaped_chars, escaped_minimal_strings)
  local escape_citation = util.escaper(escaped_citation_chars,
    escaped_minimal_strings)
  local escape_uri = util.escaper(escaped_uri_chars, escaped_minimal_strings)
  local escape_minimal = util.escaper({}, escaped_minimal_strings)
```

Define `writer->string` as a function that will transform an input plain text span `s` to the output format, `writer->citation` as a function that will transform an input citation name `c` to the output format, and `writer->uri` as a function that will transform an input URI `u` to the output format. If the `hybrid` option is enabled, use the `escape_minimal`. Otherwise, use the `escape`, `escape_citation`, and `escape_uri` functions.

```
  if options.hybrid then
    self.string = escape_minimal
    self.citation = escape_minimal
    self.uri = escape_minimal
  else
    self.string = escape
    self.citation = escape_citation
    self.uri = escape_uri
  end
```

Define `writer->escape` as a function that will transform an input plain text span to the output format. Unlike the `writer->string` function, `writer->escape` always uses the `escape` function, even when the `hybrid` option is enabled.

```
  self.escape = escape
```

Define `writer->code` as a function that will transform an input inlined code span `s` to the output format.

```
  function self.code(s)
    return {"\\markdownRendererCodeSpan{",self.escape(s),"}"}
  end
```

Define `writer->link` as a function that will transform an input hyperlink to the output format, where `lab` corresponds to the label, `src` to URI, and `tit` to the title of the link.

```
function self.link(lab,src,tit)
  return {"\\markdownRendererLink{",lab,"}",
                          "{",self.escape(src),"}",
                          "{",self.uri(src),"}",
                          "{",self.string(tit or ""),"}"}
end
```

Define `writer->table` as a function that will transform an input table to the output format, where `rows` is a sequence of columns and a column is a sequence of cell texts.

```
function self.table(rows, caption)
  if not self.is_writing then return "" end
  local buffer = {"\\markdownRendererTable{",
    caption or "", "}{", #rows - 1, "}{", #rows[1], "}"}
  local temp = rows[2] -- put alignments on the first row
  rows[2] = rows[1]
  rows[1] = temp
  for i, row in ipairs(rows) do
    table.insert(buffer, "{")
    for _, column in ipairs(row) do
      if i > 1 then -- do not use braces for alignments
        table.insert(buffer, "{")
      end
      table.insert(buffer, column)
      if i > 1 then
        table.insert(buffer, "}")
      end
    end
    table.insert(buffer, "}")
  end
  return buffer
end
```

Define `writer->image` as a function that will transform an input image to the output format, where `lab` corresponds to the label, `src` to the URL, and `tit` to the title of the image.

```
function self.image(lab,src,tit)
  return {"\\markdownRendererImage{",lab,"}",
                           "{",self.string(src),"}",
                           "{",self.uri(src),"}",
                           "{",self.string(tit or ""),"}"}
end
```

The `languages_json` table maps programming language filename extensions to fence infostrings. All `options.contentBlocksLanguageMap` files located by the

KPathSea library are loaded into a chain of tables. `languages_json` corresponds to the first table and is chained with the rest via Lua metatables.

```
local languages_json = (function()
  local ran_ok, kpse = pcall(require, "kpse")
  if ran_ok then
    kpse.set_program_name("luatex")
```

If the KPathSea library is unavailable, perhaps because we are using LuaMetaTEX, we will only locate the `options.contentBlocksLanguageMap` in the current working directory:

```
  else
    kpse = {lookup=function(filename, options) return filename end}
  end
  local base, prev, curr
  for _, filename in ipairs{kpse.lookup(options.contentBlocksLanguageMap,
                                        { all=true })} do
    local file = io.open(filename, "r")
    if not file then goto continue end
    json = file:read("*all"):gsub('("[^\n]-"):','[%1]=')
    curr = (function()
      local _ENV={ json=json, load=load } -- run in sandbox
      return load("return "..json)()
    end)()
    if type(curr) == "table" then
      if base == nil then
        base = curr
      else
        setmetatable(prev, { __index = curr })
      end
      prev = curr
    end
    ::continue::
  end
  return base or {}
end)()
```

Define `writer->contentblock` as a function that will transform an input iA Writer content block to the output format, where `src` corresponds to the URI prefix, `suf` to the URI extension, `type` to the type of the content block (`localfile` or `onlineimage`), and `tit` to the title of the content block.

```
function self.contentblock(src,suf,type,tit)
  if not self.is_writing then return "" end
  src = src.."."..suf
  suf = suf:lower()
  if type == "onlineimage" then
    return {"\\markdownRendererContentBlockOnlineImage{",suf,"}",
                              "{",self.string(src),"}",
```

```
                              "{",self.uri(src),"}",
                              "{",self.string(tit or ""),"}"}
    elseif languages_json[suf] then
      return {"\\markdownRendererContentBlockCode{",suf,"}",
                              "{",self.string(languages_json[suf]),"}",
                              "{",self.string(src),"}",
                              "{",self.uri(src),"}",
                              "{",self.string(tit or ""),"}"}
    else
      return {"\\markdownRendererContentBlock{",suf,"}",
                              "{",self.string(src),"}",
                              "{",self.uri(src),"}",
                              "{",self.string(tit or ""),"}"}
    end
  end
```

Define `writer->bulletlist` as a function that will transform an input bulleted list to the output format, where `items` is an array of the list items and `tight` specifies, whether the list is tight or not.

```
  local function ulitem(s)
    return {"\\markdownRendererUlItem ",s,
            "\\markdownRendererUlItemEnd "}
  end

  function self.bulletlist(items,tight)
    if not self.is_writing then return "" end
    local buffer = {}
    for _,item in ipairs(items) do
      buffer[#buffer + 1] = ulitem(item)
    end
    local contents = util.intersperse(buffer,"\n")
    if tight and options.tightLists then
      return {"\\markdownRendererUlBeginTight\n",contents,
        "\n\\markdownRendererUlEndTight "}
    else
      return {"\\markdownRendererUlBegin\n",contents,
        "\n\\markdownRendererUlEnd "}
    end
  end
```

Define `writer->ollist` as a function that will transform an input ordered list to the output format, where `items` is an array of the list items and `tight` specifies, whether the list is tight or not. If the optional parameter `startnum` is present, it should be used as the number of the first list item.

```
  local function olitem(s,num)
    if num ~= nil then
      return {"\\markdownRendererOlItemWithNumber{",num,"}",s,
```

```
              "\\markdownRendererOlItemEnd "}
  else
    return {"\\markdownRendererOlItem ",s,
            "\\markdownRendererOlItemEnd "}
  end
end

function self.orderedlist(items,tight,startnum)
  if not self.is_writing then return "" end
  local buffer = {}
  local num = startnum
  for _,item in ipairs(items) do
    buffer[#buffer + 1] = olitem(item,num)
    if num ~= nil then
      num = num + 1
    end
  end
  local contents = util.intersperse(buffer,"\n")
  if tight and options.tightLists then
    return {"\\markdownRendererOlBeginTight\n",contents,
      "\n\\markdownRendererOlEndTight "}
  else
    return {"\\markdownRendererOlBegin\n",contents,
      "\n\\markdownRendererOlEnd "}
  end
end
```

Define `writer->inline_html_comment` as a function that will transform the contents of an inline HTML comment, to the output format, where `contents` are the contents of the HTML comment.

```
function self.inline_html_comment(contents)
  return {"\\markdownRendererInlineHtmlComment{",contents,"}"}
end
```

Define `writer->definitionlist` as a function that will transform an input definition list to the output format, where `items` is an array of tables, each of the form `{ term = t, definitions = defs }`, where `t` is a term and `defs` is an array of definitions. `tight` specifies, whether the list is tight or not.

```
local function dlitem(term, defs)
  local retVal = {"\\markdownRendererDlItem{",term,"}"}
  for _, def in ipairs(defs) do
    retVal[#retVal+1] = {"\\markdownRendererDlDefinitionBegin ",def,
                         "\\markdownRendererDlDefinitionEnd "}
  end
  retVal[#retVal+1] = "\\markdownRendererDlItemEnd "
  return retVal
end
```

```
3279
3280  function self.definitionlist(items,tight)
3281    if not self.is_writing then return "" end
3282    local buffer = {}
3283    for _,item in ipairs(items) do
3284      buffer[#buffer + 1] = dlitem(item.term, item.definitions)
3285    end
3286    if tight and options.tightLists then
3287      return {"\\markdownRendererDlBeginTight\n", buffer,
3288        "\n\\markdownRendererDlEndTight"}
3289    else
3290      return {"\\markdownRendererDlBegin\n", buffer,
3291        "\n\\markdownRendererDlEnd"}
3292    end
3293  end
```

Define `writer->emphasis` as a function that will transform an emphasized span `s` of input text to the output format.

```
3294  function self.emphasis(s)
3295    return {"\\markdownRendererEmphasis{",s,"}"}
3296  end
```

Define `writer->tickbox` as a function that will transform a number `f` to the output format.

```
3297  function self.tickbox(f)
3298    if f == 1.0 then
3299      return "☒ "
3300    elseif f == 0.0 then
3301      return "☐ "
3302    else
3303      return "☒ "
3304    end
3305  end
```

Define `writer->strong` as a function that will transform a strongly emphasized span `s` of input text to the output format.

```
3306  function self.strong(s)
3307    return {"\\markdownRendererStrongEmphasis{",s,"}"}
3308  end
```

Define `writer->blockquote` as a function that will transform an input block quote `s` to the output format.

```
3309  function self.blockquote(s)
3310    if #util.rope_to_string(s) == 0 then return "" end
3311    return {"\\markdownRendererBlockQuoteBegin\n",s,
3312      "\n\\markdownRendererBlockQuoteEnd "}
3313  end
```

Define `writer->verbatim` as a function that will transform an input code block `s` to the output format.

```
function self.verbatim(s)
  if not self.is_writing then return "" end
  s = string.gsub(s, '[\r\n%s]*$', '')
  local name = util.cache(options.cacheDir, s, nil, nil, ".verbatim")
  return {"\\markdownRendererInputVerbatim{",name,"}"}
end
```

Define `writer->codeFence` as a function that will transform an input fenced code block `s` with the infostring `i` to the output format.

```
function self.fencedCode(i, s)
  if not self.is_writing then return "" end
  s = string.gsub(s, '[\r\n%s]*$', '')
  local name = util.cache(options.cacheDir, s, nil, nil, ".verbatim")
  return {"\\markdownRendererInputFencedCode{",name,"}{",i,"}"}
end
```

Define `writer->jekyllData` as a function that will transform an input YAML table `d` to the output format. The table is the value for the key `p` in the parent table; if `p` is nil, then the table has no parent. All scalar keys and values encountered in the table will be cast to a string following YAML serialization rules. String values will also be transformed using the function `t`.

```
function self.jekyllData(d, t, p)
  if not self.is_writing then return "" end

  local buf = {}

  local keys = {}
  for k, _ in pairs(d) do
    table.insert(keys, k)
  end
  table.sort(keys)

  if not p then
    table.insert(buf, "\\markdownRendererJekyllDataBegin")
  end

  if #d > 0 then
      table.insert(buf, "\\markdownRendererJekyllDataSequenceBegin{")
      table.insert(buf, self.uri(p or "null"))
      table.insert(buf, "}{")
      table.insert(buf, #keys)
      table.insert(buf, "}")
  else
      table.insert(buf, "\\markdownRendererJekyllDataMappingBegin{")
      table.insert(buf, self.uri(p or "null"))
```

```
3350        table.insert(buf, "}{")
3351        table.insert(buf, #keys)
3352        table.insert(buf, "}")
3353    end
3354
3355    for _, k in ipairs(keys) do
3356      local v = d[k]
3357      local typ = type(v)
3358      k = tostring(k or "null")
3359      if typ == "table" and next(v) ~= nil then
3360        table.insert(
3361          buf,
3362          self.jekyllData(v, t, k)
3363        )
3364      else
3365        k = self.uri(k)
3366        v = tostring(v)
3367        if typ == "boolean" then
3368          table.insert(buf, "\\markdownRendererJekyllDataBoolean{")
3369          table.insert(buf, k)
3370          table.insert(buf, "}{")
3371          table.insert(buf, v)
3372          table.insert(buf, "}")
3373        elseif typ == "number" then
3374          table.insert(buf, "\\markdownRendererJekyllDataNumber{")
3375          table.insert(buf, k)
3376          table.insert(buf, "}{")
3377          table.insert(buf, v)
3378          table.insert(buf, "}")
3379        elseif typ == "string" then
3380          table.insert(buf, "\\markdownRendererJekyllDataString{")
3381          table.insert(buf, k)
3382          table.insert(buf, "}{")
3383          table.insert(buf, t(v))
3384          table.insert(buf, "}")
3385        elseif typ == "table" then
3386          table.insert(buf, "\\markdownRendererJekyllDataEmpty{")
3387          table.insert(buf, k)
3388          table.insert(buf, "}")
3389        else
3390          error(format("Unexpected type %s for value of " ..
3391                       "YAML key %s", typ, k))
3392        end
3393      end
3394    end
3395
3396    if #d > 0 then
```

```
3397        table.insert(buf, "\\markdownRendererJekyllDataSequenceEnd")
3398      else
3399        table.insert(buf, "\\markdownRendererJekyllDataMappingEnd")
3400      end
3401
3402      if not p then
3403        table.insert(buf, "\\markdownRendererJekyllDataEnd")
3404      end
3405
3406      return buf
3407    end
```

Define `writer->active_headings` as a stack of identifiers of the headings that are currently active. The `writer->active_headings` member variable is mutable.

```
3408    self.active_headings = {}
```

Define `writer->heading` as a function that will transform an input heading `s` at level `level` with identifiers `identifiers` to the output format.

```
3409    function self.heading(s,level,attributes)
3410      local active_headings = self.active_headings
3411      local slice_begin_type = self.slice_begin:sub(1, 1)
3412      local slice_begin_identifier = self.slice_begin:sub(2) or ""
3413      local slice_end_type = self.slice_end:sub(1, 1)
3414      local slice_end_identifier = self.slice_end:sub(2) or ""
3415
3416      while #active_headings < level do
3417        -- push empty identifiers for implied sections
3418        table.insert(active_headings, {})
3419      end
3420
3421      while #active_headings >= level do
3422        -- pop identifiers for sections that have ended
3423        local active_identifiers = active_headings[#active_headings]
3424        if active_identifiers[slice_begin_identifier] ~= nil
3425            and slice_begin_type == "$" then
3426          self.is_writing = true
3427        end
3428        if active_identifiers[slice_end_identifier] ~= nil
3429            and slice_end_type == "$" then
3430          self.is_writing = false
3431        end
3432        table.remove(active_headings, #active_headings)
3433      end
3434
3435      -- push identifiers for the new section
3436      attributes = attributes or {}
3437      local identifiers = {}
3438      for index = 1, #attributes do
```

```
      attribute = attributes[index]
      identifiers[attribute:sub(2)] = true
    end
    if identifiers[slice_begin_identifier] ~= nil
        and slice_begin_type == "^" then
      self.is_writing = true
    end
    if identifiers[slice_end_identifier] ~= nil
        and slice_end_type == "^" then
      self.is_writing = false
    end
    table.insert(active_headings, identifiers)

    if not self.is_writing then return "" end

    local cmd
    level = level + options.shiftHeadings
    if level <= 1 then
      cmd = "\\markdownRendererHeadingOne"
    elseif level == 2 then
      cmd = "\\markdownRendererHeadingTwo"
    elseif level == 3 then
      cmd = "\\markdownRendererHeadingThree"
    elseif level == 4 then
      cmd = "\\markdownRendererHeadingFour"
    elseif level == 5 then
      cmd = "\\markdownRendererHeadingFive"
    elseif level >= 6 then
      cmd = "\\markdownRendererHeadingSix"
    else
      cmd = ""
    end
    return {cmd,"{",s,"}"}
  end
```

Define `writer->note` as a function that will transform an input footnote `s` to the output format.

```
  function self.note(s)
    return {"\\markdownRendererFootnote{",s,"}"}
  end
```

Define `writer->citations` as a function that will transform an input array of citations `cites` to the output format. If `text_cites` is enabled, the citations should be rendered in-text, when applicable. The `cites` array contains tables with the following keys and values:

- `suppress_author` – If the value of the key is true, then the author of the work should be omitted in the citation, when applicable.

- `prenote` – The value of the key is either `nil` or a rope that should be inserted before the citation.
- `postnote` – The value of the key is either `nil` or a rope that should be inserted after the citation.
- `name` – The value of this key is the citation name.

```
function self.citations(text_cites, cites)
  local buffer = {"\\markdownRenderer", text_cites and "TextCite" or "Cite",
    "{", #cites, "}"}
  for _,cite in ipairs(cites) do
    buffer[#buffer+1] = {cite.suppress_author and "-" or "+", "{",
      cite.prenote or "", "}{", cite.postnote or "", "}{", cite.name, "}"}
  end
  return buffer
end
```

Define `writer->get_state` as a function that returns the current state of the writer, where the state of a writer are its mutable member variables.

```
function self.get_state()
  return {
    is_writing=self.is_writing,
    active_headings={table.unpack(self.active_headings)},
  }
end
```

Define `writer->set_state` as a function that restores the input state `s` and returns the previous state of the writer.

```
function self.set_state(s)
  local previous_state = self.get_state()
  for key, value in pairs(s) do
    self[key] = value
  end
  return previous_state
end
```

Define `writer->defer_call` as a function that will encapsulate the input function `f`, so that `f` is called with the state of the writer at the time of calling `writer->defer_call`.

```
function self.defer_call(f)
  local previous_state = self.get_state()
  return function(...)
    local state = self.set_state(previous_state)
    local return_value = f(...)
    self.set_state(state)
    return return_value
  end
```

```
  end

  return self
end
```

3.1.4 Parsers

The `parsers` hash table stores PEG patterns that are static and can be reused between different `reader` objects.

```
local parsers                 = {}
```

3.1.4.1 Basic Parsers

```
parsers.percent               = P("%")
parsers.at                    = P("@")
parsers.comma                 = P(",")
parsers.asterisk              = P("*")
parsers.dash                  = P("-")
parsers.plus                  = P("+")
parsers.underscore            = P("_")
parsers.period                = P(".")
parsers.hash                  = P("#")
parsers.ampersand             = P("&")
parsers.backtick              = P("`")
parsers.less                  = P("<")
parsers.more                  = P(">")
parsers.space                 = P(" ")
parsers.squote                = P("'")
parsers.dquote                = P('"')
parsers.lparent               = P("(")
parsers.rparent               = P(")")
parsers.lbracket              = P("[")
parsers.rbracket              = P("]")
parsers.lbrace                = P("{")
parsers.rbrace                = P("}")
parsers.circumflex            = P("^")
parsers.slash                 = P("/")
parsers.equal                 = P("=")
parsers.colon                 = P(":")
parsers.semicolon             = P(";")
parsers.exclamation           = P("!")
parsers.pipe                  = P("|")
parsers.tilde                 = P("~")
parsers.backslash             = P("\\")
parsers.tab                   = P("\t")
parsers.newline               = P("\n")
parsers.tightblocksep         = P("\001")
```

```
3545
3546 parsers.digit                  = R("09")
3547 parsers.hexdigit               = R("09","af","AF")
3548 parsers.letter                 = R("AZ","az")
3549 parsers.alphanumeric           = R("AZ","az","09")
3550 parsers.keyword                = parsers.letter
3551                                * parsers.alphanumeric^0
3552 parsers.citation_chars         = parsers.alphanumeric
3553                                + S("#$%&-+<>~/_")
3554 parsers.internal_punctuation   = S(":;,.?")
3555
3556 parsers.doubleasterisks        = P("**")
3557 parsers.doubleunderscores      = P("__")
3558 parsers.fourspaces             = P("    ")
3559
3560 parsers.any                    = P(1)
3561 parsers.fail                   = parsers.any - 1
3562
3563 parsers.escapable              = S("\\`*_{}[]()+_.!<>#-~:^@;")
3564 parsers.anyescaped             = parsers.backslash / "" * parsers.escapable
3565                                + parsers.any
3566
3567 parsers.spacechar              = S("\t ")
3568 parsers.spacing                = S(" \n\r\t")
3569 parsers.nonspacechar           = parsers.any - parsers.spacing
3570 parsers.optionalspace          = parsers.spacechar^0
3571
3572 parsers.specialchar            = S("*_`&[]<!\\.@-^")
3573
3574 parsers.normalchar             = parsers.any - (parsers.specialchar
3575                                               + parsers.spacing
3576                                               + parsers.tightblocksep)
3577 parsers.eof                    = -parsers.any
3578 parsers.nonindentspace         = parsers.space^-3 * - parsers.spacechar
3579 parsers.indent                 = parsers.space^-3 * parsers.tab
3580                                + parsers.fourspaces / ""
3581 parsers.linechar               = P(1 - parsers.newline)
3582
3583 parsers.blankline              = parsers.optionalspace
3584                                * parsers.newline / "\n"
3585 parsers.blanklines             = parsers.blankline^0
3586 parsers.skipblanklines         = (parsers.optionalspace * parsers.newline)^0
3587 parsers.indentedline           = parsers.indent    /""
3588                                * C(parsers.linechar^1 * parsers.newline^-
    1)
3589 parsers.optionallyindentedline = parsers.indent^-1 /""
```

```
                                * C(parsers.linechar^1 * parsers.newline^-
1)
parsers.sp                      = parsers.spacing^0
parsers.spnl                    = parsers.optionalspace
                                * (parsers.newline * parsers.optionalspace)^-
1
parsers.line                    = parsers.linechar^0 * parsers.newline
parsers.nonemptyline            = parsers.line - parsers.blankline
```

The `parsers.commented_line^1` parser recognizes the regular language of TEX comments, see an equivalent finite automaton in Figure 6 on the next page.

```
parsers.commented_line_letter   = parsers.linechar
                                + parsers.newline
                                - parsers.backslash
                                - parsers.percent
parsers.commented_line          = Cg(Cc(""), "backslashes")
                                * ((#(parsers.commented_line_letter
                                     - parsers.newline)
                                   * Cb("backslashes")
                                   * Cs(parsers.commented_line_letter
                                     - parsers.newline)^1  -- initial
                                   * Cg(Cc(""), "backslashes"))
                                  + #(parsers.backslash * parsers.backslash)
                                  * Cg((parsers.backslash  -- even backslash
                                       * parsers.backslash)^1, "backslashes")
                                  + (parsers.backslash
                                    * (#parsers.percent
                                      * Cb("backslashes")
                                      / function(backslashes)
                                        return string.rep("\\", #backslashes / 2)
                                      end
                                      * C(parsers.percent)
                                      + #parsers.commented_line_letter
                                      * Cb("backslashes")
                                      * Cc("\\")
                                      * C(parsers.commented_line_letter))
                                    * Cg(Cc(""), "backslashes")))^0
                                * (#parsers.percent
                                  * Cb("backslashes")
                                  / function(backslashes)
                                    return string.rep("\\", #backslashes / 2)
                                  end
                                  * ((parsers.percent  -- comment
                                     * parsers.line
                                     * #parsers.blankline) -- blank line
                                    / "\n"
                                    + parsers.percent  -- comment
```

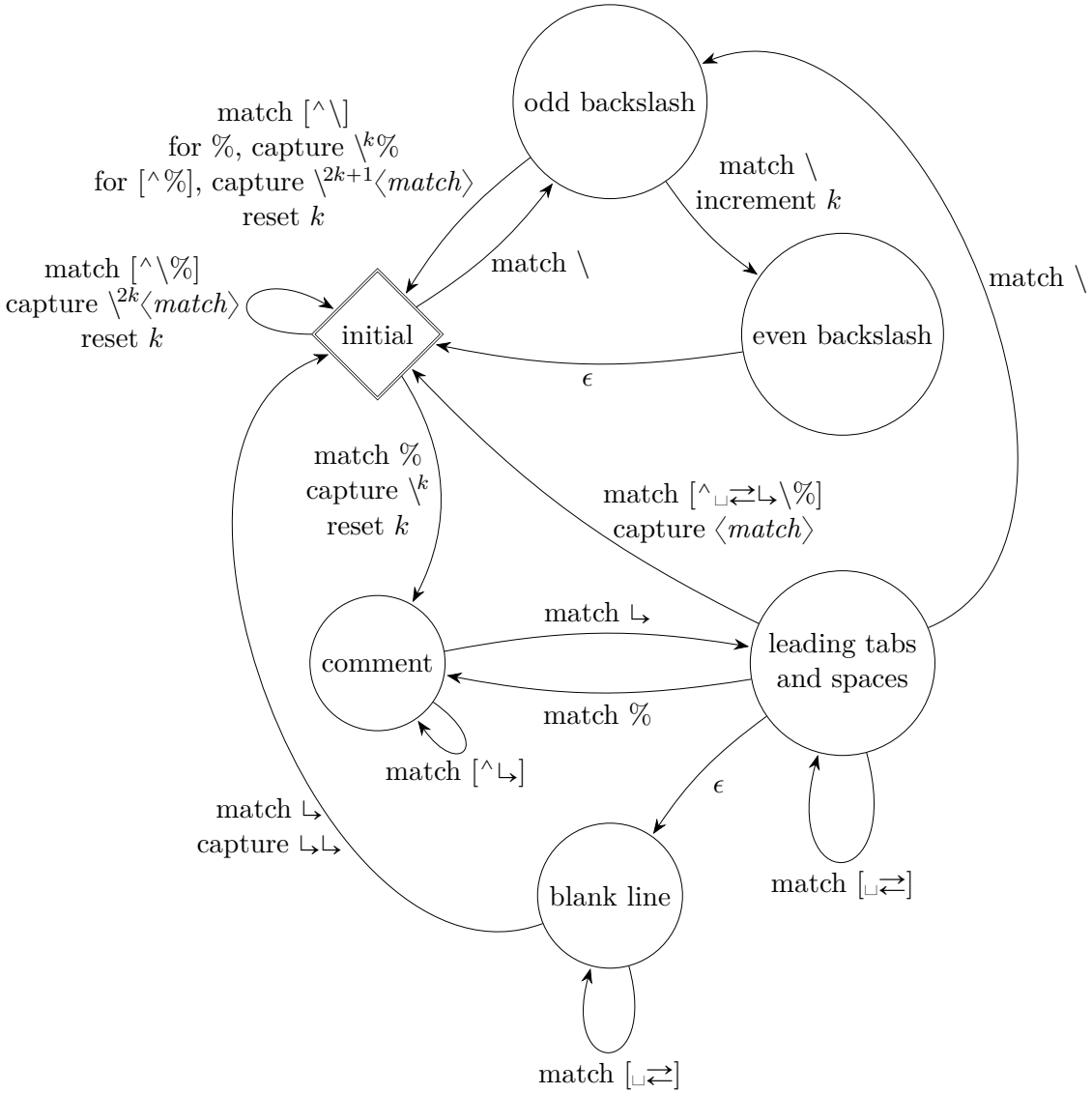

Figure 6: A pushdown automaton that recognizes TEX comments

```
                                    * parsers.line
                                    * parsers.optionalspace)  -- leading tabs and spaces
                                  + #(parsers.newline)
                                  * Cb("backslashes")
                                  * C(parsers.newline))

parsers.chunk                   = parsers.line * (parsers.optionallyindentedline
                                                  - parsers.blankline)^0

parsers.css_identifier_char     = R("AZ", "az", "09") + S("-_")
parsers.css_identifier          = (parsers.hash + parsers.period)
                                * (((parsers.css_identifier_char
                                    - parsers.dash - parsers.digit)
                                   * parsers.css_identifier_char^1)
                                  + (parsers.dash
                                    * (parsers.css_identifier_char
                                      - parsers.digit)
                                    * parsers.css_identifier_char^0))
parsers.attribute_name_char     = parsers.any - parsers.space
                                - parsers.squote - parsers.dquote
                                - parsers.more - parsers.slash
                                - parsers.equal
parsers.attribute_value_char    = parsers.any - parsers.dquote
                                - parsers.more

-- block followed by 0 or more optionally
-- indented blocks with first line indented.
parsers.indented_blocks = function(bl)
  return Cs( bl
          * (parsers.blankline^1 * parsers.indent * -parsers.blankline * bl)^0
          * (parsers.blankline^1 + parsers.eof) )
end
```

3.1.4.2 Parsers Used for Markdown Lists

```
parsers.bulletchar = C(parsers.plus + parsers.asterisk + parsers.dash)

parsers.bullet = ( parsers.bulletchar * #parsers.spacing
                                      * (parsers.tab + parsers.space^-3)
                 + parsers.space * parsers.bulletchar * #parsers.spacing
                                 * (parsers.tab + parsers.space^-2)
                 + parsers.space * parsers.space * parsers.bulletchar
                                 * #parsers.spacing
                                 * (parsers.tab + parsers.space^-1)
                 + parsers.space * parsers.space * parsers.space
                                 * parsers.bulletchar * #parsers.spacing
                 )
```

```
3676
3677 local function tickbox(interior)
3678   return parsers.optionalspace * parsers.lbracket
3679       * interior * parsers.rbracket * parsers.spacechar^1
3680 end
3681
3682 parsers.ticked_box = tickbox(S("xX")) * Cc(1.0)
3683 parsers.halfticked_box = tickbox(S("./")) * Cc(0.5)
3684 parsers.unticked_box = tickbox(parsers.spacechar^1) * Cc(0.0)
3685
```

3.1.4.3 Parsers Used for Markdown Code Spans

```
3686 parsers.openticks   = Cg(parsers.backtick^1, "ticks")
3687
3688 local function captures_equal_length(s,i,a,b)
3689   return #a == #b and i
3690 end
3691
3692 parsers.closeticks  = parsers.space^-1
3693                     * Cmt(C(parsers.backtick^1)
3694                         * Cb("ticks"), captures_equal_length)
3695
3696 parsers.intickschar = (parsers.any - S(" \n\r`"))
3697                     + (parsers.newline * -parsers.blankline)
3698                     + (parsers.space - parsers.closeticks)
3699                     + (parsers.backtick^1 - parsers.closeticks)
3700
3701 parsers.inticks     = parsers.openticks * parsers.space^-1
3702                     * C(parsers.intickschar^0) * parsers.closeticks
```

3.1.4.4 Parsers Used for Fenced Code Blocks

```
3703 local function captures_geq_length(s,i,a,b)
3704   return #a >= #b and i
3705 end
3706
3707 parsers.infostring     = (parsers.linechar - (parsers.backtick
3708                        + parsers.space^1 * (parsers.newline + parsers.eof)))^0
3709
3710 local fenceindent
3711 parsers.fencehead    = function(char)
3712   return               C(parsers.nonindentspace) / function(s) fenceindent = #s end
3713                      * Cg(char^3, "fencelength")
3714                      * parsers.optionalspace * C(parsers.infostring)
3715                      * parsers.optionalspace * (parsers.newline + parsers.eof)
3716 end
3717
```

```
parsers.fencetail    = function(char)
  return               parsers.nonindentspace
                     * Cmt(C(char^3) * Cb("fencelength"), captures_geq_length)
                     * parsers.optionalspace * (parsers.newline + parsers.eof)
                     + parsers.eof
end

parsers.fencedline   = function(char)
  return               C(parsers.line - parsers.fencetail(char))
                     / function(s)
                         i = 1
                         remaining = fenceindent
                         while true do
                           c = s:sub(i, i)
                           if c == " " and remaining > 0 then
                             remaining = remaining - 1
                             i = i + 1
                           elseif c == "\t" and remaining > 3 then
                             remaining = remaining - 4
                             i = i + 1
                           else
                             break
                           end
                         end
                         return s:sub(i)
                       end
end
```

3.1.4.5 Parsers Used for Markdown Tags and Links

```
parsers.leader      = parsers.space^-3

-- content in balanced brackets, parentheses, or quotes:
parsers.bracketed   = P{ parsers.lbracket
                         * ((parsers.anyescaped - (parsers.lbracket
                                                 + parsers.rbracket
                                                 + parsers.blankline^2)
                            ) + V(1))^0
                         * parsers.rbracket }

parsers.inparens    = P{ parsers.lparent
                         * ((parsers.anyescaped - (parsers.lparent
                                                 + parsers.rparent
                                                 + parsers.blankline^2)
                            ) + V(1))^0
                         * parsers.rparent }

```

```
parsers.squoted     = P{ parsers.squote * parsers.alphanumeric
                       * ((parsers.anyescaped - (parsers.squote
                                                 + parsers.blankline^2)
                           ) + V(1))^0
                       * parsers.squote }

parsers.dquoted     = P{ parsers.dquote * parsers.alphanumeric
                       * ((parsers.anyescaped - (parsers.dquote
                                                 + parsers.blankline^2)
                           ) + V(1))^0
                       * parsers.dquote }

-- bracketed tag for markdown links, allowing nested brackets:
parsers.tag         = parsers.lbracket
                    * Cs((parsers.alphanumeric^1
                         + parsers.bracketed
                         + parsers.inticks
                         + (parsers.anyescaped
                           - (parsers.rbracket + parsers.blankline^2)))^0)
                    * parsers.rbracket

-- url for markdown links, allowing nested brackets:
parsers.url         = parsers.less * Cs((parsers.anyescaped
                                         - parsers.more)^0)
                                   * parsers.more
                    + Cs((parsers.inparens + (parsers.anyescaped
                                              - parsers.spacing
                                              - parsers.rparent))^1)

-- quoted text, possibly with nested quotes:
parsers.title_s     = parsers.squote * Cs(((parsers.anyescaped-parsers.squote)
                                           + parsers.squoted)^0)
                                     * parsers.squote

parsers.title_d     = parsers.dquote * Cs(((parsers.anyescaped-parsers.dquote)
                                           + parsers.dquoted)^0)
                                     * parsers.dquote

parsers.title_p     = parsers.lparent
                    * Cs((parsers.inparens + (parsers.anyescaped-parsers.rparent))^0)
                    * parsers.rparent

parsers.title       = parsers.title_d + parsers.title_s + parsers.title_p

parsers.optionaltitle
                    = parsers.spnl * parsers.title * parsers.spacechar^0
                    + Cc("")
```

3.1.4.6 Parsers Used for iA Writer Content Blocks

```
parsers.contentblock_tail
                     = parsers.optionaltitle
                     * (parsers.newline + parsers.eof)

-- case insensitive online image suffix:
parsers.onlineimagesuffix
                     = (function(...)
                         local parser = nil
                         for _,suffix in ipairs({...}) do
                           local pattern=nil
                           for i=1,#suffix do
                             local char=suffix:sub(i,i)
                             char = S(char:lower()..char:upper())
                             if pattern == nil then
                               pattern = char
                             else
                               pattern = pattern * char
                             end
                           end
                           if parser == nil then
                             parser = pattern
                           else
                             parser = parser + pattern
                           end
                         end
                         return parser
                       end)("png", "jpg", "jpeg", "gif", "tif", "tiff")

-- online image url for iA Writer content blocks with mandatory suffix,
-- allowing nested brackets:
parsers.onlineimageurl
                     = (parsers.less
                       * Cs((parsers.anyescaped
                            - parsers.more
                            - #(parsers.period
                               * parsers.onlineimagesuffix
                               * parsers.more
                               * parsers.contentblock_tail))^0)
                       * parsers.period
                       * Cs(parsers.onlineimagesuffix)
                       * parsers.more
                       + (Cs((parsers.inparens
                             + (parsers.anyescaped
                               - parsers.spacing
                               - parsers.rparent
                               - #(parsers.period
```

```
                                  * parsers.onlineimagesuffix
                                  * parsers.contentblock_tail)))^0)
                          * parsers.period
                          * Cs(parsers.onlineimagesuffix))
                        ) * Cc("onlineimage")

-- filename for iA Writer content blocks with mandatory suffix:
parsers.localfilepath
                      = parsers.slash
                      * Cs((parsers.anyescaped
                          - parsers.tab
                          - parsers.newline
                          - #(parsers.period
                             * parsers.alphanumeric^1
                             * parsers.contentblock_tail))^1)
                      * parsers.period
                      * Cs(parsers.alphanumeric^1)
                      * Cc("localfile")
```

3.1.4.7 Parsers Used for Citations

```
parsers.citation_name = Cs(parsers.dash^-1) * parsers.at
                        * Cs(parsers.citation_chars
                            * (((parsers.citation_chars + parsers.internal_punctuation
                                - parsers.comma - parsers.semicolon)
                               * -#((parsers.internal_punctuation - parsers.comma
                                    - parsers.semicolon)^0
                                   * -(parsers.citation_chars + parsers.internal_punctuati
                                      - parsers.comma - parsers.semicolon)))^0
                              * parsers.citation_chars)^-1)

parsers.citation_body_prenote
                      = Cs((parsers.alphanumeric^1
                          + parsers.bracketed
                          + parsers.inticks
                          + (parsers.anyescaped
                            - (parsers.rbracket + parsers.blankline^2))
                          - (parsers.spnl * parsers.dash^-1 * parsers.at))^0)

parsers.citation_body_postnote
                      = Cs((parsers.alphanumeric^1
                          + parsers.bracketed
                          + parsers.inticks
                          + (parsers.anyescaped
                            - (parsers.rbracket + parsers.semicolon
                              + parsers.blankline^2))
                          - (parsers.spnl * parsers.rbracket))^0)
```

```
3899
3900 parsers.citation_body_chunk
3901                     = parsers.citation_body_prenote
3902                     * parsers.spnl * parsers.citation_name
3903                     * (parsers.internal_punctuation - parsers.semicolon)^-
     1
3904                     * parsers.spnl * parsers.citation_body_postnote
3905
3906 parsers.citation_body
3907                     = parsers.citation_body_chunk
3908                     * (parsers.semicolon * parsers.spnl
3909                       * parsers.citation_body_chunk)^0
3910
3911 parsers.citation_headless_body_postnote
3912                     = Cs((parsers.alphanumeric^1
3913                         + parsers.bracketed
3914                         + parsers.inticks
3915                         + (parsers.anyescaped
3916                           - (parsers.rbracket + parsers.at
3917                             + parsers.semicolon + parsers.blankline^2))
3918                         - (parsers.spnl * parsers.rbracket))^0)
3919
3920 parsers.citation_headless_body
3921                     = parsers.citation_headless_body_postnote
3922                     * (parsers.sp * parsers.semicolon * parsers.spnl
3923                       * parsers.citation_body_chunk)^0
```

3.1.4.8 Parsers Used for Footnotes

```
3924 local function strip_first_char(s)
3925   return s:sub(2)
3926 end
3927
3928 parsers.RawNoteRef = #(parsers.lbracket * parsers.circumflex)
3929                     * parsers.tag / strip_first_char
```

3.1.4.9 Parsers Used for Tables

```
3930 local function make_pipe_table_rectangular(rows)
3931   local num_columns = #rows[2]
3932   local rectangular_rows = {}
3933   for i = 1, #rows do
3934     local row = rows[i]
3935     local rectangular_row = {}
3936     for j = 1, num_columns do
3937       rectangular_row[j] = row[j] or ""
3938     end
3939     table.insert(rectangular_rows, rectangular_row)
```

```
  end
  return rectangular_rows
end

local function pipe_table_row(allow_empty_first_column
                              , nonempty_column
                              , column_separator
                              , column)
  local row_beginning
  if allow_empty_first_column then
    row_beginning = -- empty first column
                    #(parsers.spacechar^4
                     * column_separator)
                  * parsers.optionalspace
                  * column
                  * parsers.optionalspace
                  -- non-empty first column
                  + parsers.nonindentspace
                  * nonempty_column^-1
                  * parsers.optionalspace
  else
    row_beginning = parsers.nonindentspace
                  * nonempty_column^-1
                  * parsers.optionalspace
  end

  return Ct(row_beginning
            * (-- single column with no leading pipes
               #(column_separator
                 * parsers.optionalspace
                 * parsers.newline)
              * column_separator
              * parsers.optionalspace
              -- single column with leading pipes or
              -- more than a single column
              + (column_separator
                * parsers.optionalspace
                * column
                * parsers.optionalspace)^1
              * (column_separator
                * parsers.optionalspace)^-1))
end

parsers.table_hline_separator = parsers.pipe + parsers.plus
parsers.table_hline_column = (parsers.dash
                              - #(parsers.dash
                                 * (parsers.spacechar
```

```
                                    + parsers.table_hline_separator
                                    + parsers.newline)))^1
                                * (parsers.colon * Cc("r")
                                  + parsers.dash * Cc("d"))
                                + parsers.colon
                                * (parsers.dash
                                  - #(parsers.dash
                                     * (parsers.spacechar
                                       + parsers.table_hline_separator
                                       + parsers.newline)))^1
                                * (parsers.colon * Cc("c")
                                  + parsers.dash * Cc("l"))
parsers.table_hline = pipe_table_row(false
                                     , parsers.table_hline_column
                                     , parsers.table_hline_separator
                                     , parsers.table_hline_column)
parsers.table_caption_beginning = parsers.skipblanklines
                                * parsers.nonindentspace
                                * (P("Table")^-1 * parsers.colon)
                                * parsers.optionalspace
```

3.1.4.10 Parsers Used for HTML

```
-- case-insensitive match (we assume s is lowercase). must be single byte encoding
parsers.keyword_exact = function(s)
  local parser = P(0)
  for i=1,#s do
    local c = s:sub(i,i)
    local m = c .. upper(c)
    parser = parser * S(m)
  end
  return parser
end

parsers.block_keyword =
    parsers.keyword_exact("address") + parsers.keyword_exact("blockquote") +
    parsers.keyword_exact("center") + parsers.keyword_exact("del") +
    parsers.keyword_exact("dir") + parsers.keyword_exact("div") +
    parsers.keyword_exact("p") + parsers.keyword_exact("pre") +
    parsers.keyword_exact("li") + parsers.keyword_exact("ol") +
    parsers.keyword_exact("ul") + parsers.keyword_exact("dl") +
    parsers.keyword_exact("dd") + parsers.keyword_exact("form") +
    parsers.keyword_exact("fieldset") + parsers.keyword_exact("isindex") +
    parsers.keyword_exact("ins") + parsers.keyword_exact("menu") +
    parsers.keyword_exact("noframes") + parsers.keyword_exact("frameset") +
    parsers.keyword_exact("h1") + parsers.keyword_exact("h2") +
    parsers.keyword_exact("h3") + parsers.keyword_exact("h4") +
```

```
    parsers.keyword_exact("h5") + parsers.keyword_exact("h6") +
    parsers.keyword_exact("hr") + parsers.keyword_exact("script") +
    parsers.keyword_exact("noscript") + parsers.keyword_exact("table") +
    parsers.keyword_exact("tbody") + parsers.keyword_exact("tfoot") +
    parsers.keyword_exact("thead") + parsers.keyword_exact("th") +
    parsers.keyword_exact("td") + parsers.keyword_exact("tr")

-- There is no reason to support bad html, so we expect quoted attributes
parsers.htmlattributevalue
                          = parsers.squote * (parsers.any - (parsers.blankline
                                                           + parsers.squote))^0
                                           * parsers.squote
                          + parsers.dquote * (parsers.any - (parsers.blankline
                                                           + parsers.dquote))^0
                                           * parsers.dquote

parsers.htmlattribute     = parsers.spacing^1
                          * (parsers.alphanumeric + S("_-"))^1
                          * parsers.sp * parsers.equal * parsers.sp
                          * parsers.htmlattributevalue

parsers.htmlcomment       = P("<!--")
                          * parsers.optionalspace
                          * Cs((parsers.any - parsers.optionalspace * P("-->"))^0)
                          * parsers.optionalspace
                          * P("-->")

parsers.htmlinstruction   = P("<?") * (parsers.any - P("?>"))^0 * P("?>")

parsers.openelt_any = parsers.less * parsers.keyword * parsers.htmlattribute^0
                    * parsers.sp * parsers.more

parsers.openelt_exact = function(s)
  return parsers.less * parsers.sp * parsers.keyword_exact(s)
       * parsers.htmlattribute^0 * parsers.sp * parsers.more
end

parsers.openelt_block = parsers.sp * parsers.block_keyword
                      * parsers.htmlattribute^0 * parsers.sp * parsers.more

parsers.closeelt_any = parsers.less * parsers.sp * parsers.slash
                     * parsers.keyword * parsers.sp * parsers.more

parsers.closeelt_exact = function(s)
  return parsers.less * parsers.sp * parsers.slash * parsers.keyword_exact(s)
       * parsers.sp * parsers.more
end
```

```
4078
4079 parsers.emptyelt_any = parsers.less * parsers.sp * parsers.keyword
4080                      * parsers.htmlattribute^0 * parsers.sp * parsers.slash
4081                      * parsers.more
4082
4083 parsers.emptyelt_block = parsers.less * parsers.sp * parsers.block_keyword
4084                        * parsers.htmlattribute^0 * parsers.sp * parsers.slash
4085                        * parsers.more
4086
4087 parsers.displaytext = (parsers.any - parsers.less)^1
4088
4089 -- return content between two matched HTML tags
4090 parsers.in_matched = function(s)
4091   return { parsers.openelt_exact(s)
4092          * (V(1) + parsers.displaytext
4093            + (parsers.less - parsers.closeelt_exact(s)))^0
4094          * parsers.closeelt_exact(s) }
4095 end
4096
4097 local function parse_matched_tags(s,pos)
4098   local t = string.lower(lpeg.match(C(parsers.keyword),s,pos))
4099   return lpeg.match(parsers.in_matched(t),s,pos-1)
4100 end
4101
4102 parsers.in_matched_block_tags = parsers.less
4103                               * Cmt(#parsers.openelt_block, parse_matched_tags)
4104
4105 parsers.displayhtml = parsers.htmlcomment / ""
4106                     + parsers.emptyelt_block
4107                     + parsers.openelt_exact("hr")
4108                     + parsers.in_matched_block_tags
4109                     + parsers.htmlinstruction
```

3.1.4.11 Parsers Used for HTML Entities

```
4110 parsers.hexentity = parsers.ampersand * parsers.hash * S("Xx")
4111                   * C(parsers.hexdigit^1) * parsers.semicolon
4112 parsers.decentity = parsers.ampersand * parsers.hash
4113                   * C(parsers.digit^1) * parsers.semicolon
4114 parsers.tagentity = parsers.ampersand * C(parsers.alphanumeric^1)
4115                   * parsers.semicolon
```

3.1.4.12 Helpers for References

```
4116 -- parse a reference definition:  [foo]: /bar "title"
4117 parsers.define_reference_parser = parsers.leader * parsers.tag * parsers.colon
4118                                  * parsers.spacechar^0 * parsers.url
4119                                  * parsers.optionaltitle * parsers.blankline^1
```

3.1.4.13 Inline Elements

```
parsers.Inline         = V("Inline")
parsers.IndentedInline = V("IndentedInline")

-- parse many p between starter and ender
parsers.between = function(p, starter, ender)
  local ender2 = B(parsers.nonspacechar) * ender
  return (starter * #parsers.nonspacechar * Ct(p * (p - ender2)^0) * ender2)
end

parsers.urlchar      = parsers.anyescaped - parsers.newline - parsers.more
```

3.1.4.14 Block Elements

```
parsers.Block        = V("Block")

parsers.OnlineImageURL
                     = parsers.leader
                     * parsers.onlineimageurl
                     * parsers.optionaltitle

parsers.LocalFilePath
                     = parsers.leader
                     * parsers.localfilepath
                     * parsers.optionaltitle

parsers.TildeFencedCode
                     = parsers.fencehead(parsers.tilde)
                     * Cs(parsers.fencedline(parsers.tilde)^0)
                     * parsers.fencetail(parsers.tilde)

parsers.BacktickFencedCode
                     = parsers.fencehead(parsers.backtick)
                     * Cs(parsers.fencedline(parsers.backtick)^0)
                     * parsers.fencetail(parsers.backtick)

parsers.JekyllFencedCode
                     = parsers.fencehead(parsers.dash)
                     * Cs(parsers.fencedline(parsers.dash)^0)
                     * parsers.fencetail(parsers.dash)

parsers.lineof = function(c)
    return (parsers.leader * (P(c) * parsers.optionalspace)^3
            * (parsers.newline * parsers.blankline^1
              + parsers.newline^-1 * parsers.eof))
end
```

3.1.4.15 Lists

```
parsers.defstartchar = S("~:")
parsers.defstart     = ( parsers.defstartchar * #parsers.spacing
                                              * (parsers.tab + parsers.space^-
3)
                       + parsers.space * parsers.defstartchar * #parsers.spacing
                                       * (parsers.tab + parsers.space^-2)
                       + parsers.space * parsers.space * parsers.defstartchar
                                       * #parsers.spacing
                                       * (parsers.tab + parsers.space^-1)
                       + parsers.space * parsers.space * parsers.space
                                       * parsers.defstartchar * #parsers.spacing
                       )

parsers.dlchunk = Cs(parsers.line * (parsers.indentedline - parsers.blankline)^0)
```

3.1.4.16 Headings

```
parsers.heading_attribute = C(parsers.css_identifier)
                          + C((parsers.attribute_name_char
                             - parsers.rbrace)^1
                             * parsers.equal
                             * (parsers.attribute_value_char
                               - parsers.rbrace)^1)
parsers.HeadingAttributes = parsers.lbrace
                          * parsers.heading_attribute
                          * (parsers.spacechar^1
                            * parsers.heading_attribute)^0
                          * parsers.rbrace

-- parse Atx heading start and return level
parsers.HeadingStart = #parsers.hash * C(parsers.hash^-6)
                     * -parsers.hash / length

-- parse setext header ending and return level
parsers.HeadingLevel = parsers.equal^1 * Cc(1) + parsers.dash^1 * Cc(2)

local function strip_atx_end(s)
  return s:gsub("[#%s]*\n$","")
end
```

3.1.5 Markdown Reader

This section documents the `reader` object, which implements the routines for parsing the markdown input. The object corresponds to the markdown reader object that was located in the `lunamark/reader/markdown.lua` file in the Lunamark Lua module.

Although not specified in the Lua interface (see Section 2.1 on page 6), the `reader` object is exported, so that the curious user could easily tinker with the methods of the objects produced by the `reader.new` method described below. The user should be aware, however, that the implementation may change in a future revision.

The `reader.new` method creates and returns a new TEX reader object associated with the Lua interface options (see Section 2.1.2 on page 7) `options` and with a writer object `writer`. When `options` are unspecified, it is assumed that an empty table was passed to the method.

The objects produced by the `reader.new` method expose instance methods and variables of their own. As a convention, I will refer to these ⟨*member*⟩s as `reader->`⟨*member*⟩.

```
4197 M.reader = {}
4198 function M.reader.new(writer, options)
4199   local self = {}
4200   options = options or {}
```

Make the `options` table inherit from the `defaultOptions` table.

```
4201   setmetatable(options, { __index = function (_, key)
4202     return defaultOptions[key] end })
```

3.1.5.1 Top-Level Helper Functions

Define `normalize_tag` as a function that normalizes a markdown reference tag by lowercasing it, and by collapsing any adjacent whitespace characters.

```
4203   local function normalize_tag(tag)
4204     return string.lower(
4205       gsub(util.rope_to_string(tag), "[ \n\r\t]+", " "))
4206   end
```

Define `iterlines` as a function that iterates over the lines of the input string `s`, transforms them using an input function `f`, and reassembles them into a new string, which it returns.

```
4207   local function iterlines(s, f)
4208     rope = lpeg.match(Ct((parsers.line / f)^1), s)
4209     return util.rope_to_string(rope)
4210   end
```

Define `expandtabs` either as an identity function, when the `preserveTabs` Lua interface option is enabled, or to a function that expands tabs into spaces otherwise.

```
4211   local expandtabs
4212   if options.preserveTabs then
4213     expandtabs = function(s) return s end
4214   else
4215     expandtabs = function(s)
4216                    if s:find("\t") then
4217                      return iterlines(s, util.expand_tabs_in_line)
```

```
                  else
                    return s
                  end
                end
end
```

The `larsers` (as in ‘`local \luamref{parsers}'') hash table stores \acro{peg} patterns` tions‘, which impedes their reuse between different `reader` objects.

```
local larsers    = {}
```

3.1.5.2 Top-Level Parser Functions

```
local function create_parser(name, grammar, toplevel)
  return function(str)
```

If the parser is top-level and the `stripIndent` Lua option is enabled, we will first expand tabs in the input string `str` into spaces and then we will count the minimum indent across all lines, skipping blank lines. Next, we will remove the minimum indent from all lines.

```
    if toplevel and options.stripIndent then
        local min_prefix_length, min_prefix = nil, ''
        str = iterlines(str, function(line)
            if lpeg.match(parsers.nonemptyline, line) == nil then
                return line
            end
            line = util.expand_tabs_in_line(line)
            prefix = lpeg.match(C(parsers.optionalspace), line)
            local prefix_length = #prefix
            local is_shorter = min_prefix_length == nil
            is_shorter = is_shorter or prefix_length < min_prefix_length
            if is_shorter then
                min_prefix_length, min_prefix = prefix_length, prefix
            end
            return line
        end)
        str = str:gsub('^' .. min_prefix, '')
    end
```

If the parser is top-level and the `texComments` or `hybrid` Lua options are enabled, we will strip all plain TEX comments from the input string `str` together with the trailing newline characters.

```
    if toplevel and (options.texComments or options.hybrid) then
        str = lpeg.match(Ct(parsers.commented_line^1), str)
        str = util.rope_to_string(str)
    end
    local res = lpeg.match(grammar(), str)
    if res == nil then
      error(format("%s failed on:\n%s", name, str:sub(1,20)))
```

```
4251      else
4252        return res
4253      end
4254    end
4255  end
4256
4257  local parse_blocks
4258    = create_parser("parse_blocks",
4259                    function()
4260                      return larsers.blocks
4261                    end, false)
4262
4263  local parse_blocks_toplevel
4264    = create_parser("parse_blocks_toplevel",
4265                    function()
4266                      return larsers.blocks_toplevel
4267                    end, true)
4268
4269  local parse_inlines
4270    = create_parser("parse_inlines",
4271                    function()
4272                      return larsers.inlines
4273                    end, false)
4274
4275  local parse_inlines_no_link
4276    = create_parser("parse_inlines_no_link",
4277                    function()
4278                      return larsers.inlines_no_link
4279                    end, false)
4280
4281  local parse_inlines_no_inline_note
4282    = create_parser("parse_inlines_no_inline_note",
4283                    function()
4284                      return larsers.inlines_no_inline_note
4285                    end, false)
4286
4287  local parse_inlines_no_html
4288    = create_parser("parse_inlines_no_html",
4289                    function()
4290                      return larsers.inlines_no_html
4291                    end, false)
4292
4293  local parse_inlines_nbsp
4294    = create_parser("parse_inlines_nbsp",
4295                    function()
4296                      return larsers.inlines_nbsp
4297                    end, false)
```

3.1.5.3 Parsers Used for Markdown Lists (local)

```
4298  if options.hashEnumerators then
4299    larsers.dig = parsers.digit + parsers.hash
4300  else
4301    larsers.dig = parsers.digit
4302  end
4303
4304  larsers.enumerator = C(larsers.dig^3 * parsers.period) * #parsers.spacing
4305                     + C(larsers.dig^2 * parsers.period) * #parsers.spacing
4306                                         * (parsers.tab + parsers.space^1)
4307                     + C(larsers.dig * parsers.period) * #parsers.spacing
4308                                        * (parsers.tab + parsers.space^-2)
4309                     + parsers.space * C(larsers.dig^2 * parsers.period)
4310                                        * #parsers.spacing
4311                     + parsers.space * C(larsers.dig * parsers.period)
4312                                        * #parsers.spacing
4313                                        * (parsers.tab + parsers.space^-1)
4314                     + parsers.space * parsers.space * C(larsers.dig^1
4315                                        * parsers.period) * #parsers.spacing
```

3.1.5.4 Parsers Used for Blockquotes (local)

```
4316  -- strip off leading > and indents, and run through blocks
4317  larsers.blockquote_body = ((parsers.leader * parsers.more * parsers.space^-
    1)/""
4318                              * parsers.linechar^0 * parsers.newline)^1
4319                            * (-(parsers.leader * parsers.more
4320                                + parsers.blankline) * parsers.linechar^1
4321                              * parsers.newline)^0
4322
4323  if not options.breakableBlockquotes then
4324    larsers.blockquote_body = larsers.blockquote_body
4325                            * (parsers.blankline^0 / "")
4326  end
```

3.1.5.5 Parsers Used for Citations (local)

```
4327  larsers.citations = function(text_cites, raw_cites)
4328      local function normalize(str)
4329          if str == "" then
4330              str = nil
4331          else
4332              str = (options.citationNbsps and parse_inlines_nbsp or
4333                parse_inlines)(str)
4334          end
4335          return str
4336      end
4337
```

```
4338        local cites = {}
4339        for i = 1,#raw_cites,4 do
4340            cites[#cites+1] = {
4341                prenote = normalize(raw_cites[i]),
4342                suppress_author = raw_cites[i+1] == "-",
4343                name = writer.citation(raw_cites[i+2]),
4344                postnote = normalize(raw_cites[i+3]),
4345            }
4346        end
4347        return writer.citations(text_cites, cites)
4348    end
```

3.1.5.6 Parsers Used for Footnotes (local)

```
4349    local rawnotes = {}
4350
4351    -- like indirect_link
4352    local function lookup_note(ref)
4353      return writer.defer_call(function()
4354        local found = rawnotes[normalize_tag(ref)]
4355        if found then
4356          return writer.note(parse_blocks_toplevel(found))
4357        else
4358          return {"[", parse_inlines("^" .. ref), "]"}
4359        end
4360      end)
4361    end
4362
4363    local function register_note(ref,rawnote)
4364      rawnotes[normalize_tag(ref)] = rawnote
4365      return ""
4366    end
4367
4368    larsers.NoteRef    = parsers.RawNoteRef / lookup_note
4369
4370
4371    larsers.NoteBlock  = parsers.leader * parsers.RawNoteRef * parsers.colon
4372                       * parsers.spnl * parsers.indented_blocks(parsers.chunk)
4373                       / register_note
4374
4375    larsers.InlineNote = parsers.circumflex
4376                       * (parsers.tag / parse_inlines_no_inline_note) -- no notes inside n
4377                       / writer.note
```

3.1.5.7 Parsers Used for Tables (local)

```
4378 larsers.table_row = pipe_table_row(true
4379                                    , (C((parsers.linechar - parsers.pipe)^1)
```

```
                                      / parse_inlines)
                                    , parsers.pipe
                                    , (C((parsers.linechar - parsers.pipe)^0)
                                      / parse_inlines))

if options.tableCaptions then
  larsers.table_caption = #parsers.table_caption_beginning
                        * parsers.table_caption_beginning
                        * Ct(parsers.IndentedInline^1)
                        * parsers.newline
else
  larsers.table_caption = parsers.fail
end

larsers.PipeTable = Ct(larsers.table_row * parsers.newline
                     * parsers.table_hline
                     * (parsers.newline * larsers.table_row)^0)
                   / make_pipe_table_rectangular
                   * larsers.table_caption^-1
                   / writer.table
```

3.1.5.8 Helpers for Links and References (local)

```
  -- List of references defined in the document
  local references

  -- add a reference to the list
  local function register_link(tag,url,title)
      references[normalize_tag(tag)] = { url = url, title = title }
      return ""
  end

  -- lookup link reference and return either
  -- the link or nil and fallback text.
  local function lookup_reference(label,sps,tag)
      local tagpart
      if not tag then
          tag = label
          tagpart = ""
      elseif tag == "" then
          tag = label
          tagpart = "[]"
      else
          tagpart = {"[", parse_inlines(tag), "]"}
      end
      if sps then
        tagpart = {sps, tagpart}
```

```
      end
      local r = references[normalize_tag(tag)]
      if r then
        return r
      else
        return nil, {"[", parse_inlines(label), "]", tagpart}
      end
  end

  -- lookup link reference and return a link, if the reference is found,
  -- or a bracketed label otherwise.
  local function indirect_link(label,sps,tag)
    return writer.defer_call(function()
      local r,fallback = lookup_reference(label,sps,tag)
      if r then
        return writer.link(parse_inlines_no_link(label), r.url, r.title)
      else
        return fallback
      end
    end)
  end

  -- lookup image reference and return an image, if the reference is found,
  -- or a bracketed label otherwise.
  local function indirect_image(label,sps,tag)
    return writer.defer_call(function()
      local r,fallback = lookup_reference(label,sps,tag)
      if r then
        return writer.image(writer.string(label), r.url, r.title)
      else
        return {"!", fallback}
      end
    end)
  end
```

3.1.5.9 Inline Elements (local)

```
  larsers.Str      = (parsers.normalchar * (parsers.normalchar + parsers.at)^0)
                   / writer.string

  larsers.Symbol   = (parsers.specialchar - parsers.tightblocksep)
                   / writer.string

  larsers.Ellipsis = P("...") / writer.ellipsis

  larsers.Smart    = larsers.Ellipsis

```

```
4468  larsers.Code     = parsers.inticks / writer.code
4469
4470  if options.blankBeforeBlockquote then
4471    larsers.bqstart = parsers.fail
4472  else
4473    larsers.bqstart = parsers.more
4474  end
4475
4476  if options.blankBeforeHeading then
4477    larsers.headerstart = parsers.fail
4478  else
4479    larsers.headerstart = parsers.hash
4480                        + (parsers.line * (parsers.equal^1 + parsers.dash^1)
4481                        * parsers.optionalspace * parsers.newline)
4482  end
4483
4484  if not options.fencedCode or options.blankBeforeCodeFence then
4485    larsers.fencestart = parsers.fail
4486  else
4487    larsers.fencestart = parsers.fencehead(parsers.backtick)
4488                       + parsers.fencehead(parsers.tilde)
4489  end
4490
4491  larsers.Endline   = parsers.newline * -( -- newline, but not before...
4492                        parsers.blankline -- paragraph break
4493                      + parsers.tightblocksep  -- nested list
4494                      + parsers.eof       -- end of document
4495                      + larsers.bqstart
4496                      + larsers.headerstart
4497                      + larsers.fencestart
4498                    ) * parsers.spacechar^0 / writer.space
4499
4500  larsers.OptionalIndent
4501                     = parsers.spacechar^1 / writer.space
4502
4503  larsers.Space      = parsers.spacechar^2 * larsers.Endline / writer.linebreak
4504                     + parsers.spacechar^1 * larsers.Endline^-1 * parsers.eof / ""
4505                     + parsers.spacechar^1 * larsers.Endline^-1
4506                                           * parsers.optionalspace / writer.space
4507
4508  larsers.NonbreakingEndline
4509                    = parsers.newline * -( -- newline, but not before...
4510                        parsers.blankline -- paragraph break
4511                      + parsers.tightblocksep  -- nested list
4512                      + parsers.eof       -- end of document
4513                      + larsers.bqstart
4514                      + larsers.headerstart
```

```
                     + larsers.fencestart
                   ) * parsers.spacechar^0 / writer.nbsp

larsers.NonbreakingSpace
                 = parsers.spacechar^2 * larsers.Endline / writer.linebreak
                 + parsers.spacechar^1 * larsers.Endline^-1 * parsers.eof / ""
                 + parsers.spacechar^1 * larsers.Endline^-1
                                       * parsers.optionalspace / writer.nbsp

if options.underscores then
  larsers.Strong = ( parsers.between(parsers.Inline, parsers.doubleasterisks,
                                     parsers.doubleasterisks)
                   + parsers.between(parsers.Inline, parsers.doubleunderscores,
                                     parsers.doubleunderscores)
                   ) / writer.strong

  larsers.Emph   = ( parsers.between(parsers.Inline, parsers.asterisk,
                                     parsers.asterisk)
                   + parsers.between(parsers.Inline, parsers.underscore,
                                     parsers.underscore)
                   ) / writer.emphasis
else
  larsers.Strong = ( parsers.between(parsers.Inline, parsers.doubleasterisks,
                                     parsers.doubleasterisks)
                   ) / writer.strong

  larsers.Emph   = ( parsers.between(parsers.Inline, parsers.asterisk,
                                     parsers.asterisk)
                   ) / writer.emphasis
end

larsers.AutoLinkUrl    = parsers.less
                         * C(parsers.alphanumeric^1 * P("://") * parsers.urlchar^1)
                         * parsers.more
                         / function(url)
                             return writer.link(writer.escape(url), url)
                           end

larsers.AutoLinkEmail = parsers.less
                        * C((parsers.alphanumeric + S("-._+"))^1
                        * P("@") * parsers.urlchar^1)
                        * parsers.more
                        / function(email)
                            return writer.link(writer.escape(email),
                                               "mailto:"..email)
                          end

```

```
4562  larsers.DirectLink    = (parsers.tag / parse_inlines_no_link)  -- no links inside link
4563                        * parsers.spnl
4564                        * parsers.lparent
4565                        * (parsers.url + Cc(""))  -- link can be empty [foo]()
4566                        * parsers.optionaltitle
4567                        * parsers.rparent
4568                        / writer.link
4569
4570  larsers.IndirectLink  = parsers.tag * (C(parsers.spnl) * parsers.tag)^-
    1
4571                        / indirect_link
4572
4573  -- parse a link or image (direct or indirect)
4574  larsers.Link          = larsers.DirectLink + larsers.IndirectLink
4575
4576  larsers.DirectImage   = parsers.exclamation
4577                        * (parsers.tag / parse_inlines)
4578                        * parsers.spnl
4579                        * parsers.lparent
4580                        * (parsers.url + Cc(""))  -- link can be empty [foo]()
4581                        * parsers.optionaltitle
4582                        * parsers.rparent
4583                        / writer.image
4584
4585  larsers.IndirectImage = parsers.exclamation * parsers.tag
4586                        * (C(parsers.spnl) * parsers.tag)^-1 / indirect_image
4587
4588  larsers.Image         = larsers.DirectImage + larsers.IndirectImage
4589
4590  larsers.TextCitations = Ct((parsers.spnl
4591                        * Cc("")
4592                        * parsers.citation_name
4593                        * ((parsers.spnl
4594                            * parsers.lbracket
4595                            * parsers.citation_headless_body
4596                            * parsers.rbracket) + Cc("")))^1)
4597                        / function(raw_cites)
4598                            return larsers.citations(true, raw_cites)
4599                          end
4600
4601  larsers.ParenthesizedCitations
4602                        = Ct((parsers.spnl
4603                        * parsers.lbracket
4604                        * parsers.citation_body
4605                        * parsers.rbracket)^1)
4606                        / function(raw_cites)
4607                            return larsers.citations(false, raw_cites)
```

```
                          end

larsers.Citations     = larsers.TextCitations + larsers.ParenthesizedCitations

-- avoid parsing long strings of * or _ as emph/strong
larsers.UlOrStarLine  = parsers.asterisk^4 + parsers.underscore^4
                      / writer.string

larsers.EscapedChar   = parsers.backslash * C(parsers.escapable) / writer.string

larsers.InlineHtml    = parsers.emptyelt_any
                      + (parsers.htmlcomment / parse_inlines_no_html)
                      / writer.inline_html_comment
                      + parsers.htmlinstruction
                      + parsers.openelt_any
                      + parsers.closeelt_any

larsers.HtmlEntity    = parsers.hexentity / entities.hex_entity  / writer.string
                      + parsers.decentity / entities.dec_entity  / writer.string
                      + parsers.tagentity / entities.char_entity / writer.string
```

3.1.5.10 Block Elements (local)

```
larsers.ContentBlock = parsers.leader
                     * (parsers.localfilepath + parsers.onlineimageurl)
                     * parsers.contentblock_tail
                     / writer.contentblock

larsers.DisplayHtml  = parsers.displayhtml

larsers.Verbatim     = Cs( (parsers.blanklines
                         * ((parsers.indentedline - parsers.blankline))^1)^1
                         ) / expandtabs / writer.verbatim

larsers.FencedCode   = (parsers.TildeFencedCode
                       + parsers.BacktickFencedCode)
                     / function(infostring, code)
                         return writer.fencedCode(writer.string(infostring),
                                                  expandtabs(code))
                       end

larsers.JekyllData   = P("---")
                     * parsers.blankline / 0
                     * #(-parsers.blankline)  -- if followed by blank, it's an hrule
                     * C((parsers.line - P("---") - P("..."))^0)
                     * (P("---") + P("..."))
                     / function(text)
```

```
                            local tinyyaml = require("markdown-tinyyaml")
                            data = tinyyaml.parse(text)
                            return writer.jekyllData(data, function(s)
                              return parse_blocks(s)
                            end, nil)
                          end

  larsers.Blockquote    = Cs(larsers.blockquote_body^1)
                        / parse_blocks_toplevel / writer.blockquote

  larsers.HorizontalRule = ( parsers.lineof(parsers.asterisk)
                           + parsers.lineof(parsers.dash)
                           + parsers.lineof(parsers.underscore)
                           ) / writer.hrule

  larsers.Reference     = parsers.define_reference_parser / register_link

  larsers.Paragraph     = parsers.nonindentspace * Ct(parsers.Inline^1)
                        * parsers.newline
                        * ( parsers.blankline^1
                          + #parsers.hash
                          + #(parsers.leader * parsers.more * parsers.space^-
1)
                          )
                        / writer.paragraph

  larsers.ToplevelParagraph
                        = parsers.nonindentspace * Ct(parsers.Inline^1)
                        * ( parsers.newline
                        * ( parsers.blankline^1
                          + #parsers.hash
                          + #(parsers.leader * parsers.more * parsers.space^-
1)
                          + parsers.eof
                          )
                        + parsers.eof )
                        / writer.paragraph

  larsers.Plain         = parsers.nonindentspace * Ct(parsers.Inline^1)
                        / writer.plain
```

3.1.5.11 Lists (local)

```
  larsers.starter = parsers.bullet + larsers.enumerator

  if options.taskLists then
    larsers.tickbox = ( parsers.ticked_box
```

```
                      + parsers.halfticked_box
                      + parsers.unticked_box
                      ) / writer.tickbox
  else
     larsers.tickbox = parsers.fail
  end

  -- we use \001 as a separator between a tight list item and a
  -- nested list under it.
  larsers.NestedList            = Cs((parsers.optionallyindentedline
                                     - larsers.starter)^1)
                                / function(a) return "\001"..a end

  larsers.ListBlockLine         = parsers.optionallyindentedline
                                - parsers.blankline - (parsers.indent^-1
                                                     * larsers.starter)

  larsers.ListBlock             = parsers.line * larsers.ListBlockLine^0

  larsers.ListContinuationBlock = parsers.blanklines * (parsers.indent / "")
                                * larsers.ListBlock

  larsers.TightListItem = function(starter)
      return -larsers.HorizontalRule
             * (Cs(starter / "" * larsers.tickbox^-1 * larsers.ListBlock * larsers.Neste
1)
               / parse_blocks)
             * -(parsers.blanklines * parsers.indent)
  end

  larsers.LooseListItem = function(starter)
      return -larsers.HorizontalRule
             * Cs( starter / "" * larsers.tickbox^-1 * larsers.ListBlock * Cc("\n")
               * (larsers.NestedList + larsers.ListContinuationBlock^0)
               * (parsers.blanklines / "\n\n")
               ) / parse_blocks
  end

  larsers.BulletList = ( Ct(larsers.TightListItem(parsers.bullet)^1) * Cc(true)
                       * parsers.skipblanklines * -parsers.bullet
                       + Ct(larsers.LooseListItem(parsers.bullet)^1) * Cc(false)
                       * parsers.skipblanklines )
                     / writer.bulletlist

  local function ordered_list(items,tight,startNumber)
    if options.startNumber then
      startNumber = tonumber(startNumber) or 1  -- fallback for '#'
```

```
4740      if startNumber ~= nil then
4741        startNumber = math.floor(startNumber)
4742      end
4743    else
4744      startNumber = nil
4745    end
4746    return writer.orderedlist(items,tight,startNumber)
4747  end
4748
4749  larsers.OrderedList = Cg(larsers.enumerator, "listtype") *
4750                        ( Ct(larsers.TightListItem(Cb("listtype"))
4751                            * larsers.TightListItem(larsers.enumerator)^0)
4752                        * Cc(true) * parsers.skipblanklines * -larsers.enumerator
4753                        + Ct(larsers.LooseListItem(Cb("listtype"))
4754                            * larsers.LooseListItem(larsers.enumerator)^0)
4755                        * Cc(false) * parsers.skipblanklines
4756                        ) * Cb("listtype") / ordered_list
4757
4758  local function definition_list_item(term, defs, tight)
4759    return { term = parse_inlines(term), definitions = defs }
4760  end
4761
4762  larsers.DefinitionListItemLoose = C(parsers.line) * parsers.skipblanklines
4763                                  * Ct((parsers.defstart
4764                                       * parsers.indented_blocks(parsers.dlchunk)
4765                                       / parse_blocks_toplevel)^1)
4766                                  * Cc(false) / definition_list_item
4767
4768  larsers.DefinitionListItemTight = C(parsers.line)
4769                                  * Ct((parsers.defstart * parsers.dlchunk
4770                                       / parse_blocks)^1)
4771                                  * Cc(true) / definition_list_item
4772
4773  larsers.DefinitionList = ( Ct(larsers.DefinitionListItemLoose^1) * Cc(false)
4774                           + Ct(larsers.DefinitionListItemTight^1)
4775                           * (parsers.skipblanklines
4776                             * -larsers.DefinitionListItemLoose * Cc(true))
4777                           ) / writer.definitionlist
```

3.1.5.12 Blank (local)

```
4778  larsers.Blank        = parsers.blankline / ""
4779                       + larsers.NoteBlock
4780                       + larsers.Reference
4781                       + (parsers.tightblocksep / "\n")
```

3.1.5.13 Headings (local)

```
4782  -- parse atx header
4783  if options.headerAttributes then
4784    larsers.AtxHeading = Cg(parsers.HeadingStart,"level")
4785                         * parsers.optionalspace
4786                         * (C(((parsers.linechar
4787                               - ((parsers.hash^1
4788                                  * parsers.optionalspace
4789                                  * parsers.HeadingAttributes^-1
4790                                  + parsers.HeadingAttributes)
4791                                 * parsers.optionalspace
4792                                 * parsers.newline))
4793                              * (parsers.linechar
4794                                - parsers.hash
4795                                - parsers.lbrace)^0)^1)
4796                             / parse_inlines)
4797                         * Cg(Ct(parsers.newline
4798                                 + (parsers.hash^1
4799                                   * parsers.optionalspace
4800                                   * parsers.HeadingAttributes^-1
4801                                   + parsers.HeadingAttributes)
4802                                 * parsers.optionalspace
4803                                 * parsers.newline), "attributes")
4804                         * Cb("level")
4805                         * Cb("attributes")
4806                         / writer.heading
4807
4808    larsers.SetextHeading = #(parsers.line * S("=-"))
4809                            * (C(((parsers.linechar
4810                                   - (parsers.HeadingAttributes
4811                                     * parsers.optionalspace
4812                                     * parsers.newline))
4813                                  * (parsers.linechar
4814                                    - parsers.lbrace)^0)^1)
4815                               / parse_inlines)
4816                            * Cg(Ct(parsers.newline
4817                                    + (parsers.HeadingAttributes
4818                                      * parsers.optionalspace
4819                                      * parsers.newline)), "attributes")
4820                            * parsers.HeadingLevel
4821                            * Cb("attributes")
4822                            * parsers.optionalspace
4823                            * parsers.newline
4824                            / writer.heading
4825  else
4826    larsers.AtxHeading = Cg(parsers.HeadingStart,"level")
4827                         * parsers.optionalspace
4828                         * (C(parsers.line) / strip_atx_end / parse_inlines)
```

```
                        * Cb("level")
                        / writer.heading

  larsers.SetextHeading = #(parsers.line * S("=-"))
                          * Ct(parsers.linechar^1 / parse_inlines)
                          * parsers.newline
                          * parsers.HeadingLevel
                          * parsers.optionalspace
                          * parsers.newline
                          / writer.heading
end

larsers.Heading = larsers.AtxHeading + larsers.SetextHeading
```

3.1.5.14 Syntax Specification

```
local syntax =
  { "Blocks",

    Blocks                = larsers.Blank^0 * parsers.Block^-1
                          * (larsers.Blank^0 / writer.interblocksep
                            * parsers.Block)^0
                          * larsers.Blank^0 * parsers.eof,

    Blank                 = larsers.Blank,

    JekyllData            = larsers.JekyllData,

    Block                 = V("ContentBlock")
                          + V("JekyllData")
                          + V("Blockquote")
                          + V("PipeTable")
                          + V("Verbatim")
                          + V("FencedCode")
                          + V("HorizontalRule")
                          + V("BulletList")
                          + V("OrderedList")
                          + V("Heading")
                          + V("DefinitionList")
                          + V("DisplayHtml")
                          + V("Paragraph")
                          + V("Plain"),

    ContentBlock          = larsers.ContentBlock,
    Blockquote            = larsers.Blockquote,
    Verbatim              = larsers.Verbatim,
    FencedCode            = larsers.FencedCode,
```

```
4873        HorizontalRule        = larsers.HorizontalRule,
4874        BulletList            = larsers.BulletList,
4875        OrderedList           = larsers.OrderedList,
4876        Heading               = larsers.Heading,
4877        DefinitionList        = larsers.DefinitionList,
4878        DisplayHtml           = larsers.DisplayHtml,
4879        Paragraph             = larsers.Paragraph,
4880        PipeTable             = larsers.PipeTable,
4881        Plain                 = larsers.Plain,
4882
4883        Inline                = V("Str")
4884                              + V("Space")
4885                              + V("Endline")
4886                              + V("UlOrStarLine")
4887                              + V("Strong")
4888                              + V("Emph")
4889                              + V("InlineNote")
4890                              + V("NoteRef")
4891                              + V("Citations")
4892                              + V("Link")
4893                              + V("Image")
4894                              + V("Code")
4895                              + V("AutoLinkUrl")
4896                              + V("AutoLinkEmail")
4897                              + V("InlineHtml")
4898                              + V("HtmlEntity")
4899                              + V("EscapedChar")
4900                              + V("Smart")
4901                              + V("Symbol"),
4902
4903        IndentedInline        = V("Str")
4904                              + V("OptionalIndent")
4905                              + V("Endline")
4906                              + V("UlOrStarLine")
4907                              + V("Strong")
4908                              + V("Emph")
4909                              + V("InlineNote")
4910                              + V("NoteRef")
4911                              + V("Citations")
4912                              + V("Link")
4913                              + V("Image")
4914                              + V("Code")
4915                              + V("AutoLinkUrl")
4916                              + V("AutoLinkEmail")
4917                              + V("InlineHtml")
4918                              + V("HtmlEntity")
4919                              + V("EscapedChar")
```

```
                            + V("Smart")
                            + V("Symbol"),

    Str                     = larsers.Str,
    Space                   = larsers.Space,
    OptionalIndent          = larsers.OptionalIndent,
    Endline                 = larsers.Endline,
    UlOrStarLine            = larsers.UlOrStarLine,
    Strong                  = larsers.Strong,
    Emph                    = larsers.Emph,
    InlineNote              = larsers.InlineNote,
    NoteRef                 = larsers.NoteRef,
    Citations               = larsers.Citations,
    Link                    = larsers.Link,
    Image                   = larsers.Image,
    Code                    = larsers.Code,
    AutoLinkUrl             = larsers.AutoLinkUrl,
    AutoLinkEmail           = larsers.AutoLinkEmail,
    InlineHtml              = larsers.InlineHtml,
    HtmlEntity              = larsers.HtmlEntity,
    EscapedChar             = larsers.EscapedChar,
    Smart                   = larsers.Smart,
    Symbol                  = larsers.Symbol,
  }

if not options.citations then
  syntax.Citations = parsers.fail
end

if not options.contentBlocks then
  syntax.ContentBlock = parsers.fail
end

if not options.codeSpans then
  syntax.Code = parsers.fail
end

if not options.definitionLists then
  syntax.DefinitionList = parsers.fail
end

if not options.fencedCode then
  syntax.FencedCode = parsers.fail
end

if not options.footnotes then
  syntax.NoteRef = parsers.fail
```

```
4967  end
4968
4969  if not options.html then
4970    syntax.DisplayHtml = parsers.fail
4971    syntax.InlineHtml = parsers.fail
4972    syntax.HtmlEntity  = parsers.fail
4973  end
4974
4975  if not options.inlineFootnotes then
4976    syntax.InlineNote = parsers.fail
4977  end
4978
4979  if not options.jekyllData then
4980    syntax.JekyllData = parsers.fail
4981  end
4982
4983  if options.preserveTabs then
4984    options.stripIndent = false
4985  end
4986
4987  if not options.pipeTables then
4988    syntax.PipeTable = parsers.fail
4989  end
4990
4991  if not options.smartEllipses then
4992    syntax.Smart = parsers.fail
4993  end
4994
4995  local blocks_toplevel_t = util.table_copy(syntax)
4996  blocks_toplevel_t.Paragraph = larsers.ToplevelParagraph
4997  larsers.blocks_toplevel = Ct(blocks_toplevel_t)
4998
4999  larsers.blocks = Ct(syntax)
5000
5001  local inlines_t = util.table_copy(syntax)
5002  inlines_t[1] = "Inlines"
5003  inlines_t.Inlines = parsers.Inline^0 * (parsers.spacing^0 * parsers.eof / "")
5004  larsers.inlines = Ct(inlines_t)
5005
5006  local inlines_no_link_t = util.table_copy(inlines_t)
5007  inlines_no_link_t.Link = parsers.fail
5008  larsers.inlines_no_link = Ct(inlines_no_link_t)
5009
5010  local inlines_no_inline_note_t = util.table_copy(inlines_t)
5011  inlines_no_inline_note_t.InlineNote = parsers.fail
5012  larsers.inlines_no_inline_note = Ct(inlines_no_inline_note_t)
5013
```

```
local inlines_no_html_t = util.table_copy(inlines_t)
inlines_no_html_t.DisplayHtml = parsers.fail
inlines_no_html_t.InlineHtml = parsers.fail
inlines_no_html_t.HtmlEntity = parsers.fail
larsers.inlines_no_html = Ct(inlines_no_html_t)

local inlines_nbsp_t = util.table_copy(inlines_t)
inlines_nbsp_t.Endline = larsers.NonbreakingEndline
inlines_nbsp_t.Space = larsers.NonbreakingSpace
larsers.inlines_nbsp = Ct(inlines_nbsp_t)
```

3.1.5.15 Exported Conversion Function

Define `reader->convert` as a function that converts markdown string `input` into a plain TEX output and returns it. Note that the converter assumes that the input has UNIX line endings.

```
function self.convert(input)
  references = {}
```

When determining the name of the cache file, create salt for the hashing function out of the package version and the passed options recognized by the Lua interface (see Section 2.1.2 on page 7). The `cacheDir` option is disregarded.

```
  local opt_string = {}
  for k,_ in pairs(defaultOptions) do
    local v = options[k]
    if k ~= "cacheDir" then
      opt_string[#opt_string+1] = k .. "=" .. tostring(v)
    end
  end
  table.sort(opt_string)
  local salt = table.concat(opt_string, ",") .. "," .. metadata.version
```

Produce the cache file and transform its filename to plain TEX output via the `writer->pack` method.

```
  local name = util.cache(options.cacheDir, input, salt, function(input)
      return util.rope_to_string(parse_blocks_toplevel(input)) .. writer.eof
    end, ".md" .. writer.suffix)
  local output = writer.pack(name)
```

If the `frozenCache` option is enabled, populate the frozen cache in the file `frozenCacheFileName` with an entry for markdown document number `frozenCacheCounter`.

```
  if options.finalizeCache then
    local file, mode
    if options.frozenCacheCounter > 0 then
      mode = "a"
    else
      mode = "w"
    end
```

```
      file = assert(io.open(options.frozenCacheFileName, mode),
        [[could not open file "]] .. options.frozenCacheFileName
        .. [[" for writing]])
      assert(file:write([[\expandafter\global\expandafter\def\csname ]]
        .. [[markdownFrozenCache]] .. options.frozenCacheCounter
        .. [[\endcsname{]] .. output .. [[}]] .. "\n"))
      assert(file:close())
    end
    return output
  end
  return self
end
```

3.1.6 Conversion from Markdown to Plain TEX

The `new` method returns the `reader->convert` function of a reader object associated with the Lua interface options (see Section 2.1.2 on page 7) `options` and with a writer object associated with `options`.

```
function M.new(options)
  local writer = M.writer.new(options)
  local reader = M.reader.new(writer, options)
  return reader.convert
end

return M
```

3.1.7 Command-Line Implementation

The command-line implementation provides the actual conversion routine for the command-line interface described in Section 2.1.5 on page 19.

```

local input
if input_filename then
  local input_file = assert(io.open(input_filename, "r"),
    [[could not open file "]] .. input_filename .. [[" for reading]])
  input = assert(input_file:read("*a"))
  assert(input_file:close())
else
  input = assert(io.read("*a"))
end

```

First, ensure that the `options.cacheDir` directory exists.

```
local lfs = require("lfs")
if options.cacheDir and not lfs.isdir(options.cacheDir) then
  assert(lfs.mkdir(options["cacheDir"]))
```

```
5079 end
5080
5081 local ran_ok, kpse = pcall(require, "kpse")
5082 if ran_ok then kpse.set_program_name("luatex") end
5083 local md = require("markdown")
```

Since we are loading the rest of the Lua implementation dynamically, check that both the `markdown` module and the command line implementation are the same version.

```
5084 if metadata.version ~= md.metadata.version then
5085   warn("markdown-cli.lua " .. metadata.version .. " used with " ..
5086        "markdown.lua " .. md.metadata.version .. ".")
5087 end
5088 local convert = md.new(options)
```

Since the Lua converter expects UNIX line endings, normalize the input. Also add a line ending at the end of the file in case the input file has none.

```
5089 local output = convert(input:gsub("\r\n?", "\n") .. "\n")
5090
5091 if output_filename then
5092   local output_file = assert(io.open(output_filename, "w"),
5093     [[could not open file "]] .. output_filename .. [[" for writing]])
5094   assert(output_file:write(output))
5095   assert(output_file:close())
5096 else
5097   assert(io.write(output))
5098 end
```

3.2 Plain TEX Implementation

The plain TEX implementation provides macros for the interfacing between TEX and Lua and for the buffering of input text. These macros are then used to implement the macros for the conversion from markdown to plain TEX exposed by the plain TEX interface (see Section 2.2 on page 22).

3.2.1 Logging Facilities

```
5099 \ifx\markdownInfo\undefined
5100   \def\markdownInfo#1{%
5101     \immediate\write-1{(l.\the\inputlineno) markdown.tex info: #1.}}%
5102 \fi
5103 \ifx\markdownWarning\undefined
5104   \def\markdownWarning#1{%
5105     \immediate\write16{(l.\the\inputlineno) markdown.tex warning: #1}}%
5106 \fi
5107 \ifx\markdownError\undefined
5108   \def\markdownError#1#2{%
5109     \errhelp{#2.}%
```

```
    \errmessage{(l.\the\inputlineno) markdown.tex error: #1}}%
\fi
```

3.2.2 Finalizing and Freezing the Cache

When the `\markdownOptionFinalizeCache` option is enabled, then the `\markdownFrozenCacheCounter` counter is used to enumerate the markdown documents using the Lua interface `frozenCacheCounter` option.

When the `\markdownOptionFrozenCache` option is enabled, then the `\markdownFrozenCacheCounter` counter is used to render markdown documents from the frozen cache without invoking Lua.

```
\newcount\markdownFrozenCacheCounter
```

3.2.3 Token Renderer Prototypes

The following definitions should be considered placeholder.

```
\def\markdownRendererInterblockSeparatorPrototype{\par}%
\def\markdownRendererLineBreakPrototype{\hfil\break}%
\let\markdownRendererEllipsisPrototype\dots
\def\markdownRendererNbspPrototype{~}%
\def\markdownRendererLeftBracePrototype{\char`\{}%
\def\markdownRendererRightBracePrototype{\char`\}}%
\def\markdownRendererDollarSignPrototype{\char`$}%
\def\markdownRendererPercentSignPrototype{\char`\%}%
\def\markdownRendererAmpersandPrototype{\&}%
\def\markdownRendererUnderscorePrototype{\char`_}%
\def\markdownRendererHashPrototype{\char`\#}%
\def\markdownRendererCircumflexPrototype{\char`^}%
\def\markdownRendererBackslashPrototype{\char`\\}%
\def\markdownRendererTildePrototype{\char`~}%
\def\markdownRendererPipePrototype{|}%
\def\markdownRendererCodeSpanPrototype#1{{\tt#1}}%
\def\markdownRendererLinkPrototype#1#2#3#4{#2}%
\def\markdownRendererContentBlockPrototype#1#2#3#4{%
  \markdownInput{#3}}%
\def\markdownRendererContentBlockOnlineImagePrototype{%
  \markdownRendererImage}%
\def\markdownRendererContentBlockCodePrototype#1#2#3#4#5{%
  \markdownRendererInputFencedCode{#3}{#2}}%
\def\markdownRendererImagePrototype#1#2#3#4{#2}%
\def\markdownRendererUlBeginPrototype{}%
\def\markdownRendererUlBeginTightPrototype{}%
\def\markdownRendererUlItemPrototype{}%
\def\markdownRendererUlItemEndPrototype{}%
\def\markdownRendererUlEndPrototype{}%
\def\markdownRendererUlEndTightPrototype{}%
\def\markdownRendererOlBeginPrototype{}%
```

```
\def\markdownRendererOlBeginTightPrototype{}%
\def\markdownRendererOlItemPrototype{}%
\def\markdownRendererOlItemWithNumberPrototype#1{}%
\def\markdownRendererOlItemEndPrototype{}%
\def\markdownRendererOlEndPrototype{}%
\def\markdownRendererOlEndTightPrototype{}%
\def\markdownRendererDlBeginPrototype{}%
\def\markdownRendererDlBeginTightPrototype{}%
\def\markdownRendererDlItemPrototype#1{#1}%
\def\markdownRendererDlItemEndPrototype{}%
\def\markdownRendererDlDefinitionBeginPrototype{}%
\def\markdownRendererDlDefinitionEndPrototype{\par}%
\def\markdownRendererDlEndPrototype{}%
\def\markdownRendererDlEndTightPrototype{}%
\def\markdownRendererEmphasisPrototype#1{{\it#1}}%
\def\markdownRendererStrongEmphasisPrototype#1{{\bf#1}}%
\def\markdownRendererBlockQuoteBeginPrototype{\par\begingroup\it}%
\def\markdownRendererBlockQuoteEndPrototype{\endgroup\par}%
\def\markdownRendererInputVerbatimPrototype#1{%
  \par{\tt\input#1\relax{}}\par}%
\def\markdownRendererInputFencedCodePrototype#1#2{%
  \markdownRendererInputVerbatimPrototype{#1}}%
\def\markdownRendererHeadingOnePrototype#1{#1}%
\def\markdownRendererHeadingTwoPrototype#1{#1}%
\def\markdownRendererHeadingThreePrototype#1{#1}%
\def\markdownRendererHeadingFourPrototype#1{#1}%
\def\markdownRendererHeadingFivePrototype#1{#1}%
\def\markdownRendererHeadingSixPrototype#1{#1}%
\def\markdownRendererHorizontalRulePrototype{}%
\def\markdownRendererFootnotePrototype#1{#1}%
\def\markdownRendererCitePrototype#1{}%
\def\markdownRendererTextCitePrototype#1{}%
\def\markdownRendererTickedBoxPrototype{[X]}%
\def\markdownRendererHalfTickedBoxPrototype{[/]}%
\def\markdownRendererUntickedBoxPrototype{[ ]}%
```

3.2.4 Lua Snippets

The `\markdownLuaOptions` macro expands to a Lua table that contains the plain TEX options (see Section 2.2.2 on page 24) in a format recognized by Lua (see Section 2.1.2 on page 7).

```
\def\markdownLuaOptions{{%
\ifx\markdownOptionBlankBeforeBlockquote\undefined\else
  blankBeforeBlockquote = \markdownOptionBlankBeforeBlockquote,
\fi
\ifx\markdownOptionBlankBeforeCodeFence\undefined\else
```

```
  blankBeforeCodeFence = \markdownOptionBlankBeforeCodeFence,
\fi
\ifx\markdownOptionBlankBeforeHeading\undefined\else
  blankBeforeHeading = \markdownOptionBlankBeforeHeading,
\fi
\ifx\markdownOptionBreakableBlockquotes\undefined\else
  breakableBlockquotes = \markdownOptionBreakableBlockquotes,
\fi
  cacheDir = "\markdownOptionCacheDir",
\ifx\markdownOptionCitations\undefined\else
  citations = \markdownOptionCitations,
\fi
\ifx\markdownOptionCitationNbsps\undefined\else
  citationNbsps = \markdownOptionCitationNbsps,
\fi
\ifx\markdownOptionCodeSpans\undefined\else
  codeSpans = \markdownOptionCodeSpans,
\fi
\ifx\markdownOptionContentBlocks\undefined\else
  contentBlocks = \markdownOptionContentBlocks,
\fi
\ifx\markdownOptionContentBlocksLanguageMap\undefined\else
  contentBlocksLanguageMap =
    "\markdownOptionContentBlocksLanguageMap",
\fi
\ifx\markdownOptionDefinitionLists\undefined\else
  definitionLists = \markdownOptionDefinitionLists,
\fi
\ifx\markdownOptionFinalizeCache\undefined\else
  finalizeCache = \markdownOptionFinalizeCache,
\fi
  frozenCacheFileName = "\markdownOptionFrozenCacheFileName",
  frozenCacheCounter = \the\markdownFrozenCacheCounter,
\ifx\markdownOptionFootnotes\undefined\else
  footnotes = \markdownOptionFootnotes,
\fi
\ifx\markdownOptionFencedCode\undefined\else
  fencedCode = \markdownOptionFencedCode,
\fi
\ifx\markdownOptionHashEnumerators\undefined\else
  hashEnumerators = \markdownOptionHashEnumerators,
\fi
\ifx\markdownOptionHeaderAttributes\undefined\else
  headerAttributes = \markdownOptionHeaderAttributes,
\fi
\ifx\markdownOptionHtml\undefined\else
  html = \markdownOptionHtml,
```

```
\fi
\ifx\markdownOptionHybrid\undefined\else
  hybrid = \markdownOptionHybrid,
\fi
\ifx\markdownOptionInlineFootnotes\undefined\else
  inlineFootnotes = \markdownOptionInlineFootnotes,
\fi
\ifx\markdownOptionJekyllData\undefined\else
  jekyllData = \markdownOptionJekyllData,
\fi
\ifx\markdownOptionPipeTables\undefined\else
  pipeTables = \markdownOptionPipeTables,
\fi
\ifx\markdownOptionPreserveTabs\undefined\else
  preserveTabs = \markdownOptionPreserveTabs,
\fi
\ifx\markdownOptionShiftHeadings\undefined\else
  shiftHeadings = "\markdownOptionShiftHeadings",
\fi
\ifx\markdownOptionSlice\undefined\else
  slice = "\markdownOptionSlice",
\fi
\ifx\markdownOptionSmartEllipses\undefined\else
  smartEllipses = \markdownOptionSmartEllipses,
\fi
\ifx\markdownOptionStartNumber\undefined\else
  startNumber = \markdownOptionStartNumber,
\fi
\ifx\markdownOptionStripIndent\undefined\else
  stripIndent = \markdownOptionStripIndent,
\fi
\ifx\markdownOptionTableCaptions\undefined\else
  tableCaptions = \markdownOptionTableCaptions,
\fi
\ifx\markdownOptionTaskLists\undefined\else
  taskLists = \markdownOptionTaskLists,
\fi
\ifx\markdownOptionTeXComments\undefined\else
  texComments = \markdownOptionTeXComments,
\fi
\ifx\markdownOptionTightLists\undefined\else
  tightLists = \markdownOptionTightLists,
\fi
\ifx\markdownOptionUnderscores\undefined\else
  underscores = \markdownOptionUnderscores,
\fi}
}%
```

The `\markdownPrepare` macro contains the Lua code that is executed prior to any conversion from markdown to plain TeX. It exposes the `convert` function for the use by any further Lua code.

```
\def\markdownPrepare{%
```

First, ensure that the `\markdownOptionCacheDir` directory exists.

```
  local lfs = require("lfs")
  local cacheDir = "\markdownOptionCacheDir"
  if not lfs.isdir(cacheDir) then
    assert(lfs.mkdir(cacheDir))
  end
```

Next, load the `markdown` module and create a converter function using the plain TeX options, which were serialized to a Lua table via the `\markdownLuaOptions` macro.

```
  local md = require("markdown")
  local convert = md.new(\markdownLuaOptions)
}%
```

3.2.5 Buffering Markdown Input

The `\markdownIfOption{`⟨*name*⟩`}{`⟨*iftrue*⟩`}{`⟨*iffalse*⟩`}` macro is provided for testing, whether the value of `\markdownOption`⟨*name*⟩ is `true`. If the value is `true`, then ⟨*iftrue*⟩ is expanded, otherwise ⟨*iffalse*⟩ is expanded.

```
\def\markdownIfOption#1#2#3{%
  \begingroup
  \def\next{true}%
  \expandafter\ifx\csname markdownOption#1\endcsname\next
    \endgroup#2\else\endgroup#3\fi}%
```

The macros `\markdownInputFileStream` and `\markdownOutputFileStream` contain the number of the input and output file streams that will be used for the IO operations of the package.

```
\csname newread\endcsname\markdownInputFileStream
\csname newwrite\endcsname\markdownOutputFileStream
```

The `\markdownReadAndConvertTab` macro contains the tab character literal.

```
\begingroup
  \catcode`\^^I=12%
  \gdef\markdownReadAndConvertTab{^^I}%
\endgroup
```

The `\markdownReadAndConvert` macro is largely a rewrite of the LaTeX 2ε `\filecontents` macro to plain TeX.

```
\begingroup
```

Make the newline and tab characters active and swap the character codes of the backslash symbol (`\`) and the pipe symbol (`|`), so that we can use the backslash as an ordinary character inside the macro definition. Likewise, swap the character codes

of the percent sign (‘so that we can remove percent signs from the beginning of lines when \markdownOptionStripPercentSigns is enabled.

```
\catcode`\^^M=13%
\catcode`\^^I=13%
\catcode`|=0%
\catcode`\\=12%
|catcode`@=14%
|catcode`|%=12@
|gdef|markdownReadAndConvert#1#2{@
  |begingroup@
```

If we are not reading markdown documents from the frozen cache, open the \markdownOptionInputTempFileName file for writing.

```
  |markdownIfOption{FrozenCache}{}{@
    |immediate|openout|markdownOutputFileStream@
      |markdownOptionInputTempFileName|relax@
    |markdownInfo{Buffering markdown input into the temporary @
      input file "|markdownOptionInputTempFileName" and scanning @
      for the closing token sequence "#1"}@
  }@
```

Locally change the category of the special plain TEX characters to *other* in order to prevent unwanted interpretation of the input. Change also the category of the space character, so that we can retrieve it unaltered.

```
  |def|do##1{|catcode`##1=12}|dospecials@
  |catcode`| =12@
  |markdownMakeOther@
```

The \markdownReadAndConvertStripPercentSigns macro will process the individual lines of output, stipping away leading percent signs (\mref{markdownOptionStripPercentSigns

```
  |def|markdownReadAndConvertStripPercentSign##1{@
    |markdownIfOption{StripPercentSigns}{@
      |if##1%@
        |expandafter|expandafter|expandafter@
          |markdownReadAndConvertProcessLine@
      |else@
        |expandafter|expandafter|expandafter@
          |markdownReadAndConvertProcessLine@
          |expandafter|expandafter|expandafter##1@
      |fi@
    }{@
      |expandafter@
        |markdownReadAndConvertProcessLine@
        |expandafter##1@
    }@
  }@
```

The \markdownReadAndConvertProcessLine macro will process the individual lines of output. Notice the use of the comments (@) to ensure that the entire macro is at a single line and therefore no (active) newline symbols (^^M) are produced.

```
5333      |def|markdownReadAndConvertProcessLine##1#1##2#1##3|relax{@
```

If we are not reading markdown documents from the frozen cache and the ending token sequence does not appear in the line, store the line in the \markdownOptionInputTempFileName file. If we are reading markdown documents from the frozen cache and the ending token sequence does not appear in the line, gobble the line.

```
5334        |ifx|relax##3|relax@
5335          |markdownIfOption{FrozenCache}{}{@
5336            |immediate|write|markdownOutputFileStream{##1}@
5337          }@
5338        |else@
```

When the ending token sequence appears in the line, make the next newline character close the \markdownOptionInputTempFileName file, return the character categories back to the former state, convert the \markdownOptionInputTempFileName file from markdown to plain TEX, \input the result of the conversion, and expand the ending control sequence.

```
5339          |def^^M{@
5340            |markdownInfo{The ending token sequence was found}@
5341            |markdownIfOption{FrozenCache}{}{@
5342              |immediate|closeout|markdownOutputFileStream@
5343            }@
5344            |endgroup@
5345            |markdownInput{@
5346              |markdownOptionOutputDir@
5347              /|markdownOptionInputTempFileName@
5348            }@
5349            #2}@
5350        |fi@
```

Repeat with the next line.

```
5351        ^^M}@
```

Make the tab character active at expansion time and make it expand to a literal tab character.

```
5352      |catcode`|^^I=13@
5353      |def^^I{|markdownReadAndConvertTab}@
```

Make the newline character active at expansion time and make it consume the rest of the line on expansion. Throw away the rest of the first line and pass the second line to the \markdownReadAndConvertProcessLine macro.

```
5354      |catcode`|^^M=13@
5355      |def^^M##1^^M{@
```

```
      |def^^M####1^^M{@
        |markdownReadAndConvertStripPercentSign####1#1#1|relax}@
      ^^M}@
    ^^M}@
```

Reset the character categories back to the former state.

```
|endgroup
```

3.2.6 Lua Shell Escape Bridge

The following TEX code is intended for TEX engines that do not provide direct access to Lua, but expose the shell of the operating system. This corresponds to the `\markdownMode` values of `0` and `1`.

The `\markdownLuaExecute` macro defined here and in Section 3.2.7 on page 169 are meant to be indistinguishable to the remaining code.

The package assumes that although the user is not using the LuaTEX engine, their TEX distribution contains it, and uses shell access to produce and execute Lua scripts using the TEXLua interpreter [1, Section 3.1.1].

```
\ifnum\markdownMode<2\relax
\ifnum\markdownMode=0\relax
  \markdownInfo{Using mode 0: Shell escape via write18}%
\else
  \markdownInfo{Using mode 1: Shell escape via os.execute}%
\fi
```

The `\markdownExecuteShellEscape` macro contains the numeric value indicating whether the shell access is enabled (`1`), disabled (`0`), or restricted (`2`).

Inherit the value of the the `\pdfshellescape` (LuaTEX, PdfTEX) or the `\shellescape` (XETEX) commands. If neither of these commands is defined and Lua is available, attempt to access the `status.shell_escape` configuration item.

If you cannot detect, whether the shell access is enabled, act as if it were.

```
\ifx\pdfshellescape\undefined
  \ifx\shellescape\undefined
    \ifnum\markdownMode=0\relax
      \def\markdownExecuteShellEscape{1}%
    \else
      \def\markdownExecuteShellEscape{%
        \directlua{tex.sprint(status.shell_escape or "1")}}%
    \fi
  \else
    \let\markdownExecuteShellEscape\shellescape
  \fi
\else
  \let\markdownExecuteShellEscape\pdfshellescape
\fi
```

The `\markdownExecuteDirect` macro executes the code it has received as its first argument by writing it to the output file stream 18, if Lua is unavailable, or by using the Lua `os.execute` method otherwise.

```
\ifnum\markdownMode=0\relax
  \def\markdownExecuteDirect#1{\immediate\write18{#1}}%
\else
  \def\markdownExecuteDirect#1{%
    \directlua{os.execute("\luaescapestring{#1}")}}%
\fi
```

The `\markdownExecute` macro is a wrapper on top of `\markdownExecuteDirect` that checks the value of `\markdownExecuteShellEscape` and prints an error message if the shell is inaccessible.

```
\def\markdownExecute#1{%
  \ifnum\markdownExecuteShellEscape=1\relax
    \markdownExecuteDirect{#1}%
  \else
    \markdownError{I can not access the shell}{Either run the TeX
      compiler with the --shell-escape or the --enable-write18 flag,
      or set shell_escape=t in the texmf.cnf file}%
  \fi}%
```

The `\markdownLuaExecute` macro executes the Lua code it has received as its first argument. The Lua code may not directly interact with the TEX engine, but it can use the `print` function in the same manner it would use the `tex.print` method.

```
\begingroup
```

Swap the category code of the backslash symbol and the pipe symbol, so that we may use the backslash symbol freely inside the Lua code.

```
  \catcode`|=0%
  \catcode`\\=12%
  |gdef|markdownLuaExecute#1{%
```

Create the file `\markdownOptionHelperScriptFileName` and fill it with the input Lua code prepended with kpathsea initialization, so that Lua modules from the TEX distribution are available.

```
    |immediate|openout|markdownOutputFileStream=%
      |markdownOptionHelperScriptFileName
    |markdownInfo{Writing a helper Lua script to the file
      "|markdownOptionHelperScriptFileName"}%
    |immediate|write|markdownOutputFileStream{%
      local ran_ok, error = pcall(function()
        local ran_ok, kpse = pcall(require, "kpse")
        if ran_ok then kpse.set_program_name("luatex") end
        #1
      end)
```

If there was an error, use the file \markdownOptionErrorTempFileName to store the error message.

```
      if not ran_ok then
        local file = io.open("%
          |markdownOptionOutputDir
          /|markdownOptionErrorTempFileName", "w")
        if file then
          file:write(error .. "\n")
          file:close()
        end
        print('\\markdownError{An error was encountered while executing
               Lua code}{For further clues, examine the file
               "|markdownOptionOutputDir
               /|markdownOptionErrorTempFileName"}')
      end}%
    |immediate|closeout|markdownOutputFileStream
```

Execute the generated \markdownOptionHelperScriptFileName Lua script using the TEXLua binary and store the output in the \markdownOptionOutputTempFileName file.

```
    |markdownInfo{Executing a helper Lua script from the file
      "|markdownOptionHelperScriptFileName" and storing the result in the
      file "|markdownOptionOutputTempFileName"}%
    |markdownExecute{texlua "|markdownOptionOutputDir
      /|markdownOptionHelperScriptFileName" > %
      "|markdownOptionOutputDir
      /|markdownOptionOutputTempFileName"}%
```

\input the generated \markdownOptionOutputTempFileName file.

```
    |input|markdownOptionOutputTempFileName|relax}%
|endgroup
```

3.2.7 Direct Lua Access

The following TEX code is intended for TEX engines that provide direct access to Lua (LuaTEX). The macro \markdownLuaExecute defined here and in Section 3.2.6 on page 167 are meant to be indistinguishable to the remaining code. This corresponds to the \markdownMode value of 2.

```
\else
\markdownInfo{Using mode 2: Direct Lua access}%
```

The direct Lua access version of the \markdownLuaExecute macro is defined in terms of the \directlua primitive. The print function is set as an alias to the \tex.print method in order to mimic the behaviour of the \markdownLuaExecute definition from Section 3.2.6 on page 167,

```
\def\markdownLuaExecute#1{\directlua{local print = tex.print #1}}%
\fi
```

3.2.8 Typesetting Markdown

The \markdownInput macro uses an implementation of the \markdownLuaExecute macro to convert the contents of the file whose filename it has received as its single argument from markdown to plain TEX.

```
\begingroup
```

Swap the category code of the backslash symbol and the pipe symbol, so that we may use the backslash symbol freely inside the Lua code.

```
  \catcode`|=0%
  \catcode`\\=12%
  |gdef|markdownInput#1{%
```

Change the category code of the percent sign (‘of the hybrid Lua option or a malevolent actor can’t produce TeX comments in the plain TeX output of the Markdown package.

```
    |begingroup
    |catcode`|%=12
```

If we are reading from the frozen cache, input it, expand the corresponding \markdownFrozenCache⟨*number*⟩ macro, and increment \markdownFrozenCacheCounter.

```
    |markdownIfOption{FrozenCache}{%
      |ifnum|markdownFrozenCacheCounter=0|relax
        |markdownInfo{Reading frozen cache from
          "|markdownOptionFrozenCacheFileName"}%
        |input|markdownOptionFrozenCacheFileName|relax
      |fi
      |markdownInfo{Including markdown document number
        "|the|markdownFrozenCacheCounter" from frozen cache}%
      |csname markdownFrozenCache|the|markdownFrozenCacheCounter|endcsname
      |global|advance|markdownFrozenCacheCounter by 1|relax
    }{%
      |markdownInfo{Including markdown document "#1"}%
```

Attempt to open the markdown document to record it in the .log and .fls files. This allows external programs such as LATEXMk to track changes to the markdown document.

```
      |openin|markdownInputFileStream#1
      |closein|markdownInputFileStream
      |markdownLuaExecute{%
        |markdownPrepare
        local file = assert(io.open("#1", "r"),
          [[could not open file "#1" for reading]])
        local input = assert(file:read("*a"))
        assert(file:close())
```

Since the Lua converter expects UNIX line endings, normalize the input. Also add a line ending at the end of the file in case the input file has none.

```
5462          print(convert(input:gsub("\r\n?", "\n") .. "\n"))}%
```

If we are finalizing the frozen cache, increment `\markdownFrozenCacheCounter`.

```
5463        |markdownIfOption{FinalizeCache}{%
5464          |global|advance|markdownFrozenCacheCounter by 1|relax
5465        }%
5466      }%
5467      |endgroup
5468    }%
5469  |endgroup
```

3.3 LaTeX Implementation

The LaTeX implemenation makes use of the fact that, apart from some subtle differences, LaTeX implements the majority of the plain TeX format [9, Section 9]. As a consequence, we can directly reuse the existing plain TeX implementation.

The LaTeX implementation redefines the plain TeX logging macros (see Section 3.2.1 on page 159) to use the LaTeX `\PackageInfo`, `\PackageWarning`, and `\PackageError` macros.

```
5470 \newcommand\markdownInfo[1]{\PackageInfo{markdown}{#1}}%
5471 \newcommand\markdownWarning[1]{\PackageWarning{markdown}{#1}}%
5472 \newcommand\markdownError[2]{\PackageError{markdown}{#1}{#2.}}%
5473 \input markdown/markdown
5474 \def\markdownVersionSpace{ }%
5475 \ProvidesPackage{markdown}[\markdownLastModified\markdownVersionSpace v%
5476   \markdownVersion\markdownVersionSpace markdown renderer]%
```

3.3.1 Logging Facilities

The LaTeX implementation redefines the plain TeX logging macros (see Section 3.2.1 on page 159) to use the LaTeX `\PackageInfo`, `\PackageWarning`, and `\PackageError` macros.

3.3.2 Typesetting Markdown

The `\markdownInputPlainTeX` macro is used to store the original plain TeX implementation of the `\markdownInput` macro. The `\markdownInput` is then redefined to accept an optional argument with options recognized by the LaTeX interface (see Section 2.3.2 on page 41).

```
5477 \let\markdownInputPlainTeX\markdownInput
5478 \renewcommand\markdownInput[2][]{%
5479   \begingroup
5480     \markdownSetup{#1}%
5481     \markdownInputPlainTeX{#2}%
5482   \endgroup}%
```

The `markdown`, and `markdown*` LaTeX environments are implemented using the `\markdownReadAndConvert` macro.

```
\renewenvironment{markdown}{%
  \markdownReadAndConvert@markdown{}}{%
  \markdownEnd}%
\renewenvironment{markdown*}[1]{%
  \markdownSetup{#1}%
  \markdownReadAndConvert@markdown*}{%
  \markdownEnd}%
\begingroup
```

Locally swap the category code of the backslash symbol with the pipe symbol, and of the left (`{`) and right brace (`}`) with the less-than (`<`) and greater-than (`>`) signs. This is required in order that all the special symbols that appear in the first argument of the `markdownReadAndConvert` macro have the category code *other*.

```
  \catcode`\|=0\catcode`\<=1\catcode`\>=2%
  \catcode`\\=12|catcode`|{=12|catcode`|}=12%
  |gdef|markdownReadAndConvert@markdown#1<%
    |markdownReadAndConvert<\end{markdown#1}>%
                           <|end<markdown#1>>>%
|endgroup
```

3.3.3 Options

The supplied package options are processed using the `\markdownSetup` macro.

```
\DeclareOption*{%
  \expandafter\markdownSetup\expandafter{\CurrentOption}}%
\ProcessOptions\relax
```

After processing the options, activate the `renderers` and `rendererPrototypes` keys.

```
\define@key{markdownOptions}{renderers}{%
  \setkeys{markdownRenderers}{#1}%
  \def\KV@prefix{KV@markdownOptions@}}%
\define@key{markdownOptions}{rendererPrototypes}{%
  \setkeys{markdownRendererPrototypes}{#1}%
  \def\KV@prefix{KV@markdownOptions@}}%
```

3.3.3.1 LaTeX Themes

This section implements example themes provided with the Markdown package.

The `witiko/dot` theme enables the `fencedCode` Lua option:

```
\markdownSetup{fencedCode}%
```

We load the ifthen and grffile packages, see also Section 1.1.3:

```
\RequirePackage{ifthen,grffile}
```

We store the previous definition of the fenced code token renderer prototype:

```
\let\markdown@witiko@dot@oldRendererInputFencedCodePrototype
```

```
  \markdownRendererInputFencedCodePrototype
```

If the infostring starts with `dot …`, we redefine the fenced code block token renderer prototype, so that it typesets the code block via Graphviz tools if and only if the `\markdownOptionFrozenCache` plain TEX option is disabled and the code block has not been previously typeset:

```
\renewcommand\markdownRendererInputFencedCode[2]{%
  \def\next##1 ##2\relax{%
    \ifthenelse{\equal{##1}{dot}}{%
      \markdownIfOption{FrozenCache}{}{%
        \immediate\write18{%
          if ! test -e #1.pdf.source || ! diff #1 #1.pdf.source;
          then
            dot -Tpdf -o #1.pdf #1;
            cp #1 #1.pdf.source;
          fi}}%
```

We include the typeset image using the image token renderer:

```
      \markdownRendererImage{Graphviz image}{#1.pdf}{#1.pdf}{##2}%
```

If the infostring does not start with `dot …`, we use the previous definition of the fenced code token renderer prototype:

```
    }{%
      \markdown@witiko@dot@oldRendererInputFencedCodePrototype{#1}{#2}%
    }%
  }%
  \next#2 \relax}%
```

The `witiko/graphicx/http` theme stores the previous definition of the image token renderer prototype:

```
\let\markdown@witiko@graphicx@http@oldRendererImagePrototype
  \markdownRendererImagePrototype
```

We load the catchfile and grffile packages, see also Section 1.1.3:

```
\RequirePackage{catchfile,grffile}
```

We define the `\markdown@witiko@graphicx@http@counter` counter to enumerate the images for caching and the `\markdown@witiko@graphicx@http@filename` command, which will store the pathname of the file containing the pathname of the downloaded image file.

```
\newcount\markdown@witiko@graphicx@http@counter
\markdown@witiko@graphicx@http@counter=0
\newcommand\markdown@witiko@graphicx@http@filename{%
  \markdownOptionCacheDir/witiko_graphicx_http%
  .\the\markdown@witiko@graphicx@http@counter}%
```

We define the `\markdown@witiko@graphicx@http@download` command, which will receive two arguments that correspond to the URL of the online image and to the

pathname, where the online image should be downloaded. The command will produce a shell command that tries to downloads the online image to the pathname.

```
\newcommand\markdown@witiko@graphicx@http@download[2]{%
  wget -O #2 #1 || curl --location -o #2 #1 || rm -f #2}
```

We locally swap the category code of the percentage sign with the line feed control character, so that we can use percentage signs in the shell code:

```
\begingroup
\catcode`\%=12
\catcode`\^^A=14
```

We redefine the image token renderer prototype, so that it tries to download an online image.

```
\global\def\markdownRendererImagePrototype#1#2#3#4{^^A
  \begingroup
    \edef\filename{\markdown@witiko@graphicx@http@filename}^^A
```

The image will be downloaded only if the image URL has the http or https protocols and the \markdownOptionFrozenCache plain TEX option is disabled:

```
    \markdownIfOption{FrozenCache}{}{^^A
      \immediate\write18{^^A
        if printf '%s' "#3" | grep -q -E '^https?:';
        then
```

The image will be downloaded to the pathname \markdownOptionCacheDir/⟨*the MD5 digest of the image URL*⟩.⟨*the suffix of the image URL*⟩:

```
          OUTPUT_PREFIX="\markdownOptionCacheDir";
          OUTPUT_BODY="$(printf '%s' '#3' | md5sum | cut -d' ' -f1)";
          OUTPUT_SUFFIX="$(printf '%s' '#3' | sed 's/.*[.]//')";
          OUTPUT="$OUTPUT_PREFIX/$OUTPUT_BODY.$OUTPUT_SUFFIX";
```

The image will be downloaded only if it has not already been downloaded:

```
          if ! [ -e "$OUTPUT" ];
          then
            \markdown@witiko@graphicx@http@download{'#3'}{"$OUTPUT"};
            printf '%s' "$OUTPUT" > "\filename";
          fi;
```

If the image does not have the http or https protocols or the image has already been downloaded, the URL will be stored as-is:

```
        else
          printf '%s' '#3' > "\filename";
        fi}}^^A
```

We load the pathname of the downloaded image and we typeset the image using the previous definition of the image renderer prototype:

```
    \CatchFileDef{\filename}{\filename}{\endlinechar=-1}^^A
    \markdown@witiko@graphicx@http@oldRendererImagePrototype^^A
      {#1}{#2}{\filename}{#4}^^A
```

```
  \endgroup
  \global\advance\markdown@witiko@graphicx@http@counter by 1\relax}^^A
\endgroup
```

The witiko/tilde theme redefines the tilde token renderer prototype, so that it expands to a non-breaking space:

```
\renewcommand\markdownRendererTildePrototype{~}%
```

3.3.4 Token Renderer Prototypes

The following configuration should be considered placeholder. If the plain package option has been enabled (see Section 2.3.2.1 on page 42), none of it will take effect.

```
\ifmarkdownLaTeXPlain\else
```

If the \markdownOptionTightLists macro expands to false, do not load the paralist package. This is necessary for LaTeX 2ε document classes that do not play nice with paralist, such as beamer. If the \markdownOptionTightLists is undefined and the beamer document class is in use, then do not load the paralist package either.

```
\RequirePackage{ifthen}

\ifx\markdownOptionTightLists\undefined
  \@ifclassloaded{beamer}{}{%
    \RequirePackage{paralist}}%
\else
  \ifthenelse{\equal{\markdownOptionTightLists}{false}}{}{%
    \RequirePackage{paralist}}%
\fi
```

If we loaded the paralist package, define the respective renderer prototypes to make use of the capabilities of the package. Otherwise, define the renderer prototypes to fall back on the corresponding renderers for the non-tight lists.

```
\@ifpackageloaded{paralist}{
  \markdownSetup{rendererPrototypes={
    ulBeginTight = {\begin{compactitem}},
    ulEndTight = {\end{compactitem}},
    olBeginTight = {\begin{compactenum}},
    olEndTight = {\end{compactenum}},
    dlBeginTight = {\begin{compactdesc}},
    dlEndTight = {\end{compactdesc}}}}
}{
  \markdownSetup{rendererPrototypes={
    ulBeginTight = {\markdownRendererUlBegin},
    ulEndTight = {\markdownRendererUlEnd},
    olBeginTight = {\markdownRendererOlBegin},
    olEndTight = {\markdownRendererOlEnd},
    dlBeginTight = {\markdownRendererDlBegin},
```

```
    dlEndTight = {\markdownRendererDlEnd}}}}
\RequirePackage{amsmath}
\RequirePackage{amssymb}
\RequirePackage{csvsimple}
\RequirePackage{fancyvrb}
\RequirePackage{graphicx}
\markdownSetup{rendererPrototypes={
  lineBreak = {\\},
  leftBrace = {\textbraceleft},
  rightBrace = {\textbraceright},
  dollarSign = {\textdollar},
  underscore = {\textunderscore},
  circumflex = {\textasciicircum},
  backslash = {\textbackslash},
  tilde = {\textasciitilde},
  pipe = {\textbar},
  codeSpan = {\texttt{#1}},
  contentBlock = {%
    \ifthenelse{\equal{#1}{csv}}{%
      \begin{table}%
        \begin{center}%
          \csvautotabular{#3}%
        \end{center}
        \ifx\empty#4\empty\else
          \caption{#4}%
        \fi
      \end{table}}{%
      \markdownInput{#3}}},
  image = {%
    \begin{figure}%
      \begin{center}%
        \includegraphics{#3}%
      \end{center}%
      \ifx\empty#4\empty\else
        \caption{#4}%
      \fi
      \label{fig:#1}%
    \end{figure}},
  ulBegin = {\begin{itemize}},
  ulEnd = {\end{itemize}},
  olBegin = {\begin{enumerate}},
  olItem = {\item{}},
  olItemWithNumber = {\item[#1.]},
  olEnd = {\end{enumerate}},
  dlBegin = {\begin{description}},
  dlItem = {\item[#1]},
  dlEnd = {\end{description}},
```

```
  emphasis = {\emph{#1}},
  tickedBox = {$\boxtimes$},
  halfTickedBox = {$\boxdot$},
  untickedBox = {$\square$},
  blockQuoteBegin = {\begin{quotation}},
  blockQuoteEnd = {\end{quotation}},
  inputVerbatim = {\VerbatimInput{#1}},
  inputFencedCode = {%
    \ifx\relax#2\relax
      \VerbatimInput{#1}%
    \else
      \@ifundefined{minted@code}{%
        \@ifundefined{lst@version}{%
          \markdownRendererInputFencedCode{#1}{}%
```

When the listings package is loaded, use it for syntax highlighting.

```
        }{%
          \lstinputlisting[language=#2]{#1}%
        }%
```

When the minted package is loaded, use it for syntax highlighting. The minted package is preferred over listings.

```
      }{%
        \inputminted{#2}{#1}%
      }%
    \fi},
  horizontalRule = {\noindent\rule[0.5ex]{\linewidth}{1pt}},
  footnote = {\footnote{#1}}}}
```

Support the nesting of strong emphasis.

```
\def\markdownLATEXStrongEmphasis#1{%
  \IfSubStr\f@series{b}{\textnormal{#1}}{\textbf{#1}}}
\markdownSetup{rendererPrototypes={strongEmphasis={%
  \protect\markdownLATEXStrongEmphasis{#1}}}}
```

Support LaTeX document classes that do not provide chapters.

```
\@ifundefined{chapter}{%
  \markdownSetup{rendererPrototypes = {
    headingOne = {\section{#1}},
    headingTwo = {\subsection{#1}},
    headingThree = {\subsubsection{#1}},
    headingFour = {\paragraph{#1}\leavevmode},
    headingFive = {\subparagraph{#1}\leavevmode}}}
}{%
  \markdownSetup{rendererPrototypes = {
    headingOne = {\chapter{#1}},
    headingTwo = {\section{#1}},
    headingThree = {\subsection{#1}},
    headingFour = {\subsubsection{#1}},
```

```
    headingFive = {\paragraph{#1}\leavevmode},
    headingSix = {\subparagraph{#1}\leavevmode}}}
}%
```

3.3.4.1 Tickboxes

If the `taskLists` option is enabled, we will hide bullets in unordered list items with tickboxes.

```
\markdownSetup{
  rendererPrototypes = {
    ulItem = {%
      \futurelet\markdownLaTeXCheckbox\markdownLaTeXUlItem
    },
  },
}
\def\markdownLaTeXUlItem{%
  \ifx\markdownLaTeXCheckbox\markdownRendererTickedBox
    \item[\markdownLaTeXCheckbox]%
    \expandafter\@gobble
  \else
    \ifx\markdownLaTeXCheckbox\markdownRendererHalfTickedBox
      \item[\markdownLaTeXCheckbox]%
      \expandafter\expandafter\expandafter\@gobble
    \else
      \ifx\markdownLaTeXCheckbox\markdownRendererUntickedBox
        \item[\markdownLaTeXCheckbox]%
        \expandafter\expandafter\expandafter\expandafter
          \expandafter\expandafter\expandafter\@gobble
      \else
        \item{}%
      \fi
    \fi
  \fi
}
```

3.3.4.2 Citations

Here is a basic implementation for citations that uses the LaTeX `\cite` macro. There are also implementations that use the natbib `\citep`, and `\citet` macros, and the BibLaTeX `\autocites` and `\textcites` macros. These implementations will be used, when the respective packages are loaded.

```
\newcount\markdownLaTeXCitationsCounter

% Basic implementation
\RequirePackage{gobble}
\def\markdownLaTeXBasicCitations#1#2#3#4#5#6{%
  \advance\markdownLaTeXCitationsCounter by 1\relax
  \ifx\relax#4\relax
    \ifx\relax#5\relax
```

```
      \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
        \cite{#1#2#6}%  Without prenotes and postnotes, just accumulate cites
        \expandafter\expandafter\expandafter
        \expandafter\expandafter\expandafter\expandafter
        \@gobblethree
      \fi
    \else%  Before a postnote (#5), dump the accumulator
      \ifx\relax#1\relax\else
        \cite{#1}%
      \fi
      \cite[#5]{#6}%
      \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
      \else
        \expandafter\expandafter\expandafter
        \expandafter\expandafter\expandafter\expandafter
        \expandafter\expandafter\expandafter
        \expandafter\expandafter\expandafter\expandafter
        \markdownLaTeXBasicCitations
      \fi
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter{%
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter}%
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter{%
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter}%
      \expandafter\expandafter\expandafter
      \@gobblethree
    \fi
  \else%  Before a prenote (#4), dump the accumulator
    \ifx\relax#1\relax\else
      \cite{#1}%
    \fi
    \ifnum\markdownLaTeXCitationsCounter>1\relax
      \space  % Insert a space before the prenote in later citations
    \fi
    #4~\expandafter\cite\ifx\relax#5\relax{#6}\else[#5]{#6}\fi
    \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
    \else
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter
      \markdownLaTeXBasicCitations
    \fi
    \expandafter\expandafter\expandafter{%
    \expandafter\expandafter\expandafter}%
    \expandafter\expandafter\expandafter{%
```

```
    \expandafter\expandafter\expandafter}%
    \expandafter
    \@gobblethree
  \fi\markdownLaTeXBasicCitations{#1#2#6},}
\let\markdownLaTeXBasicTextCitations\markdownLaTeXBasicCitations

% Natbib implementation
\def\markdownLaTeXNatbibCitations#1#2#3#4#5{%
  \advance\markdownLaTeXCitationsCounter by 1\relax
  \ifx\relax#3\relax
    \ifx\relax#4\relax
      \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
        \citep{#1,#5}%  Without prenotes and postnotes, just accumulate cites
        \expandafter\expandafter\expandafter
        \expandafter\expandafter\expandafter\expandafter
        \@gobbletwo
      \fi
    \else%  Before a postnote (#4), dump the accumulator
      \ifx\relax#1\relax\else
        \citep{#1}%
      \fi
      \citep[][#4]{#5}%
      \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
      \else
        \expandafter\expandafter\expandafter
        \expandafter\expandafter\expandafter\expandafter
        \expandafter\expandafter\expandafter
        \expandafter\expandafter\expandafter\expandafter
        \markdownLaTeXNatbibCitations
      \fi
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter{%
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter}%
      \expandafter\expandafter\expandafter
      \@gobbletwo
    \fi
  \else%  Before a prenote (#3), dump the accumulator
    \ifx\relax#1\relax\relax\else
      \citep{#1}%
    \fi
    \citep[#3][#4]{#5}%
    \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
    \else
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter
      \markdownLaTeXNatbibCitations
```

```
    \fi
    \expandafter\expandafter\expandafter{%
    \expandafter\expandafter\expandafter}%
    \expandafter
    \@gobbletwo
  \fi\markdownLaTeXNatbibCitations{#1,#5}}
\def\markdownLaTeXNatbibTextCitations#1#2#3#4#5{%
  \advance\markdownLaTeXCitationsCounter by 1\relax
  \ifx\relax#3\relax
    \ifx\relax#4\relax
      \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
        \citet{#1,#5}%  Without prenotes and postnotes, just accumulate cites
        \expandafter\expandafter\expandafter
        \expandafter\expandafter\expandafter\expandafter
        \@gobbletwo
      \fi
    \else%  After a prenote or a postnote, dump the accumulator
      \ifx\relax#1\relax\else
        \citet{#1}%
      \fi
      , \citet[#3][#4]{#5}%
      \ifnum\markdownLaTeXCitationsCounter<\markdownLaTeXCitationsTotal\relax
        ,
      \else
        \ifnum\markdownLaTeXCitationsCounter=\markdownLaTeXCitationsTotal\relax
          ,
        \fi
      \fi
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter
      \markdownLaTeXNatbibTextCitations
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter{%
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter}%
      \expandafter\expandafter\expandafter
      \@gobbletwo
    \fi
  \else%  After a prenote or a postnote, dump the accumulator
    \ifx\relax#1\relax\relax\else
      \citet{#1}%
    \fi
    , \citet[#3][#4]{#5}%
    \ifnum\markdownLaTeXCitationsCounter<\markdownLaTeXCitationsTotal\relax
      ,
    \else
      \ifnum\markdownLaTeXCitationsCounter=\markdownLaTeXCitationsTotal\relax
```

```
        ,
      \fi
    \fi
    \expandafter\expandafter\expandafter
    \markdownLaTeXNatbibTextCitations
    \expandafter\expandafter\expandafter{%
    \expandafter\expandafter\expandafter}%
    \expandafter
    \@gobbletwo
  \fi\markdownLaTeXNatbibTextCitations{#1,#5}}

% BibLaTeX implementation
\def\markdownLaTeXBibLaTeXCitations#1#2#3#4#5{%
  \advance\markdownLaTeXCitationsCounter by 1\relax
  \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
    \autocites#1[#3][#4]{#5}%
    \expandafter\@gobbletwo
  \fi\markdownLaTeXBibLaTeXCitations{#1[#3][#4]{#5}}}
\def\markdownLaTeXBibLaTeXTextCitations#1#2#3#4#5{%
  \advance\markdownLaTeXCitationsCounter by 1\relax
  \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
    \textcites#1[#3][#4]{#5}%
    \expandafter\@gobbletwo
  \fi\markdownLaTeXBibLaTeXTextCitations{#1[#3][#4]{#5}}}

\markdownSetup{rendererPrototypes = {
  cite = {%
    \markdownLaTeXCitationsCounter=1%
    \def\markdownLaTeXCitationsTotal{#1}%
    \@ifundefined{autocites}{%
      \@ifundefined{citep}{%
        \expandafter\expandafter\expandafter
        \markdownLaTeXBasicCitations
        \expandafter\expandafter\expandafter{%
        \expandafter\expandafter\expandafter}%
        \expandafter\expandafter\expandafter{%
        \expandafter\expandafter\expandafter}%
      }{%
        \expandafter\expandafter\expandafter
        \markdownLaTeXNatbibCitations
        \expandafter\expandafter\expandafter{%
        \expandafter\expandafter\expandafter}%
      }%
    }{%
      \expandafter\expandafter\expandafter
      \markdownLaTeXBibLaTeXCitations
      \expandafter{\expandafter}%
```

```
    }},
  textCite = {%
    \markdownLaTeXCitationsCounter=1%
    \def\markdownLaTeXCitationsTotal{#1}%
    \@ifundefined{autocites}{%
      \@ifundefined{citep}{%
        \expandafter\expandafter\expandafter
        \markdownLaTeXBasicTextCitations
        \expandafter\expandafter\expandafter{%
        \expandafter\expandafter\expandafter}%
        \expandafter\expandafter\expandafter{%
        \expandafter\expandafter\expandafter}%
      }{%
        \expandafter\expandafter\expandafter
        \markdownLaTeXNatbibTextCitations
        \expandafter\expandafter\expandafter{%
        \expandafter\expandafter\expandafter}%
      }%
    }{%
      \expandafter\expandafter\expandafter
      \markdownLaTeXBibLaTeXTextCitations
      \expandafter{\expandafter}%
    }}}}
```

3.3.4.3 Links

Before consuming the parameters for the hyperlink renderer, we change the category code of the hash sign (`#`) to other, so that it cannot be mistaken for a parameter character. After the hyperlink has been typeset, we restore the original catcode.

```
\RequirePackage{url}
\def\markdownRendererLinkPrototype{%
  \begingroup
  \catcode`\#=12
  \def\next##1##2##3###4{%
    ##1\footnote{%
      \ifx\empty##4\empty\else##4: \fi\texttt<\url{##3}\texttt>}%
    \endgroup}%
  \next}
```

3.3.4.4 Tables

Here is a basic implementation of tables. If the booktabs package is loaded, then it is used to produce horizontal lines.

```
\newcount\markdownLaTeXRowCounter
\newcount\markdownLaTeXRowTotal
\newcount\markdownLaTeXColumnCounter
\newcount\markdownLaTeXColumnTotal
\newtoks\markdownLaTeXTable
```

```
\newtoks\markdownLaTeXTableAlignment
\newtoks\markdownLaTeXTableEnd
\@ifpackageloaded{booktabs}{
  \let\markdownLaTeXTopRule\toprule
  \let\markdownLaTeXMidRule\midrule
  \let\markdownLaTeXBottomRule\bottomrule
}{
  \let\markdownLaTeXTopRule\hline
  \let\markdownLaTeXMidRule\hline
  \let\markdownLaTeXBottomRule\hline
}
\markdownSetup{rendererPrototypes={
  table = {%
    \markdownLaTeXTable={}%
    \markdownLaTeXTableAlignment={}%
    \markdownLaTeXTableEnd={%
      \markdownLaTeXBottomRule
      \end{tabular}}%
    \ifx\empty#1\empty\else
      \addto@hook\markdownLaTeXTable{%
        \begin{table}
        \centering}%
      \addto@hook\markdownLaTeXTableEnd{%
        \caption{#1}
        \end{table}}%
    \fi
    \addto@hook\markdownLaTeXTable{\begin{tabular}}%
    \markdownLaTeXRowCounter=0%
    \markdownLaTeXRowTotal=#2%
    \markdownLaTeXColumnTotal=#3%
    \markdownLaTeXRenderTableRow
  }
}}
\def\markdownLaTeXRenderTableRow#1{%
  \markdownLaTeXColumnCounter=0%
  \ifnum\markdownLaTeXRowCounter=0\relax
    \markdownLaTeXReadAlignments#1%
    \markdownLaTeXTable=\expandafter\expandafter\expandafter{%
      \expandafter\the\expandafter\markdownLaTeXTable\expandafter{%
        \the\markdownLaTeXTableAlignment}}%
    \addto@hook\markdownLaTeXTable{\markdownLaTeXTopRule}%
  \else
    \markdownLaTeXRenderTableCell#1%
  \fi
  \ifnum\markdownLaTeXRowCounter=1\relax
    \addto@hook\markdownLaTeXTable\markdownLaTeXMidRule
  \fi
```

```
  \advance\markdownLaTeXRowCounter by 1\relax
  \ifnum\markdownLaTeXRowCounter>\markdownLaTeXRowTotal\relax
    \the\markdownLaTeXTable
    \the\markdownLaTeXTableEnd
    \expandafter\@gobble
  \fi\markdownLaTeXRenderTableRow}
\def\markdownLaTeXReadAlignments#1{%
  \advance\markdownLaTeXColumnCounter by 1\relax
  \if#1d%
    \addto@hook\markdownLaTeXTableAlignment{l}%
  \else
    \addto@hook\markdownLaTeXTableAlignment{#1}%
  \fi
  \ifnum\markdownLaTeXColumnCounter<\markdownLaTeXColumnTotal\relax\else
    \expandafter\@gobble
  \fi\markdownLaTeXReadAlignments}
\def\markdownLaTeXRenderTableCell#1{%
  \advance\markdownLaTeXColumnCounter by 1\relax
  \ifnum\markdownLaTeXColumnCounter<\markdownLaTeXColumnTotal\relax
    \addto@hook\markdownLaTeXTable{#1&}%
  \else
    \addto@hook\markdownLaTeXTable{#1\\}%
    \expandafter\@gobble
  \fi\markdownLaTeXRenderTableCell}
\fi
```

3.3.4.5 YAML Metadata

To parse the YAML metadata we will use the expl3 language from the LaTeX3 kernel.

```
\RequirePackage{expl3}
\ExplSyntaxOn
```

To keep track of the current type of structure we inhabit when we are traversing a YAML document, we will maintain the `\g_@@_jekyll_data_datatypes_seq` stack. At every step of the traversal, the stack will contain one of the following constants at any position p:

`\c_@@_jekyll_data_sequence_tl` The currently traversed branch of the YAML document contains a sequence at depth p.

`\c_@@_jekyll_data_mapping_tl` The currently traversed branch of the YAML document contains a mapping at depth p.

`\c_@@_jekyll_data_scalar_tl` The currently traversed branch of the YAML document contains a scalar value at depth p.

```
\seq_new:N   \g_@@_jekyll_data_datatypes_seq
\tl_const:Nn \c_@@_jekyll_data_sequence_tl   { sequence }
```

```
\tl_const:Nn \c_@@_jekyll_data_mapping_tl    { mapping  }
\tl_const:Nn \c_@@_jekyll_data_scalar_tl     { scalar   }
```

To keep track of our current place when we are traversing a YAML document, we will maintain the `\g_@@_jekyll_data_wildcard_absolute_address_seq` stack of keys using the `\markdown_jekyll_data_push_address_segment:n` macro.

```
\seq_new:N \g_@@_jekyll_data_wildcard_absolute_address_seq
\cs_new:Nn \markdown_jekyll_data_push_address_segment:n
  {
    \seq_if_empty:NF
      \g_@@_jekyll_data_datatypes_seq
      {
        \seq_get_right:NN
          \g_@@_jekyll_data_datatypes_seq
          \l_tmpa_tl
```

If we are currently in a sequence, we will put an asterisk (`*`) instead of a key into `\g_@@_jekyll_data_wildcard_absolute_address_seq` to make it represent a *wildcard*. Keeping a wildcard instead of a precise address makes it easy for the users to react to *any* item of a sequence regardless of how many there are, which can often be useful.

```
        \tl_if_eq:NNTF
          \l_tmpa_tl
          \c_@@_jekyll_data_sequence_tl
          {
            \seq_put_right:Nn
              \g_@@_jekyll_data_wildcard_absolute_address_seq
              { *  }
          }
          {
            \seq_put_right:Nn
              \g_@@_jekyll_data_wildcard_absolute_address_seq
              { #1 }
          }
      }
  }
```

Out of `\g_@@_jekyll_data_wildcard_absolute_address_seq`, we will construct the following two token lists:

`\g_@@_jekyll_data_wildcard_absolute_address_tl` An *absolute wildcard*: The wildcard from the root of the document prefixed with a slash (`/`) with individual keys and asterisks also delimited by slashes. Allows the users to react to complex context-sensitive structures with ease.

For example, the `name` key in the following YAML document would correspond to the `/*/person/name` absolute wildcard:

```
[{person: {name: Elon, surname: Musk}}]
```

`\g_@@_jekyll_data_wildcard_relative_address_tl` A *relative wildcard*: The rightmost segment of the wildcard. Allows the users to react to simple context-free structures.

For example, the `name` key in the following YAML document would correspond to the `name` relative wildcard:

```
[{person: {name: Elon, surname: Musk}}]
```

We will construct `\g_@@_jekyll_data_wildcard_absolute_address_tl` using the `\markdown_jekyll_data_concatenate_address:NN` macro and we will construct both token lists using the `\markdown_jekyll_data_update_address_tls:` macro.

```
\tl_new:N  \g_@@_jekyll_data_wildcard_absolute_address_tl
\tl_new:N  \g_@@_jekyll_data_wildcard_relative_address_tl
\cs_new:Nn \markdown_jekyll_data_concatenate_address:NN
  {
    \seq_pop_left:NN #1 \l_tmpa_tl
    \tl_set:Nx #2 { / \seq_use:Nn #1 { / } }
    \seq_put_left:NV #1 \l_tmpa_tl
  }
\cs_new:Nn \markdown_jekyll_data_update_address_tls:
  {
    \markdown_jekyll_data_concatenate_address:NN
      \g_@@_jekyll_data_wildcard_absolute_address_seq
      \g_@@_jekyll_data_wildcard_absolute_address_tl
    \seq_get_right:NN
      \g_@@_jekyll_data_wildcard_absolute_address_seq
      \g_@@_jekyll_data_wildcard_relative_address_tl
  }
```

To make sure that the stacks and token lists stay in sync, we will use the `\markdown_jekyll_data_push:nN` and `\markdown_jekyll_data_pop:` macros.

```
\cs_new:Nn \markdown_jekyll_data_push:nN
  {
    \markdown_jekyll_data_push_address_segment:n
      { #1 }
    \seq_put_right:NV
     \g_@@_jekyll_data_datatypes_seq
     #2
    \markdown_jekyll_data_update_address_tls:
  }
\cs_new:Nn \markdown_jekyll_data_pop:
```

```
  {
    \seq_pop_right:NN
      \g_@@_jekyll_data_wildcard_absolute_address_seq
      \l_tmpa_tl
    \seq_pop_right:NN
      \g_@@_jekyll_data_datatypes_seq
      \l_tmpa_tl
    \markdown_jekyll_data_update_address_tls:
  }
```

To interface with the user, we use `markdown/jekyllData` key–values from the l3keys module of the LaTeX3 kernel. The default setup will invoke the `\title`, `\author`, and `\date` macros when scalar values for keys that correspond to the `title`, `author`, and `date` relative wildcards are encountered, respectively.

```
\keys_define:nn
  { markdown/jekyllData }
  {
    author  .code:n = { \author{#1} },
    date    .code:n = { \date{#1}   },
    title   .code:n = { \title{#1}  },
  }
```

To set a single key–value, we will use the `\markdown_jekyll_data_set_keyval:Nn` macro, ignoring unknown keys. To set key–values for both absolute and relative wildcards, we will use the `\markdown_jekyll_data_set_keyvals:nn` macro.

```
\cs_new:Nn \markdown_jekyll_data_set_keyval:nn
  {
    \keys_set_known:nn
      { markdown/jekyllData }
      { { #1 } = { #2 } }
  }
\cs_generate_variant:Nn
  \markdown_jekyll_data_set_keyval:nn
  { Vn }
\cs_new:Nn \markdown_jekyll_data_set_keyvals:nn
  {
    \markdown_jekyll_data_push:nN
      { #1 }
      \c_@@_jekyll_data_scalar_tl
    \markdown_jekyll_data_set_keyval:Vn
      \g_@@_jekyll_data_wildcard_absolute_address_tl
      { #2 }
    \markdown_jekyll_data_set_keyval:Vn
      \g_@@_jekyll_data_wildcard_relative_address_tl
      { #2 }
    \markdown_jekyll_data_pop:
  }
```

Finally, we will register our macros as token renderer prototypes to be able to react to the traversal of a YAML document.

```
\markdownSetup{
  rendererPrototypes = {
    jekyllDataSequenceBegin = {
      \markdown_jekyll_data_push:nN
        { #1 }
        \c_@@_jekyll_data_sequence_tl
    },
    jekyllDataMappingBegin = {
      \markdown_jekyll_data_push:nN
        { #1 }
        \c_@@_jekyll_data_mapping_tl
    },
    jekyllDataSequenceEnd = {
      \markdown_jekyll_data_pop:
    },
    jekyllDataMappingEnd = {
      \markdown_jekyll_data_pop:
    },
    jekyllDataBoolean = {
      \markdown_jekyll_data_set_keyvals:nn
        { #1 }
        { #2 }
    },
    jekyllDataEmpty = { },
    jekyllDataNumber = {
      \markdown_jekyll_data_set_keyvals:nn
        { #1 }
        { #2 }
    },
    jekyllDataString = {
      \markdown_jekyll_data_set_keyvals:nn
        { #1 }
        { #2 }
    },
```

To complement the default setup of our key–values, we will use the `\maketitle` macro to typeset the title page of a document at the end of YAML metadata. If we are in the preamble, we will wait macro until after the beginning of the document. Otherwise, we will use the `\maketitle` macro straight away.

```
  },
}
\providecommand\IfFormatAtLeastTF{\@ifl@t@r\fmtversion}
\markdownSetup{
  rendererPrototypes = {
    jekyllDataEnd = {
```

```
      \IfFormatAtLeastTF
        { 2020-10-01 }
        { \AddToHook{begindocument/end}{\maketitle} }
        {
          \ifx\@onlypreamble\@notprerr
            % We are in the document
            \maketitle
          \else
            % We are in the preamble
            \RequirePackage{etoolbox}
            \AfterEndPreamble{\maketitle}
          \fi
        }
    },
  },
}

\ExplSyntaxOff
```

3.3.5 Miscellanea

When buffering user input, we should disable the bytes with the high bit set, since these are made active by the inputenc package. We will do this by redefining the `\markdownMakeOther` macro accordingly. The code is courtesy of Scott Pakin, the creator of the filecontents package.

```
\newcommand\markdownMakeOther{%
  \count0=128\relax
  \loop
    \catcode\count0=11\relax
    \advance\count0 by 1\relax
  \ifnum\count0<256\repeat}%
```

3.4 ConTEXt Implementation

The ConTEXt implementation makes use of the fact that, apart from some subtle differences, the Mark II and Mark IV ConTEXt formats *seem* to implement (the documentation is scarce) the majority of the plain TEX format required by the plain TEX implementation. As a consequence, we can directly reuse the existing plain TEX implementation after supplying the missing plain TEX macros.

The ConTEXt implementation redefines the plain TEX logging macros (see Section 3.2.1 on page 159) to use the ConTEXt `\writestatus` macro.

```
\def\markdownInfo#1{\writestatus{markdown}{#1.}}%
\def\markdownWarning#1{\writestatus{markdown\space warn}{#1.}}%
\def\dospecials{\do\ \do\\\do\{\do\}\do\$\do\&%
  \do\#\do\^\do\_\do\%\do\~}%
```

```
\input markdown/markdown
```

When buffering user input, we should disable the bytes with the high bit set, since these are made active by the `\enableregime` macro. We will do this by redefining the `\markdownMakeOther` macro accordingly. The code is courtesy of Scott Pakin, the creator of the filecontents LaTeX package.

```
\def\markdownMakeOther{%
  \count0=128\relax
  \loop
    \catcode\count0=11\relax
    \advance\count0 by 1\relax
  \ifnum\count0<256\repeat
```

On top of that, make the pipe character (`|`) inactive during the scanning. This is necessary, since the character is active in ConTeXt.

```
  \catcode`|=12}%
```

3.4.1 Typesetting Markdown

The `\startmarkdown` and `\stopmarkdown` macros are implemented using the `\markdownReadAndConvert` macro.

```
\begingroup
```

Locally swap the category code of the backslash symbol with the pipe symbol. This is required in order that all the special symbols that appear in the first argument of the `markdownReadAndConvert` macro have the category code *other*.

```
  \catcode`\|=0%
  \catcode`\\=12%
  |gdef|startmarkdown{%
    |markdownReadAndConvert{\stopmarkdown}%
                           {|stopmarkdown}}%
  |gdef|stopmarkdown{|markdownEnd}%
|endgroup
```

3.4.2 Token Renderer Prototypes

The following configuration should be considered placeholder.

```
\def\markdownRendererLineBreakPrototype{\blank}%
\def\markdownRendererLeftBracePrototype{\textbraceleft}%
\def\markdownRendererRightBracePrototype{\textbraceright}%
\def\markdownRendererDollarSignPrototype{\textdollar}%
\def\markdownRendererPercentSignPrototype{\percent}%
\def\markdownRendererUnderscorePrototype{\textunderscore}%
\def\markdownRendererCircumflexPrototype{\textcircumflex}%
\def\markdownRendererBackslashPrototype{\textbackslash}%
\def\markdownRendererTildePrototype{\textasciitilde}%
\def\markdownRendererPipePrototype{\char`|}%
```

```
\def\markdownRendererLinkPrototype#1#2#3#4{%
  \useURL[#1][#3][][#4]#1\footnote[#1]{\ifx\empty#4\empty\else#4:
  \fi\tt<\hyphenatedurl{#3}>}}%
\usemodule[database]
\defineseparatedlist
  [MarkdownConTeXtCSV]
  [separator={,},
   before=\bTABLE,after=\eTABLE,
   first=\bTR,last=\eTR,
   left=\bTD,right=\eTD]
\def\markdownConTeXtCSV{csv}
\def\markdownRendererContentBlockPrototype#1#2#3#4{%
  \def\markdownConTeXtCSV@arg{#1}%
  \ifx\markdownConTeXtCSV@arg\markdownConTeXtCSV
    \placetable[][tab:#1]{#4}{%
      \processseparatedfile[MarkdownConTeXtCSV][#3]}%
  \else
    \markdownInput{#3}%
  \fi}%
\def\markdownRendererImagePrototype#1#2#3#4{%
  \placefigure[][fig:#1]{#4}{\externalfigure[#3]}}%
\def\markdownRendererUlBeginPrototype{\startitemize}%
\def\markdownRendererUlBeginTightPrototype{\startitemize[packed]}%
\def\markdownRendererUlItemPrototype{\item}%
\def\markdownRendererUlEndPrototype{\stopitemize}%
\def\markdownRendererUlEndTightPrototype{\stopitemize}%
\def\markdownRendererOlBeginPrototype{\startitemize[n]}%
\def\markdownRendererOlBeginTightPrototype{\startitemize[packed,n]}%
\def\markdownRendererOlItemPrototype{\item}%
\def\markdownRendererOlItemWithNumberPrototype#1{\sym{#1.}}%
\def\markdownRendererOlEndPrototype{\stopitemize}%
\def\markdownRendererOlEndTightPrototype{\stopitemize}%
\definedescription
  [MarkdownConTeXtDlItemPrototype]
  [location=hanging,
   margin=standard,
   headstyle=bold]%
\definestartstop
  [MarkdownConTeXtDlPrototype]
  [before=\blank,
   after=\blank]%
\definestartstop
  [MarkdownConTeXtDlTightPrototype]
  [before=\blank\startpacked,
   after=\stoppacked\blank]%
\def\markdownRendererDlBeginPrototype{%
  \startMarkdownConTeXtDlPrototype}%
```

```
\def\markdownRendererDlBeginTightPrototype{%
  \startMarkdownConTeXtDlTightPrototype}%
\def\markdownRendererDlItemPrototype#1{%
  \startMarkdownConTeXtDlItemPrototype{#1}}%
\def\markdownRendererDlItemEndPrototype{%
  \stopMarkdownConTeXtDlItemPrototype}%
\def\markdownRendererDlEndPrototype{%
  \stopMarkdownConTeXtDlPrototype}%
\def\markdownRendererDlEndTightPrototype{%
  \stopMarkdownConTeXtDlTightPrototype}%
\def\markdownRendererEmphasisPrototype#1{{\em#1}}%
\def\markdownRendererStrongEmphasisPrototype#1{{\bf#1}}%
\def\markdownRendererBlockQuoteBeginPrototype{\startquotation}%
\def\markdownRendererBlockQuoteEndPrototype{\stopquotation}%
\def\markdownRendererInputVerbatimPrototype#1{\typefile{#1}}%
\def\markdownRendererInputFencedCodePrototype#1#2{%
  \ifx\relax#2\relax
    \typefile{#1}%
  \else
```

The code fence infostring is used as a name from the ConTEXt `\definetyping` macro. This allows the user to set up code highlighting mapping as follows:

```
\definetyping [latex]
\setuptyping  [latex] [option=TEX]

\starttext
  \startmarkdown
~~~ latex
\documentclass{article}
\begin{document}
  Hello world!
\end{document}
~~~
  \stopmarkdown
\stoptext
```

```
    \typefile[#2][]{#1}%
  \fi}%
\def\markdownRendererHeadingOnePrototype#1{\chapter{#1}}%
\def\markdownRendererHeadingTwoPrototype#1{\section{#1}}%
\def\markdownRendererHeadingThreePrototype#1{\subsection{#1}}%
\def\markdownRendererHeadingFourPrototype#1{\subsubsection{#1}}%
\def\markdownRendererHeadingFivePrototype#1{\subsubsubsection{#1}}%
\def\markdownRendererHeadingSixPrototype#1{\subsubsubsubsection{#1}}%
\def\markdownRendererHorizontalRulePrototype{%
```

```
  \blackrule[height=1pt, width=\hsize]}%
\def\markdownRendererFootnotePrototype#1{\footnote{#1}}%
\stopmodule\protect
```

There is a basic implementation of tables.

```
\newcount\markdownConTeXtRowCounter
\newcount\markdownConTeXtRowTotal
\newcount\markdownConTeXtColumnCounter
\newcount\markdownConTeXtColumnTotal
\newtoks\markdownConTeXtTable
\newtoks\markdownConTeXtTableFloat
\def\markdownRendererTablePrototype#1#2#3{%
  \markdownConTeXtTable={}%
  \ifx\empty#1\empty
    \markdownConTeXtTableFloat={%
      \the\markdownConTeXtTable}%
  \else
    \markdownConTeXtTableFloat={%
      \placetable{#1}{\the\markdownConTeXtTable}}%
  \fi
  \begingroup
  \setupTABLE[r][each][topframe=off, bottomframe=off, leftframe=off, rightframe=off]
  \setupTABLE[c][each][topframe=off, bottomframe=off, leftframe=off, rightframe=off]
  \setupTABLE[r][1][topframe=on, bottomframe=on]
  \setupTABLE[r][#1][bottomframe=on]
  \markdownConTeXtRowCounter=0%
  \markdownConTeXtRowTotal=#2%
  \markdownConTeXtColumnTotal=#3%
  \markdownConTeXtRenderTableRow}
\def\markdownConTeXtRenderTableRow#1{%
  \markdownConTeXtColumnCounter=0%
  \ifnum\markdownConTeXtRowCounter=0\relax
    \markdownConTeXtReadAlignments#1%
    \markdownConTeXtTable={\bTABLE}%
  \else
    \markdownConTeXtTable=\expandafter{%
      \the\markdownConTeXtTable\bTR}%
    \markdownConTeXtRenderTableCell#1%
    \markdownConTeXtTable=\expandafter{%
      \the\markdownConTeXtTable\eTR}%
  \fi
  \advance\markdownConTeXtRowCounter by 1\relax
  \ifnum\markdownConTeXtRowCounter>\markdownConTeXtRowTotal\relax
    \markdownConTeXtTable=\expandafter{%
      \the\markdownConTeXtTable\eTABLE}%
    \the\markdownConTeXtTableFloat
    \endgroup
```

```
    \expandafter\gobbleoneargument
  \fi\markdownConTeXtRenderTableRow}
\def\markdownConTeXtReadAlignments#1{%
  \advance\markdownConTeXtColumnCounter by 1\relax
  \if#1d%
    \setupTABLE[c][\the\markdownConTeXtColumnCounter][align=right]
  \fi\if#1l%
    \setupTABLE[c][\the\markdownConTeXtColumnCounter][align=right]
  \fi\if#1c%
    \setupTABLE[c][\the\markdownConTeXtColumnCounter][align=middle]
  \fi\if#1r%
    \setupTABLE[c][\the\markdownConTeXtColumnCounter][align=left]
  \fi
  \ifnum\markdownConTeXtColumnCounter<\markdownConTeXtColumnTotal\relax\else
    \expandafter\gobbleoneargument
  \fi\markdownConTeXtReadAlignments}
\def\markdownConTeXtRenderTableCell#1{%
  \advance\markdownConTeXtColumnCounter by 1\relax
  \markdownConTeXtTable=\expandafter{%
    \the\markdownConTeXtTable\bTD#1\eTD}%
  \ifnum\markdownConTeXtColumnCounter<\markdownConTeXtColumnTotal\relax\else
    \expandafter\gobbleoneargument
  \fi\markdownConTeXtRenderTableCell}
\def\markdownRendererTickedBox{$\boxtimes$}
\def\markdownRendererHalfTickedBox{$\boxdot$}
\def\markdownRendererUntickedBox{$\square$}
```

References

[1] LuaTEX development team. *LuaTEX reference manual*. Feb. 2017. URL: http://www.luatex.org/svn/trunk/manual/luatex.pdf (visited on 01/08/2018).

[2] Vít Novotný. *TeXový interpret jazyka Markdown (markdown.sty)*. 2015. URL: https://www.muni.cz/en/research/projects/32984 (visited on 02/19/2018).

[3] Anton Sotkov. *File transclusion syntax for Markdown*. Jan. 19, 2017. URL: https://github.com/iainc/Markdown-Content-Blocks (visited on 01/08/2018).

[4] Donald Ervin Knuth. *The TEXbook*. 3rd ed. Addison-Wesley, 1986. ix, 479. ISBN: 0-201-13447-0.

[5] Till Tantau, Joseph Wright, and Vedran Miletić. *The Beamer class*. Feb. 10, 2021. URL: https://mirrors.ctan.org/macros/latex/contrib/beamer/doc/beameruserguide.pdf (visited on 02/11/2021).

[6] Vít Novotný. *LATEX 2ε no longer keys packages by pathnames*. Feb. 20, 2021. URL: https://github.com/latex3/latex2e/issues/510 (visited on 02/21/2021).

[7] Geoffrey M. Poore. *The `minted` Package. Highlighted source code in LaTeX*. July 19, 2017. URL: https://mirrors.ctan.org/macros/latex/contrib/minted/minted.pdf (visited on 09/01/2020).

[8] Roberto Ierusalimschy. *Programming in Lua*. 3rd ed. Rio de Janeiro: PUC-Rio, 2013. xviii, 347. ISBN: 978-85-903798-5-0.

[9] Johannes Braams et al. *The LaTeX 2ε Sources*. Apr. 15, 2017. URL: https://mirrors.ctan.org/macros/latex/base/source2e.pdf (visited on 01/08/2018).

Index