A Markdown Interpreter for TeX

Vít Novotný witiko@mail.muni.cz

Version 2.5.4
September 12, 2017

Contents

1 Introduction

This document is a reference manual for the Markdown package. It is split into three sections. This section explains the purpose and the background of the package and outlines its prerequisites. Section 2 describes the interfaces exposed by the package along with usage notes and examples. It is aimed at the user of the package. Section 3 describes the implementation of the package. It is aimed at the developer of the package and the curious user.

1.1 About Markdown

The Markdown package provides facilities for the conversion of markdown markup to plain TeX. These are provided both in the form of a Lua module and in the form of plain TeX, LaTeX, and ConTeXt macro packages that enable the direct inclusion of markdown documents inside TeX documents.

Architecturally, the package consists of the Lunamark v0.5.0 Lua module by John MacFarlane, which was slimmed down and rewritten for the needs of the package. On top of Lunamark sits code for the plain TeX, LaTeX, and ConTeXt formats by Vít Novotný.

```
1 local metadata = {
2     version   = "2.5.4",
3     comment   = "A module for the conversion from markdown to plain TeX",
4     author    = "John MacFarlane, Hans Hagen, Vít Novotný",
5     copyright = "2009-2017 John MacFarlane, Hans Hagen; " ..
```

```
                "2016-2017 Vít Novotný",
    license   = "LPPL 1.3"
}
if not modules then modules = { } end
modules['markdown'] = metadata
```

1.2 Feedback

Please use the markdown project page on GitHub[1] to report bugs and submit feature requests. Before making a feature request, please ensure that you have thoroughly studied this manual. 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 on the TEX-LATEX Stack Exchange[2].

1.3 Acknowledgements

I would like to thank the Faculty of Informatics at the Masaryk University in Brno for providing me with the opportunity to work on this package alongside my studies. I would also like to thank the creator of the Lunamark Lua module, John Macfarlane, for releasing Lunamark under a permissive license that enabled its inclusion into the package.

The TEX part 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.

1.4 Prerequisites

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

1.4.1 Lua Prerequisites

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

LPeg $\geq$ 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 $\geq$ 0.10 is included in LuaTEX $\geq$ 0.72.0 (TEXLive $\geq$ 2013).

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

[1] https://github.com/witiko/markdown/issues
[2] https://tex.stackexchange.com

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 $\geq$ 2008).

```
12      local unicode = require("unicode")
```

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 $\geq$ 2008).

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

All the abovelisted modules are statically linked into the current version of the LuaTeX engine (see [1, Section 3.3]).

1.4.2 Plain TeX Prerequisites

The plain TeX part of the package requires that the plain TeX format (or its superset) is loaded, all the Lua prerequisites (see Section 1.4.1), 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 $\geq$ 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 (see [1, Section 3.2]).

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

The plain TeX part of the package also requires 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 note that 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.

1.4.3 LaTeX Prerequisites

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

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

all the plain TeX prerequisites (see Section 1.4.2), and the following LaTeX 2_ε 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}
```

url A package that provides the `\url` macro for the typesetting of URLs. It is used to provide the default token renderer prototype (see Section 2.2.4) for links.

```
\RequirePackage{url}
```

graphicx A package that provides the `\includegraphics` macro for the typesetting of images. It is used to provide the corresponding default token renderer prototype (see Section 2.2.4).

```
\RequirePackage{graphicx}
```

paralist A package that provides the `compactitem`, `compactenum`, and `compactdesc` macros for the typesetting of tight bulleted lists, ordered lists, and definition lists. It is used to provide the corresponding default token renderer prototypes (see Section 2.2.4).

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.

```
\RequirePackage{ifthen}
```

fancyvrb A package that provides the `\VerbatimInput` macros for the verbatim inclusion of files containing code. It is used to provide the corresponding default token renderer prototype (see Section 2.2.4).

```
\RequirePackage{fancyvrb}
```

csvsimple A package that provides the default token renderer prototype for iA Writer content blocks with the CSV filename extension (see Section 2.2.4).

```
\RequirePackage{csvsimple}
```

1.4.4 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 1.4.2), 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).

2 User Guide

This part of the manual 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 purely abstract. It serves as a means of structuring this manual and as a promise to the user that if they only access the package through the interfaces, the future versions of the package should remain backwards compatible.

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) 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 = {}
```

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). 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:

```
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 = {}
```

2.1.2.1 File and Directory Names

`cacheDir`=⟨*path*⟩ default: .

A path to the directory containing auxiliary cache files. It is considered sane to set the path to a subdirectory of `outputDir`. If the last segment of the path does not exist, it will be created by the plain TeX, LaTeX, and ConTeXt 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 = "."
```

`outputDir`=⟨*path*⟩ default: .

A path to the directory containing output files. The path must be set to the same value as the `-output-directory` option of your TeX engine for the package to function correctly.

```
24 defaultOptions.outputDir = "."
```

2.1.2.2 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-breakable spaces inside the prenotes and postnotes of citations produced via the pandoc citation syntax extension.

`false` Do not replace regular spaces with non-breakable 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 [2]:

```
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 2.2.3.9 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
```

`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.

```
36 defaultOptions.footnotes = false
```

`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.

```
37 defaultOptions.hashEnumerators = 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.

```
38 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.

```
39 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.

```
40 defaultOptions.inlineFootnotes = false
```

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

`true` Preserve all tabs in the input.

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

```
41 defaultOptions.preserveTabs = false
```

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

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

`false` Preserve all ellipses in the input.

```
42 defaultOptions.smartEllipses = false
```

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

`true` Make the number in the first item in ordered lists significant. The item numbers will be passed to the `\markdownRendererOlItemWithNumber` TEX macro.

`false` Ignore the number in the items of ordered lists. Each item will only produce a `\markdownRendererOlItem` TEX macro.

```
43 defaultOptions.startNumber = true
```

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

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

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

```
44 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.

```
45 defaultOptions.underscores = true
```

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) used during

the conversion from markdown to plain TEX, and for changing the way markdown the tokens are rendered.

```
\def\markdownLastModified{2017/09/12}%
\def\markdownVersion{2.5.4}%
```

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 otherwise. 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 (see [3, 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 macros. Some of them map directly to the options recognized by the Lua interface (see Section 2.1.2), while some of them are specific to the plain TEX interface.

2.2.2.1 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 \markdownOptionCacheDir macro corresponds to the Lua interface cacheDir option that sets the name of 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 \markdownOptionOutputDir macro corresponds to the Lua interface outputDir option that sets the name of the directory that will contain the produced cache files. The option defaults to .. The same limitations apply here as in the case of the \markdownOptionHelperScriptFileName macro.

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

2.2.2.2 Lua Interface Options

The following macros map directly to the options recognized by the Lua interface (see Section 2.1.2) 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\markdownOptionHtml\undefined
\let\markdownOptionHybrid\undefined
\let\markdownOptionInlineFootnotes\undefined
\let\markdownOptionPreserveTabs\undefined
\let\markdownOptionSmartEllipses\undefined
\let\markdownOptionStartNumber\undefined
\let\markdownOptionTightLists\undefined
```

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) 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).

2.2.3.1 Interblock Separator Renderer

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

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

2.2.3.2 Line Break Renderer

The `\markdownRendererLineBreak` macro represents a forced line break. The macro receives no arguments.

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

2.2.3.3 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 `true`. The macro receives no arguments.

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

2.2.3.4 Non-breaking Space Renderer

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

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

2.2.3.5 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}%
```

2.2.3.6 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}%
```

2.2.3.7 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}%
```

2.2.3.8 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}%
```

2.2.3.9 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[3] 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 four 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 [2] is a good starting point.

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

2.2.3.10 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.

```
\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}%
```

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

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}%
```

2.2.3.11 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 `true`. The macro receives no arguments.

```
\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}%
```

2.2.3.12 Definition List Renderers

The following macros are only produces, when the `definitionLists` option is `true`.

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}%
```

2.2.3.13 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}%
```

2.2.3.14 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}%
```

2.2.3.15 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 `true`. 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}%
```

2.2.3.16 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}%
```

2.2.3.17 Horizontal Rule Renderer

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

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

2.2.3.18 Footnote Renderer

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

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

2.2.3.19 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 `true`. 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}%
```

2.2.3.20 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 `true`. The macro receives parameters in the same format as the `\markdownRendererCite` macro.

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

2.2.4 Token Renderer Prototypes

The following TEX macros provide definitions for the token renderers (see Section 2.2.3) 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 and 3.4).

```
\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{}%
\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\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{}%
```

2.2.5 Logging Facilities

The `\markdownInfo`, `\markdownWarning`, and `\markdownError` macros provide access to logging to the rest of the macros. Their first argument specifies the text of the info, warning, or error message.

```
\def\markdownInfo#1{}%
\def\markdownWarning#1{}%
```

The `\markdownError` macro receives a second argument that provides a help text suggesting a remedy to the error.

```
\def\markdownError#1#2{}%
```

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 3.2.6), 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) 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).

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). Note that ⟨*options*⟩ inside the `\usepackage` macro may not set the `markdownRenderers` (see Section 2.3.2.2) and `markdownRendererPrototypes` (see Section 2.3.2.3) 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) as its only argument. These options will only influnce 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*⟩.

The LaTeX options map directly to the options recognized by the plain TeX interface (see Section 2.2.2) and to the markdown token renderers and their prototypes recognized by the plain TeX interface (see Sections 2.2.3 and 2.2.4).

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

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

2.3.2.1 Plain TeX Interface Options

The following options map directly to the option macros exposed by the plain TeX interface (see Section 2.2.2).

```
\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}{hashEnumerators}[true]{%
  \def\markdownOptionHashEnumerators{#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}{preserveTabs}[true]{%
  \def\markdownOptionPreserveTabs{#1}%
\define@key{markdownOptions}{smartEllipses}[true]{%
  \def\markdownOptionSmartEllipses{#1}%
\define@key{markdownOptions}{startNumber}[true]{%
  \def\markdownOptionStartNumber{#1}%
\define@key{markdownOptions}{tightLists}[true]{%
  \def\markdownOptionTightLists{#1}%
\define@key{markdownOptions}{underscores}[true]{%
  \def\markdownOptionUnderscores{#1}%
```

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

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

2.3.2.2 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).

```
\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}{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}%
```

The following example LaTeX code showcases a possible configuration of the `\markdownRendererLink` and `\markdownRendererEmphasis` markdown token renderers.

```
\markdownSetup{
  renderers = {
    link = {#4},                    % Render links as the link title.
    emphasis = {\emph{#1}},    % Render emphasized text via `\emph`.
  }
}
```

2.3.2.3 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).

```
\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}{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}}%
```

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}},    % Render inline code via `\texttt`.
  }
}
```

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).

```
\writestatus{loading}{ConTeXt User Module / 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 Technical Documentation

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

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).

```
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"))
    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
  return setmetatable(u, getmetatable(t))
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 [4, Chapter 21].

```
function util.expand_tabs_in_line(s, tabstop)
  local tab = tabstop or 4
  local corr = 0
  return (s:gsub("()\t", function(p)
```

```
            local sp = tab - (p - 1 + corr) % tab
            corr = corr - 1 + sp
            return string.rep(" ", sp)
          end))
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.

```
function util.walk(t, f)
  local typ = type(t)
  if typ == "string" then
    f(t)
  elseif typ == "table" then
    local i = 1
    local n
    n = t[i]
    while n do
      util.walk(n, f)
      i = i + 1
      n = t[i]
    end
  elseif typ == "function" then
    local ok, val = pcall(t)
    if ok then
      util.walk(val,f)
    end
  else
    f(tostring(t))
  end
end
```

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

```
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 $1 \leq$ `i` $\leq$ `#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
  end
  return new
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 $1 \leq$ `i` $\leq$ `#ary`.

```
function util.map(ary, f)
  local new = {}
  for i,v in ipairs(ary) do
    new[i] = f(v)
  end
  return new
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.

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

Build a string of escapable characters.

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

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

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

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

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

capture that replaces any occurance of the string `k` with the string `v` for each $(\texttt{k},\texttt{v}) \in$ `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.

```
  if string_escapes then
    for k,v in pairs(string_escapes) do
      escapable = P(k) / v + escapable
    end
  end
```

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

```
  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 = {
  ["quot"] = 0x0022,
  ["amp"] = 0x0026,
  ["apos"] = 0x0027,
  ["lt"] = 0x003C,
  ["gt"] = 0x003E,
  ["nbsp"] = 160,
  ["iexcl"] = 0x00A1,
  ["cent"] = 0x00A2,
  ["pound"] = 0x00A3,
  ["curren"] = 0x00A4,
  ["yen"] = 0x00A5,
  ["brvbar"] = 0x00A6,
  ["sect"] = 0x00A7,
  ["uml"] = 0x00A8,
  ["copy"] = 0x00A9,
  ["ordf"] = 0x00AA,
  ["laquo"] = 0x00AB,
  ["not"] = 0x00AC,
  ["shy"] = 173,
  ["reg"] = 0x00AE,
  ["macr"] = 0x00AF,
  ["deg"] = 0x00B0,
  ["plusmn"] = 0x00B1,
  ["sup2"] = 0x00B2,
  ["sup3"] = 0x00B3,
  ["acute"] = 0x00B4,
  ["micro"] = 0x00B5,
  ["para"] = 0x00B6,
  ["middot"] = 0x00B7,
  ["cedil"] = 0x00B8,
  ["sup1"] = 0x00B9,
  ["ordm"] = 0x00BA,
  ["raquo"] = 0x00BB,
  ["frac14"] = 0x00BC,
```

```
735   ["frac12"] = 0x00BD,
736   ["frac34"] = 0x00BE,
737   ["iquest"] = 0x00BF,
738   ["Agrave"] = 0x00C0,
739   ["Aacute"] = 0x00C1,
740   ["Acirc"] = 0x00C2,
741   ["Atilde"] = 0x00C3,
742   ["Auml"] = 0x00C4,
743   ["Aring"] = 0x00C5,
744   ["AElig"] = 0x00C6,
745   ["Ccedil"] = 0x00C7,
746   ["Egrave"] = 0x00C8,
747   ["Eacute"] = 0x00C9,
748   ["Ecirc"] = 0x00CA,
749   ["Euml"] = 0x00CB,
750   ["Igrave"] = 0x00CC,
751   ["Iacute"] = 0x00CD,
752   ["Icirc"] = 0x00CE,
753   ["Iuml"] = 0x00CF,
754   ["ETH"] = 0x00D0,
755   ["Ntilde"] = 0x00D1,
756   ["Ograve"] = 0x00D2,
757   ["Oacute"] = 0x00D3,
758   ["Ocirc"] = 0x00D4,
759   ["Otilde"] = 0x00D5,
760   ["Ouml"] = 0x00D6,
761   ["times"] = 0x00D7,
762   ["Oslash"] = 0x00D8,
763   ["Ugrave"] = 0x00D9,
764   ["Uacute"] = 0x00DA,
765   ["Ucirc"] = 0x00DB,
766   ["Uuml"] = 0x00DC,
767   ["Yacute"] = 0x00DD,
768   ["THORN"] = 0x00DE,
769   ["szlig"] = 0x00DF,
770   ["agrave"] = 0x00E0,
771   ["aacute"] = 0x00E1,
772   ["acirc"] = 0x00E2,
773   ["atilde"] = 0x00E3,
774   ["auml"] = 0x00E4,
775   ["aring"] = 0x00E5,
776   ["aelig"] = 0x00E6,
777   ["ccedil"] = 0x00E7,
778   ["egrave"] = 0x00E8,
779   ["eacute"] = 0x00E9,
780   ["ecirc"] = 0x00EA,
781   ["euml"] = 0x00EB,
```

```
782   ["igrave"] = 0x00EC,
783   ["iacute"] = 0x00ED,
784   ["icirc"] = 0x00EE,
785   ["iuml"] = 0x00EF,
786   ["eth"] = 0x00F0,
787   ["ntilde"] = 0x00F1,
788   ["ograve"] = 0x00F2,
789   ["oacute"] = 0x00F3,
790   ["ocirc"] = 0x00F4,
791   ["otilde"] = 0x00F5,
792   ["ouml"] = 0x00F6,
793   ["divide"] = 0x00F7,
794   ["oslash"] = 0x00F8,
795   ["ugrave"] = 0x00F9,
796   ["uacute"] = 0x00FA,
797   ["ucirc"] = 0x00FB,
798   ["uuml"] = 0x00FC,
799   ["yacute"] = 0x00FD,
800   ["thorn"] = 0x00FE,
801   ["yuml"] = 0x00FF,
802   ["OElig"] = 0x0152,
803   ["oelig"] = 0x0153,
804   ["Scaron"] = 0x0160,
805   ["scaron"] = 0x0161,
806   ["Yuml"] = 0x0178,
807   ["fnof"] = 0x0192,
808   ["circ"] = 0x02C6,
809   ["tilde"] = 0x02DC,
810   ["Alpha"] = 0x0391,
811   ["Beta"] = 0x0392,
812   ["Gamma"] = 0x0393,
813   ["Delta"] = 0x0394,
814   ["Epsilon"] = 0x0395,
815   ["Zeta"] = 0x0396,
816   ["Eta"] = 0x0397,
817   ["Theta"] = 0x0398,
818   ["Iota"] = 0x0399,
819   ["Kappa"] = 0x039A,
820   ["Lambda"] = 0x039B,
821   ["Mu"] = 0x039C,
822   ["Nu"] = 0x039D,
823   ["Xi"] = 0x039E,
824   ["Omicron"] = 0x039F,
825   ["Pi"] = 0x03A0,
826   ["Rho"] = 0x03A1,
827   ["Sigma"] = 0x03A3,
828   ["Tau"] = 0x03A4,
```

```
829   ["Upsilon"] = 0x03A5,
830   ["Phi"] = 0x03A6,
831   ["Chi"] = 0x03A7,
832   ["Psi"] = 0x03A8,
833   ["Omega"] = 0x03A9,
834   ["alpha"] = 0x03B1,
835   ["beta"] = 0x03B2,
836   ["gamma"] = 0x03B3,
837   ["delta"] = 0x03B4,
838   ["epsilon"] = 0x03B5,
839   ["zeta"] = 0x03B6,
840   ["eta"] = 0x03B7,
841   ["theta"] = 0x03B8,
842   ["iota"] = 0x03B9,
843   ["kappa"] = 0x03BA,
844   ["lambda"] = 0x03BB,
845   ["mu"] = 0x03BC,
846   ["nu"] = 0x03BD,
847   ["xi"] = 0x03BE,
848   ["omicron"] = 0x03BF,
849   ["pi"] = 0x03C0,
850   ["rho"] = 0x03C1,
851   ["sigmaf"] = 0x03C2,
852   ["sigma"] = 0x03C3,
853   ["tau"] = 0x03C4,
854   ["upsilon"] = 0x03C5,
855   ["phi"] = 0x03C6,
856   ["chi"] = 0x03C7,
857   ["psi"] = 0x03C8,
858   ["omega"] = 0x03C9,
859   ["thetasym"] = 0x03D1,
860   ["upsih"] = 0x03D2,
861   ["piv"] = 0x03D6,
862   ["ensp"] = 0x2002,
863   ["emsp"] = 0x2003,
864   ["thinsp"] = 0x2009,
865   ["ndash"] = 0x2013,
866   ["mdash"] = 0x2014,
867   ["lsquo"] = 0x2018,
868   ["rsquo"] = 0x2019,
869   ["sbquo"] = 0x201A,
870   ["ldquo"] = 0x201C,
871   ["rdquo"] = 0x201D,
872   ["bdquo"] = 0x201E,
873   ["dagger"] = 0x2020,
874   ["Dagger"] = 0x2021,
875   ["bull"] = 0x2022,
```

```
876   ["hellip"] = 0x2026,
877   ["permil"] = 0x2030,
878   ["prime"] = 0x2032,
879   ["Prime"] = 0x2033,
880   ["lsaquo"] = 0x2039,
881   ["rsaquo"] = 0x203A,
882   ["oline"] = 0x203E,
883   ["frasl"] = 0x2044,
884   ["euro"] = 0x20AC,
885   ["image"] = 0x2111,
886   ["weierp"] = 0x2118,
887   ["real"] = 0x211C,
888   ["trade"] = 0x2122,
889   ["alefsym"] = 0x2135,
890   ["larr"] = 0x2190,
891   ["uarr"] = 0x2191,
892   ["rarr"] = 0x2192,
893   ["darr"] = 0x2193,
894   ["harr"] = 0x2194,
895   ["crarr"] = 0x21B5,
896   ["lArr"] = 0x21D0,
897   ["uArr"] = 0x21D1,
898   ["rArr"] = 0x21D2,
899   ["dArr"] = 0x21D3,
900   ["hArr"] = 0x21D4,
901   ["forall"] = 0x2200,
902   ["part"] = 0x2202,
903   ["exist"] = 0x2203,
904   ["empty"] = 0x2205,
905   ["nabla"] = 0x2207,
906   ["isin"] = 0x2208,
907   ["notin"] = 0x2209,
908   ["ni"] = 0x220B,
909   ["prod"] = 0x220F,
910   ["sum"] = 0x2211,
911   ["minus"] = 0x2212,
912   ["lowast"] = 0x2217,
913   ["radic"] = 0x221A,
914   ["prop"] = 0x221D,
915   ["infin"] = 0x221E,
916   ["ang"] = 0x2220,
917   ["and"] = 0x2227,
918   ["or"] = 0x2228,
919   ["cap"] = 0x2229,
920   ["cup"] = 0x222A,
921   ["int"] = 0x222B,
922   ["there4"] = 0x2234,
```

```
  ["sim"] = 0x223C,
  ["cong"] = 0x2245,
  ["asymp"] = 0x2248,
  ["ne"] = 0x2260,
  ["equiv"] = 0x2261,
  ["le"] = 0x2264,
  ["ge"] = 0x2265,
  ["sub"] = 0x2282,
  ["sup"] = 0x2283,
  ["nsub"] = 0x2284,
  ["sube"] = 0x2286,
  ["supe"] = 0x2287,
  ["oplus"] = 0x2295,
  ["otimes"] = 0x2297,
  ["perp"] = 0x22A5,
  ["sdot"] = 0x22C5,
  ["lceil"] = 0x2308,
  ["rceil"] = 0x2309,
  ["lfloor"] = 0x230A,
  ["rfloor"] = 0x230B,
  ["lang"] = 0x27E8,
  ["rang"] = 0x27E9,
  ["loz"] = 0x25CA,
  ["spades"] = 0x2660,
  ["clubs"] = 0x2663,
  ["hearts"] = 0x2665,
  ["diams"] = 0x2666,
}
```

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]
  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), 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.

```
961 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) `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*⟩.

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

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

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

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

```
967   self.suffix = ".tex"
```

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

```
968   self.space = " "
```

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

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

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

```
970   function self.plain(s)
971     return s
972   end
```

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

```
973   function self.paragraph(s)
974     return s
975   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.

```
function self.pack(name)
  return [[\input"]] .. name .. [["\relax]]
end
```

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

```
self.interblocksep = "\\markdownRendererInterblockSeparator\n{}"
```

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.

```
self.hrule = "\\markdownRendererHorizontalRule{}"
```

Define a table `escaped_chars` containing the mapping from special plain TEX characters (including the active pipe character (`|`) of ConTEXt) to their escaped variants. Define tables `escaped_minimal_chars` and `escaped_minimal_strings` containing the mapping from special plain characters and character strings that need to be escaped even in content that will not be typeset.

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

```
    ["#"] = "\\markdownRendererHash{}",
    ["\\"] = "\\markdownRendererBackslash{}",
  }
  local escaped_minimal_strings = {
    ["^^"] = "\\markdownRendererCircumflex\\markdownRendererCircumflex ",
  }
```

Use the `escaped_chars` table to create an escaper function `escape` and the `escaped_minimal_chars` and `escaped_minimal_strings` tables to create an escaper function `escape_minimal`.

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

Define `writer->string` as a function that will transform an input plain text span `s` 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 `true`, use identity functions. Otherwise, use the `escape` and `escape_minimal` functions.

```
  if options.hybrid then
    self.string = function(s) return s end
    self.citation = function(c) return c end
    self.uri = function(u) return u end
  else
    self.string = escape
    self.citation = escape_citation
    self.uri = escape_uri
  end
```

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{",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.string(src),"}",
                           "{",self.uri(src),"}",
                           "{",self.string(tit or ""),"}"}
  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 kpathsea 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 kpse = require('kpse')
  kpse.set_program_name('luatex')
  local base, prev, curr
  for _, file in ipairs{kpse.lookup(options.contentBlocksLanguageMap,
                                    { all=true })} do
    json = assert(io.open(file, "r")):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
  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)
    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)
    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)
    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` and `writer->display_html` as functions that will transform an inline or block HTML element respectively to the output format, where `html` is the HTML input.

```
  function self.inline_html(html)  return "" end
  function self.display_html(html) return "" 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

  function self.definitionlist(items,tight)
    local buffer = {}
    for _,item in ipairs(items) do
      buffer[#buffer + 1] = dlitem(item.term, item.definitions)
```

```
1148      end
1149      if tight and options.tightLists then
1150        return {"\\markdownRendererDlBeginTight\n", buffer,
1151          "\n\\markdownRendererDlEndTight"}
1152      else
1153        return {"\\markdownRendererDlBegin\n", buffer,
1154          "\n\\markdownRendererDlEnd"}
1155      end
1156    end
```

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

```
1157    function self.emphasis(s)
1158      return {"\\markdownRendererEmphasis{",s,"}"}
1159    end
```

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

```
1160    function self.strong(s)
1161      return {"\\markdownRendererStrongEmphasis{",s,"}"}
1162    end
```

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

```
1163    function self.blockquote(s)
1164      return {"\\markdownRendererBlockQuoteBegin\n",s,
1165        "\n\\markdownRendererBlockQuoteEnd "}
1166    end
```

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

```
1167    function self.verbatim(s)
1168      local name = util.cache(options.cacheDir, s, nil, nil, ".verbatim")
1169      return {"\\markdownRendererInputVerbatim{",name,"}"}
1170    end
```

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

```
1171    function self.fencedCode(i, s)
1172      local name = util.cache(options.cacheDir, s, nil, nil, ".verbatim")
1173      return {"\\markdownRendererInputFencedCode{",name,"}{",i,"}"}
1174    end
```

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

```
1175    function self.heading(s,level)
1176      local cmd
1177      if level == 1 then
1178        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 `true`, 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

```

```
  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.circumflex            = P("^")
parsers.slash                 = P("/")
parsers.equal                 = P("=")
parsers.colon                 = P(":")
parsers.semicolon             = P(";")
parsers.exclamation           = P("!")
parsers.tilde                 = P("~")
parsers.tab                   = P("\t")
parsers.newline               = P("\n")
parsers.tightblocksep         = P("\001")

parsers.digit                 = R("09")
parsers.hexdigit              = R("09","af","AF")
parsers.letter                = R("AZ","az")
parsers.alphanumeric          = R("AZ","az","09")
parsers.keyword               = parsers.letter
```

```
                                * parsers.alphanumeric^0
parsers.citation_chars          = parsers.alphanumeric
                                + S("#$%&-+<>~/_")
parsers.internal_punctuation    = S(":;,.?")

parsers.doubleasterisks         = P("**")
parsers.doubleunderscores       = P("__")
parsers.fourspaces              = P("    ")

parsers.any                     = P(1)
parsers.fail                    = parsers.any - 1

parsers.escapable               = S("\\`*_{}[]()+_.!<>#-~:^@;")
parsers.anyescaped              = P("\\") / "" * parsers.escapable
                                + parsers.any

parsers.spacechar               = S("\t ")
parsers.spacing                 = S(" \n\r\t")
parsers.nonspacechar            = parsers.any - parsers.spacing
parsers.optionalspace           = parsers.spacechar^0

parsers.specialchar             = S("*_`&[]<!\\.@-^")

parsers.normalchar              = parsers.any - (parsers.specialchar
                                              + parsers.spacing
                                              + parsers.tightblocksep)
parsers.eof                     = -parsers.any
parsers.nonindentspace          = parsers.space^-3 * - parsers.spacechar
parsers.indent                  = parsers.space^-3 * parsers.tab
                                + parsers.fourspaces / ""
parsers.linechar                = P(1 - parsers.newline)

parsers.blankline               = parsers.optionalspace
                                * parsers.newline / "\n"
parsers.blanklines              = parsers.blankline^0
parsers.skipblanklines          = (parsers.optionalspace * parsers.newline)^0
parsers.indentedline            = parsers.indent    /""
                                * C(parsers.linechar^1 * parsers.newline^-1)
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.linechar^1 * parsers.eof
parsers.nonemptyline            = parsers.line - parsers.blankline

```

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

-- 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
                 )
```

3.1.4.3 Parsers Used for Markdown Code Spans

```
parsers.openticks   = Cg(parsers.backtick^1, "ticks")

local function captures_equal_length(s,i,a,b)
  return #a == #b and i
end

parsers.closeticks  = parsers.space^-1
                    * Cmt(C(parsers.backtick^1)
                        * Cb("ticks"), captures_equal_length)

parsers.intickschar = (parsers.any - S(" \n\r`"))
                    + (parsers.newline * -parsers.blankline)
                    + (parsers.space - parsers.closeticks)
                    + (parsers.backtick^1 - parsers.closeticks)

parsers.inticks     = parsers.openticks * parsers.space^-1
                    * C(parsers.intickschar^0) * parsers.closeticks
```

3.1.4.4 Parsers Used for Fenced Code Blocks

```
local function captures_geq_length(s,i,a,b)
  return #a >= #b and i
end

parsers.infostring     = (parsers.linechar - (parsers.backtick
                       + parsers.space^1 * (parsers.newline + parsers.eof)))^0

local fenceindent
parsers.fencehead    = function(char)
  return               C(parsers.nonindentspace) / function(s) fenceindent = #s end
                     * Cg(char^3, "fencelength")
                     * parsers.optionalspace * C(parsers.infostring)
                     * parsers.optionalspace * (parsers.newline + parsers.eof)
end

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)
```

```
1511
1512 parsers.citation_body_prenote
1513                     = Cs((parsers.alphanumeric^1
1514                         + parsers.bracketed
1515                         + parsers.inticks
1516                         + (parsers.anyescaped
1517                           - (parsers.rbracket + parsers.blankline^2))
1518                         - (parsers.spnl * parsers.dash^-1 * parsers.at))^0)
1519
1520 parsers.citation_body_postnote
1521                     = Cs((parsers.alphanumeric^1
1522                         + parsers.bracketed
1523                         + parsers.inticks
1524                         + (parsers.anyescaped
1525                           - (parsers.rbracket + parsers.semicolon
1526                             + parsers.blankline^2))
1527                         - (parsers.spnl * parsers.rbracket))^0)
1528
1529 parsers.citation_body_chunk
1530                     = parsers.citation_body_prenote
1531                     * parsers.spnl * parsers.citation_name
1532                     * ((parsers.internal_punctuation - parsers.semicolon)
1533                       * parsers.spnl)^-1
1534                     * parsers.citation_body_postnote
1535
1536 parsers.citation_body
1537                     = parsers.citation_body_chunk
1538                     * (parsers.semicolon * parsers.spnl
1539                       * parsers.citation_body_chunk)^0
1540
1541 parsers.citation_headless_body_postnote
1542                     = Cs((parsers.alphanumeric^1
1543                         + parsers.bracketed
1544                         + parsers.inticks
1545                         + (parsers.anyescaped
1546                           - (parsers.rbracket + parsers.at
1547                             + parsers.semicolon + parsers.blankline^2))
1548                         - (parsers.spnl * parsers.rbracket))^0)
1549
1550 parsers.citation_headless_body
1551                     = parsers.citation_headless_body_postnote
1552                     * (parsers.sp * parsers.semicolon * parsers.spnl
1553                       * parsers.citation_body_chunk)^0
```

3.1.4.8 Parsers Used for Footnotes

```
1554 local function strip_first_char(s)
```

```
  return s:sub(2)
end

parsers.RawNoteRef = #(parsers.lbracket * parsers.circumflex)
                   * parsers.tag / strip_first_char
```

3.1.4.9 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
```

```
1599
1600 parsers.htmlattribute     = parsers.spacing^1
1601                           * (parsers.alphanumeric + S("_-"))^1
1602                           * parsers.sp * parsers.equal * parsers.sp
1603                           * parsers.htmlattributevalue
1604
1605 parsers.htmlcomment       = P("<!--") * (parsers.any - P("-->"))^0 * P("-->")
1606
1607 parsers.htmlinstruction   = P("<?")   * (parsers.any - P("?>" ))^0 * P("?>" )
1608
1609 parsers.openelt_any = parsers.less * parsers.keyword * parsers.htmlattribute^0
1610                     * parsers.sp * parsers.more
1611
1612 parsers.openelt_exact = function(s)
1613   return parsers.less * parsers.sp * parsers.keyword_exact(s)
1614        * parsers.htmlattribute^0 * parsers.sp * parsers.more
1615 end
1616
1617 parsers.openelt_block = parsers.sp * parsers.block_keyword
1618                       * parsers.htmlattribute^0 * parsers.sp * parsers.more
1619
1620 parsers.closeelt_any = parsers.less * parsers.sp * parsers.slash
1621                      * parsers.keyword * parsers.sp * parsers.more
1622
1623 parsers.closeelt_exact = function(s)
1624   return parsers.less * parsers.sp * parsers.slash * parsers.keyword_exact(s)
1625        * parsers.sp * parsers.more
1626 end
1627
1628 parsers.emptyelt_any = parsers.less * parsers.sp * parsers.keyword
1629                      * parsers.htmlattribute^0 * parsers.sp * parsers.slash
1630                      * parsers.more
1631
1632 parsers.emptyelt_block = parsers.less * parsers.sp * parsers.block_keyword
1633                        * parsers.htmlattribute^0 * parsers.sp * parsers.slash
1634                        * parsers.more
1635
1636 parsers.displaytext = (parsers.any - parsers.less)^1
1637
1638 -- return content between two matched HTML tags
1639 parsers.in_matched = function(s)
1640   return { parsers.openelt_exact(s)
1641          * (V(1) + parsers.displaytext
1642            + (parsers.less - parsers.closeelt_exact(s)))^0
1643          * parsers.closeelt_exact(s) }
1644 end
1645
```

```
local function parse_matched_tags(s,pos)
  local t = string.lower(lpeg.match(C(parsers.keyword),s,pos))
  return lpeg.match(parsers.in_matched(t),s,pos-1)
end

parsers.in_matched_block_tags = parsers.less
                              * Cmt(#parsers.openelt_block, parse_matched_tags)

parsers.displayhtml = parsers.htmlcomment
                    + parsers.emptyelt_block
                    + parsers.openelt_exact("hr")
                    + parsers.in_matched_block_tags
                    + parsers.htmlinstruction

parsers.inlinehtml  = parsers.emptyelt_any
                    + parsers.htmlcomment
                    + parsers.htmlinstruction
                    + parsers.openelt_any
                    + parsers.closeelt_any
```

3.1.4.10 Parsers Used for HTML entities

```
parsers.hexentity = parsers.ampersand * parsers.hash * S("Xx")
                  * C(parsers.hexdigit^1) * parsers.semicolon
parsers.decentity = parsers.ampersand * parsers.hash
                  * C(parsers.digit^1) * parsers.semicolon
parsers.tagentity = parsers.ampersand * C(parsers.alphanumeric^1)
                  * parsers.semicolon
```

3.1.4.11 Helpers for References

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

3.1.4.12 Inline Elements

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

-- 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
```

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

3.1.4.14 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)
```

3.1.4.15 Headings

```
1724 -- parse Atx heading start and return level
1725 parsers.HeadingStart = #parsers.hash * C(parsers.hash^-6)
1726                       * -parsers.hash / length
1727
1728 -- parse setext header ending and return level
1729 parsers.HeadingLevel = parsers.equal^1 * Cc(1) + parsers.dash^1 * Cc(2)
1730
1731 local function strip_atx_end(s)
1732   return s:gsub("[#%s]*\n$","")
1733 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), 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) `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*⟩.

```
1734 M.reader = {}
1735 function M.reader.new(writer, options)
1736   local self = {}
1737   options = options or {}
```

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

```
1738   setmetatable(options, { __index = function (_, key)
1739     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.

```
1740   local function normalize_tag(tag)
1741     return unicode.utf8.lower(
1742       gsub(util.rope_to_string(tag), "[ \n\r\t]+", " "))
1743   end
```

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

```
local expandtabs
if options.preserveTabs then
  expandtabs = function(s) return s end
else
  expandtabs = function(s)
                 if s:find("\t") then
                   return s:gsub("[^\n]*", util.expand_tabs_in_line)
                 else
                   return s
                 end
               end
end
```

The `larsers` (as in "local `parsers`") hash table stores PEG patterns that depend on the received `options`, which impedes their reuse between different `reader` objects.

```
local larsers    = {}
```

3.1.5.2 Top-Level Parser Functions

```
local function create_parser(name, grammar)
  return function(str)
    local res = lpeg.match(grammar(), str)
    if res == nil then
      error(format("%s failed on:\n%s", name, str:sub(1,20)))
    else
      return res
    end
  end
end

local parse_blocks
  = create_parser("parse_blocks",
                  function()
                    return larsers.blocks
                  end)

local parse_blocks_toplevel
  = create_parser("parse_blocks_toplevel",
                  function()
                    return larsers.blocks_toplevel
                  end)

local parse_inlines
  = create_parser("parse_inlines",
                  function()
```

```
                    return larsers.inlines
                  end)

local parse_inlines_no_link
  = create_parser("parse_inlines_no_link",
                  function()
                    return larsers.inlines_no_link
                  end)

local parse_inlines_no_inline_note
  = create_parser("parse_inlines_no_inline_note",
                  function()
                    return larsers.inlines_no_inline_note
                  end)

local parse_inlines_nbsp
  = create_parser("parse_inlines_nbsp",
                  function()
                    return larsers.inlines_nbsp
                  end)
```

3.1.5.3 Parsers Used for Markdown Lists (local)

```
if options.hashEnumerators then
  larsers.dig = parsers.digit + parsers.hash
else
  larsers.dig = parsers.digit
end

larsers.enumerator = C(larsers.dig^3 * parsers.period) * #parsers.spacing
                   + C(larsers.dig^2 * parsers.period) * #parsers.spacing
                                       * (parsers.tab + parsers.space^1)
                   + C(larsers.dig * parsers.period) * #parsers.spacing
                                      * (parsers.tab + parsers.space^-2)
                   + parsers.space * C(larsers.dig^2 * parsers.period)
                                      * #parsers.spacing
                   + parsers.space * C(larsers.dig * parsers.period)
                                      * #parsers.spacing
                                      * (parsers.tab + parsers.space^-1)
                   + parsers.space * parsers.space * C(larsers.dig^1
                                      * parsers.period) * #parsers.spacing
```

3.1.5.4 Parsers Used for Blockquotes (local)

```
-- strip off leading > and indents, and run through blocks
larsers.blockquote_body = ((parsers.leader * parsers.more * parsers.space^-1)/""
                           * parsers.linechar^0 * parsers.newline)^1
                         * (-(parsers.leader * parsers.more
```

```
                                + parsers.blankline) * parsers.linechar^1
                              * parsers.newline)^0

if not options.breakableBlockquotes then
  larsers.blockquote_body = larsers.blockquote_body
                          * (parsers.blankline^0 / "")
end
```

3.1.5.5 Parsers Used for Citations (local)

```
larsers.citations = function(text_cites, raw_cites)
    local function normalize(str)
        if str == "" then
            str = nil
        else
            str = (options.citationNbsps and parse_inlines_nbsp or
              parse_inlines)(str)
        end
        return str
    end

    local cites = {}
    for i = 1,#raw_cites,4 do
        cites[#cites+1] = {
            prenote = normalize(raw_cites[i]),
            suppress_author = raw_cites[i+1] == "-",
            name = writer.citation(raw_cites[i+2]),
            postnote = normalize(raw_cites[i+3]),
        }
    end
    return writer.citations(text_cites, cites)
end
```

3.1.5.6 Parsers Used for Footnotes (local)

```
local rawnotes = {}

-- like indirect_link
local function lookup_note(ref)
  return function()
    local found = rawnotes[normalize_tag(ref)]
    if found then
      return writer.note(parse_blocks_toplevel(found))
    else
      return {"[", parse_inlines("^" .. ref), "]"}
    end
  end
end
```

```
1867
1868  local function register_note(ref,rawnote)
1869    rawnotes[normalize_tag(ref)] = rawnote
1870    return ""
1871  end
1872
1873  larsers.NoteRef    = parsers.RawNoteRef / lookup_note
1874
1875
1876  larsers.NoteBlock  = parsers.leader * parsers.RawNoteRef * parsers.colon
1877                     * parsers.spnl * parsers.indented_blocks(parsers.chunk)
1878                     / register_note
1879
1880  larsers.InlineNote = parsers.circumflex
1881                     * (parsers.tag / parse_inlines_no_inline_note) -- no notes inside n
1882                     / writer.note
```

3.1.5.7 Helpers for Links and References (local)

```
1883  -- List of references defined in the document
1884  local references
1885
1886  -- add a reference to the list
1887  local function register_link(tag,url,title)
1888      references[normalize_tag(tag)] = { url = url, title = title }
1889      return ""
1890  end
1891
1892  -- lookup link reference and return either
1893  -- the link or nil and fallback text.
1894  local function lookup_reference(label,sps,tag)
1895      local tagpart
1896      if not tag then
1897          tag = label
1898          tagpart = ""
1899      elseif tag == "" then
1900          tag = label
1901          tagpart = "[]"
1902      else
1903          tagpart = {"[", parse_inlines(tag), "]"}
1904      end
1905      if sps then
1906        tagpart = {sps, tagpart}
1907      end
1908      local r = references[normalize_tag(tag)]
1909      if r then
1910        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 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 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
```

3.1.5.8 Inline Elements (local)

```
  larsers.Str      = parsers.normalchar^1 / writer.string

  larsers.Symbol   = (parsers.specialchar - parsers.tightblocksep)
                   / writer.string

  larsers.Ellipsis = P("...") / writer.ellipsis

  larsers.Smart    = larsers.Ellipsis

  larsers.Code     = parsers.inticks / writer.code

  if options.blankBeforeBlockquote then
    larsers.bqstart = parsers.fail
  else
```

```
  larsers.bqstart = parsers.more
end

if options.blankBeforeHeading then
  larsers.headerstart = parsers.fail
else
  larsers.headerstart = parsers.hash
                      + (parsers.line * (parsers.equal^1 + parsers.dash^1)
                      * parsers.optionalspace * parsers.newline)
end

if not options.fencedCode or options.blankBeforeCodeFence then
  larsers.fencestart = parsers.fail
else
  larsers.fencestart = parsers.fencehead(parsers.backtick)
                     + parsers.fencehead(parsers.tilde)
end

larsers.Endline   = parsers.newline * -( -- newline, but not before...
                      parsers.blankline -- paragraph break
                    + parsers.tightblocksep  -- nested list
                    + parsers.eof       -- end of document
                    + larsers.bqstart
                    + larsers.headerstart
                    + larsers.fencestart
                  ) * parsers.spacechar^0 / writer.space

larsers.Space      = parsers.spacechar^2 * larsers.Endline / writer.linebreak
                   + parsers.spacechar^1 * larsers.Endline^-1 * parsers.eof / ""
                   + parsers.spacechar^1 * larsers.Endline^-1
                                         * parsers.optionalspace / writer.space

larsers.NonbreakingEndline
                  = parsers.newline * -( -- newline, but not before...
                      parsers.blankline -- paragraph break
                    + parsers.tightblocksep  -- nested list
                    + parsers.eof       -- end of document
                    + larsers.bqstart
                    + 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
```

```
2002
2003  if options.underscores then
2004    larsers.Strong = ( parsers.between(parsers.Inline, parsers.doubleasterisks,
2005                                       parsers.doubleasterisks)
2006                     + parsers.between(parsers.Inline, parsers.doubleunderscores,
2007                                       parsers.doubleunderscores)
2008                     ) / writer.strong
2009
2010    larsers.Emph   = ( parsers.between(parsers.Inline, parsers.asterisk,
2011                                       parsers.asterisk)
2012                     + parsers.between(parsers.Inline, parsers.underscore,
2013                                       parsers.underscore)
2014                     ) / writer.emphasis
2015  else
2016    larsers.Strong = ( parsers.between(parsers.Inline, parsers.doubleasterisks,
2017                                       parsers.doubleasterisks)
2018                     ) / writer.strong
2019
2020    larsers.Emph   = ( parsers.between(parsers.Inline, parsers.asterisk,
2021                                       parsers.asterisk)
2022                     ) / writer.emphasis
2023  end
2024
2025  larsers.AutoLinkUrl    = parsers.less
2026                          * C(parsers.alphanumeric^1 * P("://") * parsers.urlchar^1)
2027                          * parsers.more
2028                          / function(url)
2029                              return writer.link(writer.string(url), url)
2030                            end
2031
2032  larsers.AutoLinkEmail = parsers.less
2033                        * C((parsers.alphanumeric + S("-._+"))^1
2034                        * P("@") * parsers.urlchar^1)
2035                        * parsers.more
2036                        / function(email)
2037                            return writer.link(writer.string(email),
2038                                               "mailto:"..email)
2039                          end
2040
2041  larsers.DirectLink    = (parsers.tag / parse_inlines_no_link)  -- no links inside link
2042                        * parsers.spnl
2043                        * parsers.lparent
2044                        * (parsers.url + Cc(""))  -- link can be empty [foo]()
2045                        * parsers.optionaltitle
2046                        * parsers.rparent
2047                        / writer.link
2048
```

```
larsers.IndirectLink  = parsers.tag * (C(parsers.spnl) * parsers.tag)^-1
                      / indirect_link

-- parse a link or image (direct or indirect)
larsers.Link          = larsers.DirectLink + larsers.IndirectLink

larsers.DirectImage   = parsers.exclamation
                      * (parsers.tag / parse_inlines)
                      * parsers.spnl
                      * parsers.lparent
                      * (parsers.url + Cc(""))  -- link can be empty [foo]()
                      * parsers.optionaltitle
                      * parsers.rparent
                      / writer.image

larsers.IndirectImage = parsers.exclamation * parsers.tag
                      * (C(parsers.spnl) * parsers.tag)^-1 / indirect_image

larsers.Image         = larsers.DirectImage + larsers.IndirectImage

larsers.TextCitations = Ct(Cc("")
                      * parsers.citation_name
                      * ((parsers.spnl
                          * parsers.lbracket
                          * parsers.citation_headless_body
                          * parsers.rbracket) + Cc("")))
                      / function(raw_cites)
                          return larsers.citations(true, raw_cites)
                        end

larsers.ParenthesizedCitations
                      = Ct(parsers.lbracket
                      * parsers.citation_body
                      * parsers.rbracket)
                      / function(raw_cites)
                          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   = S("\\") * C(parsers.escapable) / writer.string

larsers.InlineHtml    = C(parsers.inlinehtml) / writer.inline_html
```

```
2096
2097  larsers.HtmlEntity    = parsers.hexentity / entities.hex_entity  / writer.string
2098                        + parsers.decentity / entities.dec_entity  / writer.string
2099                        + parsers.tagentity / entities.char_entity / writer.string
```

3.1.5.9 Block Elements (local)

```
2100  larsers.ContentBlock = parsers.leader
2101                       * (parsers.localfilepath + parsers.onlineimageurl)
2102                       * parsers.contentblock_tail
2103                       / writer.contentblock
2104
2105  larsers.DisplayHtml  = C(parsers.displayhtml)
2106                       / expandtabs / writer.display_html
2107
2108  larsers.Verbatim     = Cs( (parsers.blanklines
2109                           * ((parsers.indentedline - parsers.blankline))^1)^1
2110                           ) / expandtabs / writer.verbatim
2111
2112  larsers.FencedCode   = (parsers.TildeFencedCode
2113                         + parsers.BacktickFencedCode)
2114                       / function(infostring, code)
2115                           return writer.fencedCode(writer.string(infostring),
2116                                                    expandtabs(code))
2117                         end
2118
2119  larsers.Blockquote   = Cs(larsers.blockquote_body^1)
2120                       / parse_blocks_toplevel / writer.blockquote
2121
2122  larsers.HorizontalRule = ( parsers.lineof(parsers.asterisk)
2123                           + parsers.lineof(parsers.dash)
2124                           + parsers.lineof(parsers.underscore)
2125                           ) / writer.hrule
2126
2127  larsers.Reference    = parsers.define_reference_parser / register_link
2128
2129  larsers.Paragraph    = parsers.nonindentspace * Ct(parsers.Inline^1)
2130                       * parsers.newline
2131                       * ( parsers.blankline^1
2132                         + #parsers.hash
2133                         + #(parsers.leader * parsers.more * parsers.space^-1)
2134                         )
2135                       / writer.paragraph
2136
2137  larsers.ToplevelParagraph
2138                       = parsers.nonindentspace * Ct(parsers.Inline^1)
2139                       * ( 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
```

3.1.5.10 Lists (local)

```
larsers.starter = parsers.bullet + larsers.enumerator

-- 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.ListBlock * larsers.NestedList^-1)
             / parse_blocks)
           * -(parsers.blanklines * parsers.indent)
end

larsers.LooseListItem = function(starter)
    return -larsers.HorizontalRule
           * Cs( starter / "" * 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 '#'
  else
    startNumber = nil
  end
  return writer.orderedlist(items,tight,startNumber)
end

larsers.OrderedList = Cg(larsers.enumerator, "listtype") *
                    ( Ct(larsers.TightListItem(Cb("listtype"))
                        * larsers.TightListItem(larsers.enumerator)^0)
                    * Cc(true) * parsers.skipblanklines * -larsers.enumerator
                    + Ct(larsers.LooseListItem(Cb("listtype"))
                        * larsers.LooseListItem(larsers.enumerator)^0)
                    * Cc(false) * parsers.skipblanklines
                    ) * Cb("listtype") / ordered_list

local function definition_list_item(term, defs, tight)
  return { term = parse_inlines(term), definitions = defs }
end

larsers.DefinitionListItemLoose = C(parsers.line) * parsers.skipblanklines
                                * Ct((parsers.defstart
                                     * parsers.indented_blocks(parsers.dlchunk)
                                     / parse_blocks_toplevel)^1)
                                * Cc(false) / definition_list_item

larsers.DefinitionListItemTight = C(parsers.line)
                                * Ct((parsers.defstart * parsers.dlchunk
                                     / parse_blocks)^1)
                                * Cc(true) / definition_list_item

larsers.DefinitionList = ( Ct(larsers.DefinitionListItemLoose^1) * Cc(false)
                         + Ct(larsers.DefinitionListItemTight^1)
                         * (parsers.skipblanklines
                           * -larsers.DefinitionListItemLoose * Cc(true))
                         ) / writer.definitionlist
```

3.1.5.11 Blank (local)

```
larsers.Blank        = parsers.blankline / ""
                     + larsers.NoteBlock
```

```
                      + larsers.Reference
                      + (parsers.tightblocksep / "\n")
```

3.1.5.12 Headings (local)

```
-- parse atx header
larsers.AtxHeading = Cg(parsers.HeadingStart,"level")
                   * parsers.optionalspace
                   * (C(parsers.line) / strip_atx_end / parse_inlines)
                   * Cb("level")
                   / writer.heading

-- parse setext header
larsers.SetextHeading = #(parsers.line * S("=-"))
                        * Ct(parsers.line / parse_inlines)
                        * parsers.HeadingLevel
                        * parsers.optionalspace * parsers.newline
                        / writer.heading

larsers.Heading = larsers.AtxHeading + larsers.SetextHeading
```

3.1.5.13 Syntax Specification

```
local syntax =
  { "Blocks",

    Blocks                = larsers.Blank^0 * parsers.Block^-1
                          * (larsers.Blank^0 / function()
                                                 return writer.interblocksep
                                               end
                            * parsers.Block)^0
                          * larsers.Blank^0 * parsers.eof,

    Blank                 = larsers.Blank,

    Block                 = V("ContentBlock")
                          + V("Blockquote")
                          + 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,
        HorizontalRule        = larsers.HorizontalRule,
        BulletList            = larsers.BulletList,
        OrderedList           = larsers.OrderedList,
        Heading               = larsers.Heading,
        DefinitionList        = larsers.DefinitionList,
        DisplayHtml           = larsers.DisplayHtml,
        Paragraph             = larsers.Paragraph,
        Plain                 = larsers.Plain,

        Inline                = V("Str")
                              + V("Space")
                              + V("Endline")
                              + V("UlOrStarLine")
                              + V("Strong")
                              + V("Emph")
                              + V("InlineNote")
                              + V("NoteRef")
                              + V("Citations")
                              + V("Link")
                              + V("Image")
                              + V("Code")
                              + V("AutoLinkUrl")
                              + V("AutoLinkEmail")
                              + V("InlineHtml")
                              + V("HtmlEntity")
                              + V("EscapedChar")
                              + V("Smart")
                              + V("Symbol"),

        Str                   = larsers.Str,
        Space                 = larsers.Space,
        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
  end

  if not options.html then
    syntax.DisplayHtml = parsers.fail
    syntax.InlineHtml = parsers.fail
    syntax.HtmlEntity  = parsers.fail
  end

  if not options.inlineFootnotes then
    syntax.InlineNote = parsers.fail
  end

  if not options.smartEllipses then
    syntax.Smart = parsers.fail
  end

  local blocks_toplevel_t = util.table_copy(syntax)
  blocks_toplevel_t.Paragraph = larsers.ToplevelParagraph
```

```
2364  larsers.blocks_toplevel = Ct(blocks_toplevel_t)
2365
2366  larsers.blocks = Ct(syntax)
2367
2368  local inlines_t = util.table_copy(syntax)
2369  inlines_t[1] = "Inlines"
2370  inlines_t.Inlines = parsers.Inline^0 * (parsers.spacing^0 * parsers.eof / "")
2371  larsers.inlines = Ct(inlines_t)
2372
2373  local inlines_no_link_t = util.table_copy(inlines_t)
2374  inlines_no_link_t.Link = parsers.fail
2375  larsers.inlines_no_link = Ct(inlines_no_link_t)
2376
2377  local inlines_no_inline_note_t = util.table_copy(inlines_t)
2378  inlines_no_inline_note_t.InlineNote = parsers.fail
2379  larsers.inlines_no_inline_note = Ct(inlines_no_inline_note_t)
2380
2381  local inlines_nbsp_t = util.table_copy(inlines_t)
2382  inlines_nbsp_t.Endline = larsers.NonbreakingEndline
2383  inlines_nbsp_t.Space = larsers.NonbreakingSpace
2384  larsers.inlines_nbsp = Ct(inlines_nbsp_t)
```

3.1.5.14 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.

```
2385  function self.convert(input)
2386    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). The `cacheDir` option is disregarded.

```
2387    local opt_string = {}
2388    for k,_ in pairs(defaultOptions) do
2389      local v = options[k]
2390      if k ~= "cacheDir" then
2391        opt_string[#opt_string+1] = k .. "=" .. tostring(v)
2392      end
2393    end
2394    table.sort(opt_string)
2395    local salt = table.concat(opt_string, ",") .. "," .. metadata.version
```

Produce the cache file, transform its filename via the `writer->pack` method, and return the result.

```
2396    local name = util.cache(options.cacheDir, input, salt, function(input)
2397        return util.rope_to_string(parse_blocks_toplevel(input)) .. writer.eof
2398      end, ".md" .. writer.suffix)
```

```
    return writer.pack(name)
  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) `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
```

3.2 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).

3.2.1 Logging Facilities

```
\def\markdownInfo#1{%
  \immediate\write-1{(l.\the\inputlineno) markdown.tex info: #1.}}%
\def\markdownWarning#1{%
  \immediate\write16{(l.\the\inputlineno) markdown.tex warning: #1}}%
\def\markdownError#1#2{%
  \errhelp{#2.}%
  \errmessage{(l.\the\inputlineno) markdown.tex error: #1}}%
```

3.2.2 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{\char`&}%
\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{}%
```

3.2.3 Lua Snippets

The `\markdownLuaOptions` macro expands to a Lua table that contains the plain TEX options (see Section 2.2.2) in a format recognized by Lua (see Section 2.1.2).

```
\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\markdownOptionFootnotes\undefined\else
  footnotes = \markdownOptionFootnotes,
\fi
\ifx\markdownOptionFencedCode\undefined\else
  fencedCode = \markdownOptionFencedCode,
\fi
\ifx\markdownOptionHashEnumerators\undefined\else
  hashEnumerators = \markdownOptionHashEnumerators,
\fi
\ifx\markdownOptionHtml\undefined\else
  html = \markdownOptionHtml,
\fi
\ifx\markdownOptionHybrid\undefined\else
  hybrid = \markdownOptionHybrid,
\fi
\ifx\markdownOptionInlineFootnotes\undefined\else
  inlineFootnotes = \markdownOptionInlineFootnotes,
\fi
  outputDir = "\markdownOptionOutputDir",
\ifx\markdownOptionPreserveTabs\undefined\else
  preserveTabs = \markdownOptionPreserveTabs,
\fi
\ifx\markdownOptionSmartEllipses\undefined\else
  smartEllipses = \markdownOptionSmartEllipses,
\fi
\ifx\markdownOptionStartNumber\undefined\else
  startNumber = \markdownOptionStartNumber,
\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 lfs.isdir(cacheDir) == true then else
  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)
}%
```

3.2.4 Buffering Markdown Input

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 2_ε `\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.

```
  \catcode`\^^M=13%
  \catcode`\^^I=13%
  \catcode`|=0%
  \catcode`\\=12%
  |gdef|markdownReadAndConvert#1#2{%
    |begingroup%
```

Open the `\markdownOptionInputTempFileName` file for writing.

```
    |immediate|openout|markdownOutputFileStream%
      |markdownOptionInputTempFileName%
    |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 \markdownReadAndConvertProcessLine macro will process the individual lines of output. Note the use of the comments to ensure that the entire macro is at a single line and therefore no (active) newline symbols are produced.

```
2578      |def|markdownReadAndConvertProcessLine##1#1##2#1##3|relax{%
```

When the ending token sequence does not appear in the line, store the line in the \markdownOptionInputTempFileName file.

```
2579        |ifx|relax##3|relax%
2580          |immediate|write|markdownOutputFileStream{##1}%
2581        |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.

```
2582          |def^^M{%
2583            |markdownInfo{The ending token sequence was found}%
2584            |immediate|closeout|markdownOutputFileStream%
2585            |endgroup%
2586            |markdownInput|markdownOptionInputTempFileName%
2587            #2}%
2588        |fi%
```

Repeat with the next line.

```
2589        ^^M}%
```

Make the tab character active at expansion time and make it expand to a literal tab character.

```
2590      |catcode`|^^I=13%
2591      |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.

```
2592      |catcode`|^^M=13%
2593      |def^^M##1^^M{%
2594        |def^^M####1^^M{%
2595          |markdownReadAndConvertProcessLine####1#1#1|relax}%
2596        ^^M}%
2597      ^^M}%
```

Reset the character categories back to the former state.

```
2598 |endgroup
```

3.2.5 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 3.2.6 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 (see [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 kpse = require('kpse')
        kpse.set_program_name('luatex')
        #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
```

3.2.6 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 3.2.5 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 3.2.5,

```
\def\markdownLuaExecute#1{\directlua{local print = tex.print #1}}%
\fi
```

3.2.7 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{%
  |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 input = assert(io.open("#1","r")):read("*a")
```

Since the Lua converter expects UNIX line endings, normalize the input.

```
    print(convert(input:gsub("\r\n?", "\n")))}}%
|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 (see [5, Section 9]). As a consequence, we can directly reuse the existing plain TeX implementation.

```
\input markdown
\def\markdownVersionSpace{ }%
\ProvidesPackage{markdown}[\markdownLastModified\markdownVersionSpace v%
  \markdownVersion\markdownVersionSpace markdown renderer]%
```

3.3.1 Logging Facilities

The LaTeX implementation redefines the plain TeX logging macros (see Section 3.2.1) to use the LaTeX `\PackageInfo`, `\PackageWarning`, and `\PackageError` macros.

```
\renewcommand\markdownInfo[1]{\PackageInfo{markdown}{#1}}%
\renewcommand\markdownWarning[1]{\PackageWarning{markdown}{#1}}%
\renewcommand\markdownError[2]{\PackageError{markdown}{#1}{#2.}}%
```

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).

```
\let\markdownInputPlainTeX\markdownInput
```

```
\renewcommand\markdownInput[2][]{%
  \begingroup
    \markdownSetup{#1}%
    \markdownInputPlainTeX{#2}%
  \endgroup}%
```

The `markdown`, and `markdown*` LaTeX environments are implemented using the `\markdownReadAndConvert` macro.

```
\renewenvironment{markdown}{%
  \markdownReadAndConvert@markdown{}}\relax
\renewenvironment{markdown*}[1]{%
  \markdownSetup{#1}%
  \markdownReadAndConvert@markdown*}\relax
\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@}}%
```

3.3.4 Token Renderer Prototypes

The following configuration should be considered placeholder.

If the `\markdownOptionTightLists` macro expands to `false`, do not load the paralist package. This is necessary for LaTeX 2$_\varepsilon$ 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.

```
\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}}}}
\markdownSetup{rendererPrototypes={
  lineBreak = {\\},
  leftBrace = {\textbraceleft},
  rightBrace = {\textbraceright},
  dollarSign = {\textdollar},
  underscore = {\textunderscore},
  circumflex = {\textasciicircum},
  backslash = {\textbackslash},
  tilde = {\textasciitilde},
  pipe = {\textbar},
  codeSpan = {\texttt{#1}},
  link = {#1\footnote{\ifx\empty#4\empty\else#4:
    \fi\texttt<\url{#3}\texttt>}},
  contentBlock = {%
    \ifthenelse{\equal{#1}{csv}}{%
      \begin{table}%
        \begin{center}%
          \csvautotabular{#3}%
```

```
        \end{center}
        \ifx\empty#4\empty\else
          \caption{#4}%
        \fi
        \label{tab:#1}%
      \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}},
  ulItem = {\item},
  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}},
  blockQuoteBegin = {\begin{quotation}},
  blockQuoteEnd = {\end{quotation}},
  inputVerbatim = {\VerbatimInput{#1}},
  inputFencedCode = {%
    \ifx\relax#2\relax
      \VerbatimInput{#1}%
    \else
      \ifx\minted@jobname\undefined
        \ifx\lst@version\undefined
          \markdownRendererInputFencedCode{#1}{}%
```

When the listings package is loaded, use it for syntax highlighting.

```
        \else
          \lstinputlisting[language=#2]{#1}%
        \fi
```

When the minted package is loaded, use it for syntax highlighting. The minted package is preferred over listings.

```
      \else
        \inputminted{#2}{#1}%
```

```
      \fi
    \fi},
  horizontalRule = {\noindent\rule[0.5ex]{\linewidth}{1pt}},
  footnote = {\footnote{#1}}}}
```

Support the nesting of strong emphasis.

```
\newif\ifmarkdownLATEXStrongEmphasisNested
\markdownLATEXStrongEmphasisNestedfalse
\markdownSetup{rendererPrototypes={
  strongEmphasis = {%
    \ifmarkdownLATEXStrongEmphasisNested
      \markdownLATEXStrongEmphasisNestedfalse
      \textmd{#1}%
      \markdownLATEXStrongEmphasisNestedtrue
    \else
      \markdownLATEXStrongEmphasisNestedtrue
      \textbf{#1}%
      \markdownLATEXStrongEmphasisNestedfalse
    \fi}}}
```

Support LaTeX document classes that do not provide chapters.

```
\ifx\chapter\undefined
  \markdownSetup{rendererPrototypes = {
    headingOne = {\section{#1}},
    headingTwo = {\subsection{#1}},
    headingThree = {\subsubsection{#1}},
    headingFour = {\paragraph{#1}},
    headingFive = {\subparagraph{#1}}}}
\else
  \markdownSetup{rendererPrototypes = {
    headingOne = {\chapter{#1}},
    headingTwo = {\section{#1}},
    headingThree = {\subsection{#1}},
    headingFour = {\subsubsection{#1}},
    headingFive = {\paragraph{#1}},
    headingSix = {\subparagraph{#1}}}}
\fi
```

There is a basic implementation for citations that uses the LaTeX `\cite` macro. There is also a more advanced implementation that uses the BibLaTeX `\autocites` and `\textcites` macros. This implementation will be used, when BibLaTeX is loaded.

```
\newcount\markdownLaTeXCitationsCounter

% Basic implementation
\def\markdownLaTeXBasicCitations#1#2#3#4{%
  \advance\markdownLaTeXCitationsCounter by 1\relax
  \ifx\relax#2\relax\else#2~\fi\cite[#3]{#4}%
  \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
```

```
    \expandafter\@gobble
  \fi\markdownLaTeXBasicCitations}
\let\markdownLaTeXBasicTextCitations\markdownLaTeXBasicCitations

% 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}%
    \ifx\autocites\undefined
      \expandafter
      \markdownLaTeXBasicCitations
    \else
      \expandafter\expandafter\expandafter
      \markdownLaTeXBibLaTeXCitations
      \expandafter{\expandafter}%
    \fi},
  textCite = {%
    \markdownLaTeXCitationsCounter=1%
    \def\markdownLaTeXCitationsTotal{#1}%
    \ifx\textcites\undefined
      \expandafter
      \markdownLaTeXBasicTextCitations
    \else
      \expandafter\expandafter\expandafter
      \markdownLaTeXBibLaTeXTextCitations
      \expandafter{\expandafter}%
    \fi}}}
```

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.

```
\def\dospecials{\do\ \do\\\do\{\do\}\do\$\do\&%
  \do\#\do\^\do\_\do\%\do\~}%
\input 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 Logging Facilities

The ConTEXt implementation redefines the plain TEX logging macros (see Section 3.2.1) to use the ConTEXt `\writestatus` macro.

```
\def\markdownInfo#1{\writestatus{markdown}{#1.}}%
\def\markdownWarning#1{\writestatus{markdown\space warn}{#1.}}%
```

3.4.2 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}}%
|endgroup
```

3.4.3 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:

```
% Map the ‘TEX‘ syntax highlighter to the ‘latex‘ infostring.
\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
```

References

1. LUATEX DEVELOPMENT TEAM. *LuaTEX reference manual* [online]. 2016 [visited on 2016-11-27]. Available from: http://www.luatex.org/svn/trunk/manual/luatex.pdf.
2. SOTKOV, Anton. *File transclusion syntax for Markdown* [online]. 2017 [visited on 2017-03-18]. Available from: https://github.com/iainc/Markdown-Content-Blocks.
3. KNUTH, Donald Ervin. *The TEXbook*. 3rd ed. Addison-Wesley, 1986. ISBN 0-201-13447-0.

4. IERUSALIMSCHY, Roberto. *Programming in Lua*. 3rd ed. Rio de Janeiro: PUC-Rio, 2013. ISBN 978-85-903798-5-0.
5. BRAAMS, Johannes; CARLISLE, David; JEFFREY, Alan; LAMPORT, Leslie; MITTELBACH, Frank; ROWLEY, Chris; SCHÖPF, Rainer. *The LaTeX 2$_\varepsilon$ Sources* [online]. 2016 [visited on 2016-09-27]. Available from: http://mirrors.ctan.org/macros/latex/base/source2e.pdf.