A Markdown Interpreter for TEX

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1 Introduction

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

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

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

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

```
local metadata = {
    version   = "(((VERSION)))",
    comment   = "A module for the conversion from markdown to plain TeX",
    author    = "John MacFarlane, Hans Hagen, Vít Novotný",
    copyright = {"2009-2016 John MacFarlane, Hans Hagen",
                 "2016-2022 Vít Novotný"},
    license   = "LPPL 1.3c"
}

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

1.1 Requirements

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

1.1.1 Lua Requirements

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

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

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

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

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

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

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

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

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

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

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

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

1.1.2 Plain TeX Requirements

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

expl3 A package that enables the expl3 language from the LaTeX3 kernel in TeX Live ⩽ 2019. It is used to implement reflection capabilities that allow us to enumerate and inspect high-level concepts such as options, renderers, and renderer prototypes.

```
⟨@@=markdown⟩
\ifx\ExplSyntaxOn\undefined
  \input expl3-generic\relax
\fi
```

lt3luabridge A package that allows us to execute Lua code with LuaTeX as well as with other TeX engines that provide the *shell escape* capability, which allows them to execute code with the system's shell.

The plain TeX part of the package also requires the following Lua module:

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

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

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

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

1.1.3 LaTeX Requirements

The LaTeX part of the package requires that the LaTeX 2$_\varepsilon$ format is loaded,

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

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

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

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

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

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

ifthen A package that provides a concise syntax for the inspection of macro values. It is used in the `witiko/dot` LaTeX theme (see Section 2.3.2.2), and to provide default token renderer prototypes.

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

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

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

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

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

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

etoolbox A package that is used to polyfill the general hook management system in the default renderer prototypes for YAML metadata, see Section 3.3.4.6, and also in the default renderer prototype for attribute identifiers.

soulutf8 A package that is used in the default renderer prototype for strike-throughs.

```
\RequirePackage{expl3}
```

1.1.4 ConTeXt Prerequisites

The ConTeXt part of the package requires that either the Mark II or the Mark IV format is loaded, all the plain TeX prerequisites (see Section 1.1.2), 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).

1.2 Feedback

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

1.3 Acknowledgements

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

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

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

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

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

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

2 Interfaces

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

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

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

2.1 Lua Interface

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

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

```
28 local M = {metadata = metadata}
```

2.1.1 Conversion from Markdown to Plain TEX

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

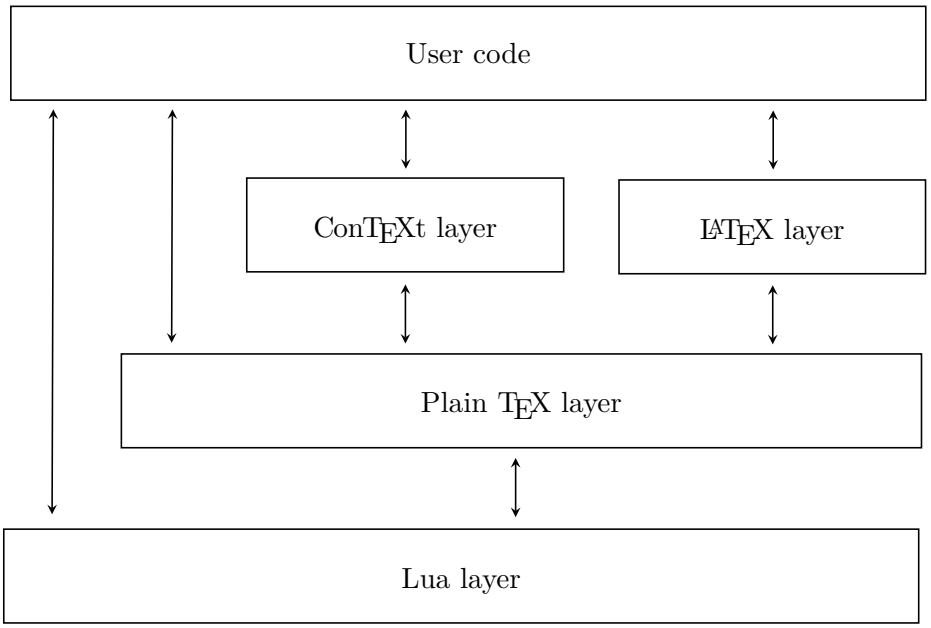

Figure 1: A block diagram of the Markdown package

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

```lua
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.

```
local defaultOptions = {}
```

To enable the enumeration of Lua options, we will maintain the `\g_@@_lua_options_seq` sequence.

```
\ExplSyntaxOn
\seq_new:N \g_@@_lua_options_seq
```

To enable the reflection of default Lua options and their types, we will maintain the `\g_@@_default_lua_options_prop` and `\g_@@_lua_option_types_prop` property lists, respectively.

```
\prop_new:N \g_@@_lua_option_types_prop
```

```
\prop_new:N \g_@@_default_lua_options_prop
\seq_new:N \g_@@_option_layers_seq
\tl_const:Nn \c_@@_option_layer_lua_tl { lua }
\seq_put_right:NV \g_@@_option_layers_seq \c_@@_option_layer_lua_tl
\cs_new:Nn
  \@@_add_lua_option:nnn
  {
    \@@_add_option:Vnnn
      \c_@@_option_layer_lua_tl
      { #1 }
      { #2 }
      { #3 }
  }
\cs_new:Nn
  \@@_add_option:nnnn
  {
    \seq_put_right:cn
      { g_@@_ #1 _options_seq }
      { #2 }
    \prop_put:cnn
      { g_@@_ #1 _option_types_prop }
      { #2 }
      { #3 }
    \prop_put:cnn
      { g_@@_default_ #1 _options_prop }
      { #2 }
      { #4 }
    \@@_typecheck_option:n
      { #2 }
  }
\cs_generate_variant:Nn
  \@@_add_option:nnnn
  { Vnnn }
\tl_const:Nn \c_@@_option_value_true_tl  { true  }
\tl_const:Nn \c_@@_option_value_false_tl { false }
\cs_new:Nn \@@_typecheck_option:n
  {
    \@@_get_option_type:nN
      { #1 }
      \l_tmpa_tl
    \str_case_e:Vn
      \l_tmpa_tl
      {
        { \c_@@_option_type_boolean_tl }
          {
            \@@_get_option_value:nN
              { #1 }
```

```
              \l_tmpa_tl
            \bool_if:nF
              {
                \str_if_eq_p:VV
                  \l_tmpa_tl
                  \c_@@_option_value_true_tl ||
                \str_if_eq_p:VV
                  \l_tmpa_tl
                  \c_@@_option_value_false_tl
              }
              {
                \msg_error:nnnV
                  { @@ }
                  { failed-typecheck-for-boolean-option }
                  { #1 }
                  \l_tmpa_tl
              }
          }
      }
  }
\msg_new:nnn
  { @@ }
  { failed-typecheck-for-boolean-option }
  {
    Option~#1~has~value~#2,~
    but~a~boolean~(true~or~false)~was~expected.
  }
\cs_generate_variant:Nn
  \str_case_e:nn
  { Vn }
\cs_generate_variant:Nn
  \msg_error:nnnn
  { nnnV }
\seq_new:N \g_@@_option_types_seq
\tl_const:Nn \c_@@_option_type_counter_tl { counter }
\seq_put_right:NV \g_@@_option_types_seq \c_@@_option_type_counter_tl
\tl_const:Nn \c_@@_option_type_boolean_tl { boolean }
\seq_put_right:NV \g_@@_option_types_seq \c_@@_option_type_boolean_tl
\tl_const:Nn \c_@@_option_type_number_tl  { number  }
\seq_put_right:NV \g_@@_option_types_seq \c_@@_option_type_number_tl
\tl_const:Nn \c_@@_option_type_path_tl    { path    }
\seq_put_right:NV \g_@@_option_types_seq \c_@@_option_type_path_tl
\tl_const:Nn \c_@@_option_type_slice_tl   { slice   }
\seq_put_right:NV \g_@@_option_types_seq \c_@@_option_type_slice_tl
\tl_const:Nn \c_@@_option_type_string_tl  { string  }
\seq_put_right:NV \g_@@_option_types_seq \c_@@_option_type_string_tl
\cs_new:Nn
```

```
  \@@_get_option_type:nN
  {
    \bool_set_false:N
      \l_tmpa_bool
    \seq_map_inline:Nn
      \g_@@_option_layers_seq
      {
        \prop_get:cnNT
          { g_@@_ ##1 _option_types_prop }
          { #1 }
          \l_tmpa_tl
          {
            \bool_set_true:N
              \l_tmpa_bool
            \seq_map_break:
          }
      }
    \bool_if:nF
      \l_tmpa_bool
      {
        \msg_error:nnn
          { @@ }
          { undefined-option }
          { #1 }
      }
    \seq_if_in:NVF
      \g_@@_option_types_seq
      \l_tmpa_tl
      {
        \msg_error:nnnV
          { @@ }
          { unknown-option-type }
          { #1 }
          \l_tmpa_tl
      }
    \tl_set_eq:NN
      #2
      \l_tmpa_tl
  }
\msg_new:nnn
  { @@ }
  { unknown-option-type }
  {
    Option~#1~has~unknown~type~#2.
  }
\msg_new:nnn
  { @@ }
```

```
  { undefined-option }
  {
    Option~#1~is~undefined.
  }
\cs_new:Nn
  \@@_get_default_option_value:nN
  {
    \bool_set_false:N
      \l_tmpa_bool
    \seq_map_inline:Nn
      \g_@@_option_layers_seq
      {
        \prop_get:cnNT
          { g_@@_default_ ##1 _options_prop }
          { #1 }
          #2
          {
            \bool_set_true:N
              \l_tmpa_bool
            \seq_map_break:
          }
      }
    \bool_if:nF
      \l_tmpa_bool
      {
        \msg_error:nnn
          { @@ }
          { undefined-option }
          { #1 }
      }
  }
\cs_new:Nn
  \@@_get_option_value:nN
  {
    \@@_option_tl_to_csname:nN
      { #1 }
      \l_tmpa_tl
    \cs_if_free:cTF
      { \l_tmpa_tl }
      {
        \@@_get_default_option_value:nN
          { #1 }
          #2
      }
      {
        \@@_get_option_type:nN
          { #1 }
```

```
          \l_tmpa_tl
        \str_if_eq:NNTF
          \c_@@_option_type_counter_tl
          \l_tmpa_tl
          {
            \@@_option_tl_to_csname:nN
              { #1 }
              \l_tmpa_tl
            \tl_set:Nx
              #2
              { \the \cs:w \l_tmpa_tl \cs_end: }
          }
          {
            \@@_option_tl_to_csname:nN
              { #1 }
              \l_tmpa_tl
            \tl_set:Nv
              #2
              { \l_tmpa_tl }
          }
      }
  }
\cs_new:Nn \@@_option_tl_to_csname:nN
  {
    \tl_set:Nn
      \l_tmpa_tl
      { \str_uppercase:n { #1 } }
    \tl_set:Nx
      #2
      {
        markdownOption
        \tl_head:f { \l_tmpa_tl }
        \tl_tail:n { #1 }
      }
  }
```

2.1.3 File and Directory Names

`cacheDir`=⟨*path*⟩ default: .

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

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

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

```
\@@_add_lua_option:nnn
  { cacheDir }
  { path }
  { \markdownOptionOutputDir / _markdown_\jobname }
defaultOptions.cacheDir = "."
```

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

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

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

```
\@@_add_lua_option:nnn
  { frozenCacheFileName }
  { path }
  { \markdownOptionCacheDir / frozenCache.tex }
defaultOptions.frozenCacheFileName = "frozenCache.tex"
```

2.1.4 Parser Options

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

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

```
\@@_add_lua_option:nnn
  { blankBeforeBlockquote }
  { boolean }
  { false }
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.

```
\@@_add_lua_option:nnn
  { blankBeforeCodeFence }
  { boolean }
  { false }
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.

```
\@@_add_lua_option:nnn
  { blankBeforeHeading }
  { boolean }
  { false }
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.

```
\@@_add_lua_option:nnn
  { breakableBlockquotes }
  { boolean }
  { false }
defaultOptions.breakableBlockquotes = false
```

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

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

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

```
\@@_add_lua_option:nnn
  { citationNbsps }
  { boolean }
  { true }
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.

```
\@@_add_lua_option:nnn
  { citations }
  { boolean }
  { false }
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.''
```

```
\@@_add_lua_option:nnn
  { codeSpans }
  { boolean }
  { true }
defaultOptions.codeSpans = true
```

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

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

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

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

```
\@@_add_lua_option:nnn
  { contentBlocks }
  { boolean }
  { false }
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 2.2.3.11 for more information.

```
\@@_add_lua_option:nnn
  { contentBlocksLanguageMap }
  { path }
  { markdown-languages.json }
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.

```
\@@_add_lua_option:nnn
  { definitionLists }
  { boolean }
  { false }
defaultOptions.definitionLists = false
```

`eagerCache`=`true`, `false` default: `true`

`true` Converted markdown documents will be cached in `cacheDir`. This can be useful for post-processing the converted documents and for recovering historical versions of the documents from the cache. However, it also produces a large number of auxiliary files on the disk and obscures the output of the Lua command-line interface when it is used for plumbing.

This behavior will always be used if the `finalizeCache` option is enabled.

`false` Converted markdown documents will not be cached. This decreases the number of auxiliary files that we produce and makes it easier to use the Lua command-line interface for plumbing.

This behavior will only be used when the `finalizeCache` option is disabled. Recursive nesting of markdown document fragments is undefined behavior when `eagerCache` is disabled.

```
\@@_add_lua_option:nnn
  { eagerCache }
  { boolean }
  { true }
defaultOptions.eagerCache = true
```

`expectJekyllData`=`true`, `false` default: `false`

`false` When the `jekyllData` option is enabled, then a markdown document may begin with YAML metadata if and only if the metadata begin with the end-of-directives marker (`---`) and they end with either the end-of-directives or the end-of-document marker (`...`):

```
\documentclass{article}
\usepackage[jekyllData]{markdown}
\begin{document}
\begin{markdown}
---
- this
- is
- YAML
...
- followed
- by
- Markdown
\end{markdown}
\begin{markdown}
- this
- is
- Markdown
\end{markdown}
\end{document}
```

`true` When the `jekyllData` option is enabled, then a markdown document may begin directly with YAML metadata and may contain nothing but YAML metadata.

```
\documentclass{article}
\usepackage[jekyllData, expectJekyllData]{markdown}
\begin{document}
\begin{markdown}
- this
- is
- YAML
...
- followed
- by
- Markdown
\end{markdown}
\begin{markdown}
- this
- is
- YAML
\end{markdown}
\end{document}
```

```
\@@_add_lua_option:nnn
  { expectJekyllData }
  { boolean }
  { false }
defaultOptions.expectJekyllData = false
```

`fancyLists`=`true`, `false` default: `false`

`true` Enable the Pandoc fancy list extension:

```
a) first item
b) second item
c) third item
```

`false` Disable the Pandoc fancy list extension.

```
\@@_add_lua_option:nnn
  { fancyLists }
  { boolean }
  { false }
defaultOptions.fancyLists = 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.

```
\@@_add_lua_option:nnn
  { fencedCode }
  { boolean }
  { false }
defaultOptions.fencedCode = false
```

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

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

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

```
\@@_add_lua_option:nnn
  { finalizeCache }
  { boolean }
  { false }
```

```
defaultOptions.finalizeCache = false
```

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

`true` Enable the Pandoc footnote syntax extension:

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

[^1]: Here is the footnote.

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

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

        { some.code }

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

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

`false` Disable the Pandoc footnote syntax extension.

```
\@@_add_lua_option:nnn
  { footnotes }
  { boolean }
  { false }
defaultOptions.footnotes = false
```

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

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

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

```
\@@_add_lua_option:nnn
  { frozenCacheCounter }
  { counter }
  { 0 }
```

```
defaultOptions.frozenCacheCounter = 0
```

`hardLineBreaks`=true, false default: `false`

`true` Interpret all newlines within a paragraph as hard line breaks instead of spaces.

`false` Interpret all newlines within a paragraph as spaces.

```
\@@_add_lua_option:nnn
  { hardLineBreaks }
  { boolean }
  { false }
defaultOptions.hardLineBreaks = 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.

```
\@@_add_lua_option:nnn
  { hashEnumerators }
  { boolean }
  { false }
defaultOptions.hashEnumerators = false
```

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

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

```
# My first heading {#foo}

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

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

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

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

```
\@@_add_lua_option:nnn
  { headerAttributes }
  { boolean }
  { false }
defaultOptions.headerAttributes = false
```

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

`true` Enable the recognition of inline HTML tags, block HTML elements, HTML comments, HTML instructions, and entities in the input. Inline HTML tags, block HTML elements and HTML comments will be rendered, HTML instructions 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.

```
\@@_add_lua_option:nnn
  { html }
  { boolean }
  { false }
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.

```
\@@_add_lua_option:nnn
  { hybrid }
  { boolean }
  { false }
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.

```
\@@_add_lua_option:nnn
  { inlineFootnotes }
  { boolean }
  { false }
defaultOptions.inlineFootnotes = false
```

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

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

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

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

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

```
\@@_add_lua_option:nnn
  { jekyllData }
  { boolean }
  { false }
defaultOptions.jekyllData = false
```

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

`true` Enable the PHP Markdown pipe table syntax extension:

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

`false` Disable the PHP Markdown pipe table syntax extension.

```
\@@_add_lua_option:nnn
  { pipeTables }
  { boolean }
  { false }
defaultOptions.pipeTables = false
```

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

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

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

```
\@@_add_lua_option:nnn
  { preserveTabs }
  { boolean }
  { false }
defaultOptions.preserveTabs = false
```

`relativeReferences`=true, false default: `false`

`true` Enable relative references[6] in autolinks:

```
I conclude in Section <#conclusion>.

Conclusion {#conclusion}
==========
In this paper, we have discovered that most
grandmas would rather eat dinner with their
grandchildren than get eaten. Begone, wolf!
```

[6] See https://datatracker.ietf.org/doc/html/rfc3986#section-4.2.

`false` Disable relative references in autolinks.

```
\@@_add_lua_option:nnn
  { relativeReferences }
  { boolean }
  { false }
defaultOptions.relativeReferences = false
```

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

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

```
\@@_add_lua_option:nnn
  { shiftHeadings }
  { number }
  { 0 }
defaultOptions.shiftHeadings = 0
```

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

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

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

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

```
\@@_add_lua_option:nnn
  { slice }
  { slice }
  { ^~$ }
defaultOptions.slice = "^ $"
```

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

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

`false` Preserve all ellipses in the input.

```
\@@_add_lua_option:nnn
  { smartEllipses }
  { boolean }
  { false }
defaultOptions.smartEllipses = false
```

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

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

`false` Ignore the numbers in the ordered list items. Each item will only produce a `\markdownRendererOlItem` TEX macro.

```
\@@_add_lua_option:nnn
  { startNumber }
  { boolean }
  { true }
defaultOptions.startNumber = true
```

`strikeThrough`=`true`, `false` default: `false`

`true` Enable the Pandoc strike-through syntax extension:

```
This ~~is deleted text.~~
```

`false` Disable the Pandoc strike-through syntax extension.

```
\@@_add_lua_option:nnn
  { strikeThrough }
  { boolean }
  { false }
defaultOptions.strikeThrough = false
```

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

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

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

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

```
\@@_add_lua_option:nnn
  { stripIndent }
  { boolean }
  { false }
defaultOptions.stripIndent = false
```

`subscripts`=true, false default: `false`

`true` Enable the Pandoc subscript syntax extension:

```
H~2~O is a liquid.
```

`false` Disable the Pandoc subscript syntax extension.

```
\@@_add_lua_option:nnn
  { subscripts }
  { boolean }
  { false }
defaultOptions.subscripts = false
```

`superscripts`=true, false default: `false`

`true` Enable the Pandoc superscript syntax extension:

```
2^10^ is 1024.
```

`false` Disable the Pandoc superscript syntax extension.

```
\@@_add_lua_option:nnn
  { superscripts }
  { boolean }
  { false }
defaultOptions.superscripts = false
```

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

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

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

  : Demonstration of pipe table syntax.
```

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

```
\@@_add_lua_option:nnn
  { tableCaptions }
  { boolean }
  { false }
defaultOptions.tableCaptions = false
```

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

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

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

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

```
\@@_add_lua_option:nnn
  { taskLists }
  { boolean }
  { false }
defaultOptions.taskLists = false
```

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

`true` Strip TEX-style comments.

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

Always enabled when `hybrid` is enabled.

`false` Do not strip TEX-style comments.

```
\@@_add_lua_option:nnn
  { texComments }
  { boolean }
  { false }
defaultOptions.texComments = false
```

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

`true` Unordered and ordered lists whose items do not consist of multiple paragraphs will be considered *tight*. Tight lists will produce tight renderers that may produce different output than lists that are not tight:

```
- This is
- a tight
- unordered list.

- This is

  not a tight

- unordered list.
```

`false` Unordered and ordered lists whose items consist of multiple paragraphs will be treated the same way as lists that consist of multiple paragraphs.

```
\@@_add_lua_option:nnn
  { tightLists }
  { boolean }
  { true }
```

```
460 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.

```
461 \@@_add_lua_option:nnn
462   { underscores }
463   { boolean }
464   { true }
465 \ExplSyntaxOff
466 defaultOptions.underscores = true
```

2.1.5 Command-Line Interface

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

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

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

```
467
468 local HELP_STRING = [[
469 Usage: texlua ]] .. arg[0] .. [[ [OPTIONS] -- [INPUT_FILE] [OUTPUT_FILE]
470 where OPTIONS are documented in the Lua interface section of the
471 technical Markdown package documentation.
```

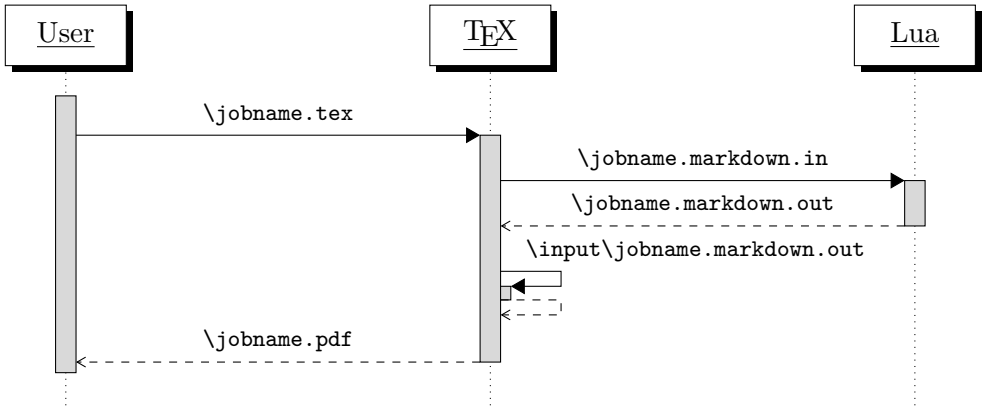

Figure 2: A sequence diagram of the Markdown package typesetting a markdown document using the TEX interface

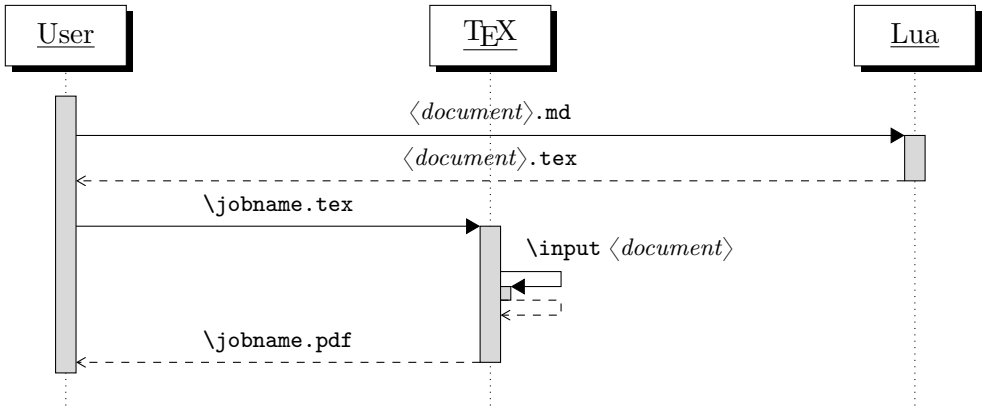

Figure 3: A sequence diagram of the Markdown package typesetting a markdown document using the Lua command-line interface

```
472
473 When OUTPUT_FILE is unspecified, the result of the conversion will be
474 written to the standard output. When INPUT_FILE is also unspecified, the
475 result of the conversion will be read from the standard input.
476
477 Report bugs to: witiko@mail.muni.cz
478 Markdown package home page: <https://github.com/witiko/markdown>]]
479
480 local VERSION_STRING = [[
481 markdown-cli.lua (Markdown) ]] .. metadata.version .. [[
482
483 Copyright (C) ]] .. table.concat(metadata.copyright,
484                                  "\nCopyright (C) ") .. [[
485
486 License: ]] .. metadata.license
487
488 local function warn(s)
489   io.stderr:write("Warning: " .. s .. "\n") end
490
491 local function error(s)
492   io.stderr:write("Error: " .. s .. "\n")
493   os.exit(1) end
494
495 local process_options = true
496 local options = {}
497 local input_filename
498 local output_filename
499 for i = 1, #arg do
500   if process_options then
```

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

```
501     if arg[i] == "--" then
502       process_options = false
503       goto continue
```

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

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

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

```
506       local default_type = type(defaultOptions[key])
507       if default_type == "boolean" then
```

```
508         options[key] = (value == "true")
509       elseif default_type == "number" then
510         options[key] = tonumber(value)
511       else
512         if default_type ~= "string" then
513           if default_type == "nil" then
514             warn('Option "' .. key .. '" not recognized.')
515           else
516             warn('Option "' .. key .. '" type not recognized, please file ' ..
517                  'a report to the package maintainer.')
518           end
519           warn('Parsing the ' .. 'value "' .. value ..'" of option "' ..
520                key .. '" as a string.')
521         end
522         options[key] = value
523       end
524       goto continue
```

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

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

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

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

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

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

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

```
535   elseif output_filename == nil then
536     output_filename = arg[i]
537   else
538     error('Unexpected argument: "' .. arg[i] .. '".')
539   end
```

```
  ::continue::
end
```

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

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

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

```
\input hello
```

2.2 Plain TEX Interface

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

```
\def\markdownLastModified{(((LASTMODIFIED)))}%
\def\markdownVersion{(((VERSION)))}%
```

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

```
\input markdown
```

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

2.2.1 Typesetting Markdown

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

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

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

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

There are several limitations to the macros you need to be aware of. The first limitation concerns the `\markdownEnd` macro, which must be visible directly from the

input line buffer (it may not be produced as a result of input expansion). Otherwise, it will not be recognized as the end of the markdown string. As a corrolary, the `\markdownEnd` string may not appear anywhere inside the markdown input.

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

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

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

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

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

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

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

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

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

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

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

2.2.2 Options

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

To enable the enumeration of plain TEX options, we will maintain the `\g_@@_plain_tex_options_seq` sequence.

```
\ExplSyntaxOn
\seq_new:N \g_@@_plain_tex_options_seq
```

To enable the reflection of default plain TEX options and their types, we will maintain the `\g_@@_default_plain_tex_options_prop` and `\g_@@_plain_tex_option_types_prop` property lists, respectively.

```
\prop_new:N \g_@@_plain_tex_option_types_prop
\prop_new:N \g_@@_default_plain_tex_options_prop
\tl_const:Nn \c_@@_option_layer_plain_tex_tl { plain_tex }
\seq_put_right:NV \g_@@_option_layers_seq \c_@@_option_layer_plain_tex_tl
\cs_new:Nn
  \@@_add_plain_tex_option:nnn
  {
    \@@_add_option:Vnnn
      \c_@@_option_layer_plain_tex_tl
      { #1 }
      { #2 }
      { #3 }
  }
```

2.2.2.1 Finalizing and Freezing the Cache

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

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

```
\@@_add_plain_tex_option:nnn
  { frozenCache }
  { boolean }
  { false }
```

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

1. Remove the `cacheDir` cache directory with stale auxiliary cache files.
2. Enable the `\markdownOptionFinalizeCache` option.

4. Typeset the plain TEX document to populate and finalize the cache.
5. Enable the `\markdownOptionFrozenCache` option.
6. Publish the source code of the plain TEX document and the `cacheDir` directory.

2.2.2.2 File and Directory Names

The `\markdownOptionHelperScriptFileName` macro sets the filename of the helper Lua script file that is created during the conversion from markdown to plain TEX in TEX engines without the `\directlua` primitive. It defaults to `\jobname.markdown.lua`, where `\jobname` is the base name of the document being typeset.

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

```
\@@_add_plain_tex_option:nnn
  { helperScriptFileName }
  { path }
  { \jobname.markdown.lua }
```

The `\markdownOptionHelperScriptFileName` macro has been deprecated and will be removed in Markdown 3.0.0. To control the filename of the helper Lua script file, use the `\g_luabridge_helper_script_filename_str` macro from the lt3luabridge package.

```
\str_new:N
  \g_luabridge_helper_script_filename_str
\tl_gset:Nn
  \g_luabridge_helper_script_filename_str
  { \markdownOptionHelperScriptFileName }
```

The `\markdownOptionInputTempFileName` macro sets the filename of the temporary input file that is created during the buffering of markdown text from a TEX source. It defaults to `\jobname.markdown.in`. The same limitations as in the case of the `\markdownOptionHelperScriptFileName` macro apply here.

```
\@@_add_plain_tex_option:nnn
  { inputTempFileName }
  { path }
  { \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.

```
\@@_add_plain_tex_option:nnn
  { outputTempFileName }
  { path }
  { \jobname.markdown.out }
```

The \markdownOptionOutputTempFileName macro has been deprecated and will be removed in Markdown 3.0.0.

```
\str_new:N
  \g_luabridge_standard_output_filename_str
\tl_gset:Nn
  \g_luabridge_standard_output_filename_str
  { \markdownOptionOutputTempFileName }
```

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.

```
\@@_add_plain_tex_option:nnn
  { errorTempFileName }
  { path }
  { \jobname.markdown.err }
```

The \markdownOptionErrorTempFileName macro has been deprecated and will be removed in Markdown 3.0.0. To control the filename of the temporary file for Lua errors, use the \g_luabridge_error_output_filename_str macro from the lt3luabridge package.

```
\str_new:N
  \g_luabridge_error_output_filename_str
\tl_gset:Nn
  \g_luabridge_error_output_filename_str
  { \markdownOptionErrorTempFileName }
```

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

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

```
\@@_add_plain_tex_option:nnn
  { outputDir }
  { path }
  { . }
```

Here, we automatically define plain TEX macros for the above plain TEX options.

Furthemore, we also define macros that map directly to the options recognized by the Lua interface, such as \markdownOptionHybrid for the hybrid Lua option (see Section 2.1.2), which are not processed by the plain TEX implementation, only passed along to Lua.

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.

```
\cs_new:Nn \@@_plain_tex_define_option_commands:
  {
    \seq_map_inline:Nn
      \g_@@_option_layers_seq
      {
        \seq_map_inline:cn
          { g_@@_ ##1 _options_seq }
          {
              \@@_plain_tex_define_option_command:n
                { ####1 }
          }
      }
  }
\cs_new:Nn \@@_plain_tex_define_option_command:n
  {
    \@@_get_default_option_value:nN
      { #1 }
      \l_tmpa_tl
    \@@_set_option_value:nV
      { #1 }
      \l_tmpa_tl
  }
\cs_new:Nn
  \@@_set_option_value:nn
  {
    \@@_define_option:n
      { #1 }
    \@@_get_option_type:nN
      { #1 }
      \l_tmpa_tl
    \str_if_eq:NNTF
      \c_@@_option_type_counter_tl
      \l_tmpa_tl
      {
        \@@_option_tl_to_csname:nN
          { #1 }
          \l_tmpa_tl
        \int_gset:cn
          { \l_tmpa_tl }
          { #2 }
      }
      {
        \@@_option_tl_to_csname:nN
          { #1 }
```

```
          \l_tmpa_tl
        \cs_set:cpn
          { \l_tmpa_tl }
          { #2 }
      }
  }
\cs_generate_variant:Nn
  \@@_set_option_value:nn
  { nV }
\cs_new:Nn
  \@@_define_option:n
  {
    \@@_option_tl_to_csname:nN
      { #1 }
      \l_tmpa_tl
    \cs_if_free:cT
      { \l_tmpa_tl }
      {
        \@@_get_option_type:nN
          { #1 }
          \l_tmpb_tl
        \str_if_eq:NNT
          \c_@@_option_type_counter_tl
          \l_tmpb_tl
          {
            \@@_option_tl_to_csname:nN
              { #1 }
              \l_tmpa_tl
            \int_new:c
              { \l_tmpa_tl }
          }
      }
  }
\@@_plain_tex_define_option_commands:
```

2.2.2.3 Miscellaneous Options

The `\markdownOptionStripPercentSigns` macro controls whether a percent sign (`%`) at the beginning of a line will be discarded when buffering Markdown input (see Section 3.2.4) or not. Notably, this enables the use of markdown when writing TEX package documentation using the Doc LATEX package [5] or similar. The recognized values of the macro are `true` (discard) and `false` (retain). It defaults to `false`.

```
\seq_put_right:Nn
  \g_@@_plain_tex_options_seq
  { stripPercentSigns }
\prop_put:Nnn
  \g_@@_plain_tex_option_types_prop
```

```
  { stripPercentSigns }
  { boolean }
\prop_put:Nnx
  \g_@@_default_plain_tex_options_prop
  { stripPercentSigns }
  { false }
\ExplSyntaxOff
```

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).

To enable the enumeration of token renderers, we will maintain the `\g_@@_renderers_seq` sequence.

```
\ExplSyntaxOn
\seq_new:N \g_@@_renderers_seq
```

To enable the reflection of token renderers and their parameters, we will maintain the `\g_@@_renderer_arities_prop` property list.

```
\prop_new:N \g_@@_renderer_arities_prop
\ExplSyntaxOff
```

2.2.3.1 Tickbox Renderers

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

```
\def\markdownRendererTickedBox{%
  \markdownRendererTickedBoxPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { tickedBox }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { tickedBox }
  { 0 }
\ExplSyntaxOff
\def\markdownRendererHalfTickedBox{%
  \markdownRendererHalfTickedBoxPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
```

```
  \g_@@_renderers_seq
  { halfTickedBox }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { halfTickedBox }
  { 0 }
\ExplSyntaxOff
\def\markdownRendererUntickedBox{%
  \markdownRendererUntickedBoxPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { untickedBox }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { untickedBox }
  { 0 }
\ExplSyntaxOff
```

2.2.3.2 Markdown Document Renderers

The `\markdownRendererDocumentBegin` and `\markdownRendererDocumentEnd` macros represent the beginning and the end of a *markdown* document. The macros receive no arguments.

A TEX document may contain any number of markdown documents. Additionally, markdown documents may appear not only in a sequence, but several markdown documents may also be *nested*. Redefinitions of the macros should take this into account.

```
\def\markdownRendererDocumentBegin{%
  \markdownRendererDocumentBeginPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { documentBegin }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { documentBegin }
  { 0 }
\ExplSyntaxOff
\def\markdownRendererDocumentEnd{%
  \markdownRendererDocumentEndPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { documentEnd }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
```

```
  { documentEnd }
  { 0 }
\ExplSyntaxOff
```

2.2.3.3 Interblock Separator Renderer

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

```
\def\markdownRendererInterblockSeparator{%
  \markdownRendererInterblockSeparatorPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { interblockSeparator }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { interblockSeparator }
  { 0 }
\ExplSyntaxOff
```

2.2.3.4 Line Break Renderer

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

```
\def\markdownRendererLineBreak{%
  \markdownRendererLineBreakPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { lineBreak }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { lineBreak }
  { 0 }
\ExplSyntaxOff
```

2.2.3.5 Ellipsis Renderer

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

```
\def\markdownRendererEllipsis{%
  \markdownRendererEllipsisPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { ellipsis }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
```

```
  { ellipsis }
  { 0 }
\ExplSyntaxOff
```

2.2.3.6 Non-Breaking Space Renderer

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

```
\def\markdownRendererNbsp{%
  \markdownRendererNbspPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { nbsp }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { nbsp }
  { 0 }
\ExplSyntaxOff
```

2.2.3.7 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}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { leftBrace }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { leftBrace }
  { 0 }
\ExplSyntaxOff
\def\markdownRendererRightBrace{%
  \markdownRendererRightBracePrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { rightBrace }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { rightBrace }
  { 0 }
\ExplSyntaxOff
\def\markdownRendererDollarSign{%
  \markdownRendererDollarSignPrototype}%
```

```
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { dollarSign }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { dollarSign }
  { 0 }
\ExplSyntaxOff
\def\markdownRendererPercentSign{%
  \markdownRendererPercentSignPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { percentSign }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { percentSign }
  { 0 }
\ExplSyntaxOff
\def\markdownRendererAmpersand{%
  \markdownRendererAmpersandPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { ampersand }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { ampersand }
  { 0 }
\ExplSyntaxOff
\def\markdownRendererUnderscore{%
  \markdownRendererUnderscorePrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { underscore }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { underscore }
  { 0 }
\ExplSyntaxOff
\def\markdownRendererHash{%
  \markdownRendererHashPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
```

```
  { hash }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { hash }
  { 0 }
\ExplSyntaxOff
\def\markdownRendererCircumflex{%
  \markdownRendererCircumflexPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { circumflex }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { circumflex }
  { 0 }
\ExplSyntaxOff
\def\markdownRendererBackslash{%
  \markdownRendererBackslashPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { backslash }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { backslash }
  { 0 }
\ExplSyntaxOff
\def\markdownRendererTilde{%
  \markdownRendererTildePrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { tilde }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { tilde }
  { 0 }
\ExplSyntaxOff
\def\markdownRendererPipe{%
  \markdownRendererPipePrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { pipe }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
```

```
  { pipe }
  { 0 }
\ExplSyntaxOff
```

2.2.3.8 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}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { codeSpan }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { codeSpan }
  { 1 }
\ExplSyntaxOff
```

2.2.3.9 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}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { link }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { link }
  { 4 }
\ExplSyntaxOff
```

2.2.3.10 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}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { image }
```

```
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { image }
  { 4 }
\ExplSyntaxOff
```

2.2.3.11 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}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { contentBlock }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { contentBlock }
  { 4 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererContentBlockOnlineImage{%
  \markdownRendererContentBlockOnlineImagePrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { contentBlockOnlineImage }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { contentBlockOnlineImage }
  { 4 }
\ExplSyntaxOff
```

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[7] 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.

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

The macro receives five arguments: the local file name extension s cast to the lower case, the language v, the fully escaped URI that can be directly typeset, the raw URI that can be used outside typesetting, and the title of the content block.

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

```
\def\markdownRendererContentBlockCode{%
  \markdownRendererContentBlockCodePrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { contentBlockCode }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { contentBlockCode }
  { 5 }
\ExplSyntaxOff
```

2.2.3.12 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}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { ulBegin }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { ulBegin }
  { 0 }
\ExplSyntaxOff
```

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 disabled. The macro receives no arguments.

```
\def\markdownRendererUlBeginTight{%
  \markdownRendererUlBeginTightPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
```

```
  \g_@@_renderers_seq
  { ulBeginTight }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { ulBeginTight }
  { 0 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererUlItem{%
  \markdownRendererUlItemPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { ulItem }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { ulItem }
  { 0 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererUlItemEnd{%
  \markdownRendererUlItemEndPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { ulItemEnd }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { ulItemEnd }
  { 0 }
\ExplSyntaxOff
```

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}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { ulEnd }
\prop_put:Nnn
```

```
  \g_@@_renderer_arities_prop
  { ulEnd }
  { 0 }
\ExplSyntaxOff
```

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 disabled. The macro receives no arguments.

```
\def\markdownRendererUlEndTight{%
  \markdownRendererUlEndTightPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { ulEndTight }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { ulEndTight }
  { 0 }
\ExplSyntaxOff
```

2.2.3.13 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). This macro will only be produced, when the `fancyLists` option is disabled. The macro receives no arguments.

```
\def\markdownRendererOlBegin{%
  \markdownRendererOlBeginPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { olBegin }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { olBegin }
  { 0 }
\ExplSyntaxOff
```

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 enabled and the `fancyLists` option is disabled. The macro receives no arguments.

```
\def\markdownRendererOlBeginTight{%
  \markdownRendererOlBeginTightPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
```

```
  \g_@@_renderers_seq
  { olBeginTight }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { olBeginTight }
  { 0 }
\ExplSyntaxOff
```

The `\markdownRendererFancyOlBegin` macro represents the beginning of a fancy ordered list that contains an item with several paragraphs of text (the list is not tight). This macro will only be produced, when the `fancyLists` option is enabled. The macro receives two arguments: the style of the list item labels (`Decimal`, `LowerRoman`, `UpperRoman`, `LowerAlpha`, and `UpperAlpha`), and the style of delimiters between list item labels and texts (`Default`, `OneParen`, and `Period`).

```
\def\markdownRendererFancyOlBegin{%
  \markdownRendererFancyOlBeginPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { fancyOlBegin }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { fancyOlBegin }
  { 2 }
\ExplSyntaxOff
```

The `\markdownRendererFancyOlBeginTight` macro represents the beginning of a fancy ordered list that contains no item with several paragraphs of text (the list is tight). This macro will only be produced, when the `fancyLists` and `tightLists` options are enabled. The macro receives two arguments: the style of the list item labels, and the style of delimiters between list item labels and texts. See the `\markdownRendererFancyOlBegin` macro for the valid style values.

```
\def\markdownRendererFancyOlBeginTight{%
  \markdownRendererFancyOlBeginTightPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { fancyOlBeginTight }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { fancyOlBeginTight }
  { 2 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererOlItem{%
  \markdownRendererOlItemPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { olItem }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { olItem }
  { 0 }
\ExplSyntaxOff
```

The `\markdownRendererOlItemEnd` macro represents the end of an item in an ordered list. This macro will only be produced, when the `fancyLists` option is disabled. The macro receives no arguments.

```
\def\markdownRendererOlItemEnd{%
  \markdownRendererOlItemEndPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { olItemEnd }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { olItemEnd }
  { 0 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererOlItemWithNumber{%
  \markdownRendererOlItemWithNumberPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { olItemWithNumber }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { olItemWithNumber }
  { 1 }
\ExplSyntaxOff
```

The \markdownRendererFancyOlItem macro represents an item in a fancy ordered list. This macro will only be produced, when the startNumber option is disabled and the fancyLists option is enabled. The macro receives no arguments.

```
\def\markdownRendererFancyOlItem{%
  \markdownRendererFancyOlItemPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { fancyOlItem }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { fancyOlItem }
  { 0 }
\ExplSyntaxOff
```

The \markdownRendererFancyOlItemEnd macro represents the end of an item in a fancy ordered list. This macro will only be produced, when the fancyLists option is enabled. The macro receives no arguments.

```
\def\markdownRendererFancyOlItemEnd{%
  \markdownRendererFancyOlItemEndPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { fancyOlItemEnd }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { fancyOlItemEnd }
  { 0 }
\ExplSyntaxOff
```

The \markdownRendererFancyOlItemWithNumber macro represents an item in a fancy ordered list. This macro will only be produced, when the startNumber and fancyLists options are enabled. The macro receives a single numeric argument that corresponds to the item number.

```
\def\markdownRendererFancyOlItemWithNumber{%
  \markdownRendererFancyOlItemWithNumberPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { fancyOlItemWithNumber }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { fancyOlItemWithNumber }
  { 1 }
\ExplSyntaxOff
```

The \markdownRendererOlEnd macro represents the end of an ordered list that contains an item with several paragraphs of text (the list is not tight). This macro will only be produced, when the fancyLists option is disabled. The macro receives no arguments.

```
\def\markdownRendererOlEnd{%
  \markdownRendererOlEndPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { olEnd }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { olEnd }
  { 0 }
\ExplSyntaxOff
```

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 enabled and the fancyLists option is disabled. The macro receives no arguments.

```
\def\markdownRendererOlEndTight{%
  \markdownRendererOlEndTightPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { olEndTight }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { olEndTight }
  { 0 }
\ExplSyntaxOff
```

The \markdownRendererFancyOlEnd macro represents the end of a fancy ordered list that contains an item with several paragraphs of text (the list is not tight). This macro will only be produced, when the fancyLists option is enabled. The macro receives no arguments.

```
\def\markdownRendererFancyOlEnd{%
  \markdownRendererFancyOlEndPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { fancyOlEnd }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { fancyOlEnd }
```

```
  { 0 }
\ExplSyntaxOff
```

The `\markdownRendererFancyOlEndTight` macro represents the end of a fancy ordered list that contains no item with several paragraphs of text (the list is tight). This macro will only be produced, when the `fancyLists` and `tightLists` options are enabled. The macro receives no arguments.

```
\def\markdownRendererFancyOlEndTight{%
  \markdownRendererFancyOlEndTightPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { fancyOlEndTight }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { fancyOlEndTight }
  { 0 }
\ExplSyntaxOff
```

2.2.3.14 Definition List Renderers

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

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

```
\def\markdownRendererDlBegin{%
  \markdownRendererDlBeginPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { dlBegin }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { dlBegin }
  { 0 }
\ExplSyntaxOff
```

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 disabled. The macro receives no arguments.

```
\def\markdownRendererDlBeginTight{%
  \markdownRendererDlBeginTightPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
```

```
  { dlBeginTight }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { dlBeginTight }
  { 0 }
\ExplSyntaxOff
```

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}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { dlItem }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { dlItem }
  { 1 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererDlItemEnd{%
  \markdownRendererDlItemEndPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { dlItemEnd }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { dlItemEnd }
  { 0 }
\ExplSyntaxOff
```

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}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { dlDefinitionBegin }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { dlDefinitionBegin }
  { 0 }
```

```
\ExplSyntaxOff
```

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}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { dlDefinitionEnd }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { dlDefinitionEnd }
  { 0 }
\ExplSyntaxOff
```

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}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { dlEnd }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { dlEnd }
  { 0 }
\ExplSyntaxOff
```

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 disabled. The macro receives no arguments.

```
\def\markdownRendererDlEndTight{%
  \markdownRendererDlEndTightPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { dlEndTight }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { dlEndTight }
  { 0 }
\ExplSyntaxOff
```

2.2.3.15 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}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { emphasis }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { emphasis }
  { 1 }
\ExplSyntaxOff
```

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}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { strongEmphasis }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { strongEmphasis }
  { 1 }
\ExplSyntaxOff
```

2.2.3.16 Block Quote Renderers

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

```
\def\markdownRendererBlockQuoteBegin{%
  \markdownRendererBlockQuoteBeginPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { blockQuoteBegin }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { blockQuoteBegin }
  { 0 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererBlockQuoteEnd{%
  \markdownRendererBlockQuoteEndPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { blockQuoteEnd }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { blockQuoteEnd }
  { 0 }
\ExplSyntaxOff
```

2.2.3.17 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}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { inputVerbatim }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { inputVerbatim }
  { 1 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererInputFencedCode{%
  \markdownRendererInputFencedCodePrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { inputFencedCode }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { inputFencedCode }
  { 2 }
\ExplSyntaxOff
```

2.2.3.18 YAML Metadata Renderers

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

```
\def\markdownRendererJekyllDataBegin{%
  \markdownRendererJekyllDataBeginPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { jekyllDataBegin }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { jekyllDataBegin }
  { 0 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererJekyllDataEnd{%
  \markdownRendererJekyllDataEndPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { jekyllDataEnd }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { jekyllDataEnd }
  { 0 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererJekyllDataMappingBegin{%
  \markdownRendererJekyllDataMappingBeginPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { jekyllDataMappingBegin }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { jekyllDataMappingBegin }
  { 2 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererJekyllDataMappingEnd{%
  \markdownRendererJekyllDataMappingEndPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { jekyllDataMappingEnd }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { jekyllDataMappingEnd }
  { 0 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererJekyllDataSequenceBegin{%
  \markdownRendererJekyllDataSequenceBeginPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { jekyllDataSequenceBegin }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { jekyllDataSequenceBegin }
  { 2 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererJekyllDataSequenceEnd{%
  \markdownRendererJekyllDataSequenceEndPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { jekyllDataSequenceEnd }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { jekyllDataSequenceEnd }
  { 0 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererJekyllDataBoolean{%
  \markdownRendererJekyllDataBooleanPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { jekyllDataBoolean }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { jekyllDataBoolean }
  { 2 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererJekyllDataNumber{%
  \markdownRendererJekyllDataNumberPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { jekyllDataNumber }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { jekyllDataNumber }
  { 2 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererJekyllDataString{%
  \markdownRendererJekyllDataStringPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { jekyllDataString }
\prop_put:Nnn
```

```
  \g_@@_renderer_arities_prop
  { jekyllDataString }
  { 2 }
\ExplSyntaxOff
```

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

See also Section 2.2.4.1 for the description of the high-level expl3 interface that you can also use to react to YAML metadata.

```
\def\markdownRendererJekyllDataEmpty{%
  \markdownRendererJekyllDataEmptyPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { jekyllDataEmpty }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { jekyllDataEmpty }
  { 1 }
\ExplSyntaxOff
```

2.2.3.19 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}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { headingOne }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { headingOne }
  { 1 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererHeadingTwo{%
  \markdownRendererHeadingTwoPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
```

```
  { headingTwo }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { headingTwo }
  { 1 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererHeadingThree{%
  \markdownRendererHeadingThreePrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { headingThree }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { headingThree }
  { 1 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererHeadingFour{%
  \markdownRendererHeadingFourPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { headingFour }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { headingFour }
  { 1 }
\ExplSyntaxOff
```

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

```
\def\markdownRendererHeadingFive{%
  \markdownRendererHeadingFivePrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { headingFive }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { headingFive }
  { 1 }
```

```
\ExplSyntaxOff
```

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

```
\def\markdownRendererHeadingSix{%
  \markdownRendererHeadingSixPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { headingSix }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { headingSix }
  { 1 }
\ExplSyntaxOff
```

2.2.3.20 Horizontal Rule Renderer

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

```
\def\markdownRendererHorizontalRule{%
  \markdownRendererHorizontalRulePrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { horizontalRule }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { horizontalRule }
  { 0 }
\ExplSyntaxOff
```

2.2.3.21 Footnote Renderer

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

```
\def\markdownRendererFootnote{%
  \markdownRendererFootnotePrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { footnote }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { footnote }
  { 1 }
\ExplSyntaxOff
```

2.2.3.22 Parenthesized Citations Renderer

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

```
\def\markdownRendererCite{%
  \markdownRendererCitePrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { cite }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { cite }
  { 1 }
\ExplSyntaxOff
```

2.2.3.23 Text Citations Renderer

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

```
\def\markdownRendererTextCite{%
  \markdownRendererTextCitePrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { textCite }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { textCite }
  { 1 }
\ExplSyntaxOff
```

2.2.3.24 Table Renderer

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

- `d` – The corresponding column has an unspecified (default) alignment.

- `l` – The corresponding column is left-aligned.
- `c` – The corresponding column is centered.
- `r` – The corresponding column is right-aligned.

```
\def\markdownRendererTable{%
  \markdownRendererTablePrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { table }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { table }
  { 3 }
\ExplSyntaxOff
```

2.2.3.25 HTML Comment Renderers

The `\markdownRendererInlineHtmlComment` macro represents the contents of an inline HTML comment. This macro will only be produced, when the `html` option is enabled. The macro receives a single argument that corresponds to the contents of the HTML comment.

The `\markdownRendererBlockHtmlCommentBegin` and `\markdownRendererBlockHtmlCommentEn` macros represent the beginning and the end of a block HTML comment. The macros receive no arguments.

```
\def\markdownRendererInlineHtmlComment{%
  \markdownRendererInlineHtmlCommentPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { inlineHtmlComment }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { inlineHtmlComment }
  { 1 }
\ExplSyntaxOff
\def\markdownRendererBlockHtmlCommentBegin{%
  \markdownRendererBlockHtmlCommentBeginPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { blockHtmlCommentBegin }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { blockHtmlCommentBegin }
  { 0 }
\ExplSyntaxOff
\def\markdownRendererBlockHtmlCommentEnd{%
```

```
  \markdownRendererBlockHtmlCommentEndPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { blockHtmlCommentEnd }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { blockHtmlCommentEnd }
  { 0 }
\ExplSyntaxOff
```

2.2.3.26 HTML Tag and Element Renderers

The `\markdownRendererInlineHtmlTag` macro represents an opening, closing, or empty inline HTML tag. This macro will only be produced, when the `html` option is enabled. The macro receives a single argument that corresponds to the contents of the HTML tag.

The `\markdownRendererInputBlockHtmlElement` macro represents a block HTML element. This macro will only be produced, when the `html` option is enabled. The macro receives a single argument that filename of a file containing the contents of the HTML element.

```
\def\markdownRendererInlineHtmlTag{%
  \markdownRendererInlineHtmlTagPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { inlineHtmlTag }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { inlineHtmlTag }
  { 1 }
\ExplSyntaxOff
\def\markdownRendererInputBlockHtmlElement{%
  \markdownRendererInputBlockHtmlElementPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { inputBlockHtmlElement }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { inputBlockHtmlElement }
  { 1 }
\ExplSyntaxOff
```

2.2.3.27 Attribute Renderers

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

`\markdownRendererAttributeIdentifier` represents the ⟨*identifier*⟩ of a markdown element (`id="`⟨*identifier*⟩`"` in HTML and `#`⟨*identifier*⟩ in Markdown's `headerAttributes` syntax extension). The macro receives a single attribute that corresponds to the ⟨*identifier*⟩.

`\markdownRendererAttributeClassName` represents the ⟨*class name*⟩ of a markdown element (`class="`⟨*class name*⟩ ...`"` in HTML and `.`⟨*class name*⟩ in Markdown's `headerAttributes` syntax extension). The macro receives a single attribute that corresponds to the ⟨*class name*⟩.

`\markdownRendererAttributeKeyValue` represents a HTML attribute in the form ⟨*key*⟩`=`⟨*value*⟩ that is neither an identifier nor a class name. The macro receives two attributes that correspond to the ⟨*key*⟩ and the ⟨*value*⟩, respectively.

```
\def\markdownRendererAttributeIdentifier{%
  \markdownRendererAttributeIdentifierPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { attributeIdentifier }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { attributeIdentifier }
  { 1 }
\ExplSyntaxOff
\def\markdownRendererAttributeClassName{%
  \markdownRendererAttributeClassNamePrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { attributeClassName }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { attributeClassName }
  { 1 }
\ExplSyntaxOff
\def\markdownRendererAttributeKeyValue{%
  \markdownRendererAttributeKeyValuePrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { attributeKeyValue }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { attributeKeyValue }
  { 2 }
\ExplSyntaxOff
```

2.2.3.28 Header Attribute Context Renderers

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

The `\markdownRendererHeaderAttributeContextBegin` and `\markdownRendererHeaderAttri` macros represent the beginning and the end of a section in which the attributes of a heading apply. The macros receive no arguments.

```
\def\markdownRendererHeaderAttributeContextBegin{%
  \markdownRendererHeaderAttributeContextBeginPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { headerAttributeContextBegin }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { headerAttributeContextBegin }
  { 0 }
\ExplSyntaxOff
\def\markdownRendererHeaderAttributeContextEnd{%
  \markdownRendererHeaderAttributeContextEndPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { headerAttributeContextEnd }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { headerAttributeContextEnd }
  { 0 }
\ExplSyntaxOff
```

2.2.3.29 Strike-Through Renderer

The `\markdownRendererStrikeThrough` macro represents a strike-through span of text. The macro receives a single argument that corresponds to the striked-out span of text. This macro will only be produced, when the `strikeThrough` option is enabled.

```
\def\markdownRendererStrikeThrough{%
  \markdownRendererStrikeThroughPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { strikeThrough }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { strikeThrough }
  { 1 }
\ExplSyntaxOff
```

2.2.3.30 Superscript Renderer

The `\markdownRendererSuperscript` macro represents a superscript span of text. The macro receives a single argument that corresponds to the superscript span of text. This macro will only be produced, when the `superscripts` option is enabled.

```
\def\markdownRendererSuperscript{%
  \markdownRendererSuperscriptPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { superscript }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { superscript }
  { 1 }
\ExplSyntaxOff
```

2.2.3.31 Subscript Renderer

The `\markdownRendererSubscript` macro represents a subscript span of text. The macro receives a single argument that corresponds to the subscript span of text. This macro will only be produced, when the `subscripts` option is enabled.

```
\def\markdownRendererSubscript{%
  \markdownRendererSubscriptPrototype}%
\ExplSyntaxOn
\seq_put_right:Nn
  \g_@@_renderers_seq
  { subscript }
\prop_put:Nnn
  \g_@@_renderer_arities_prop
  { subscript }
  { 1 }
\ExplSyntaxOff
```

2.2.4 Token Renderer Prototypes

2.2.4.1 YAML Metadata Renderer Prototypes

By default, the renderer prototypes for YAML metadata provide a high-level interface that can be programmed using the `markdown/jekyllData` key–values from the l3keys module of the LaTeX3 kernel.

```
\ExplSyntaxOn
\keys_define:nn
  { markdown/jekyllData }
  { }
\ExplSyntaxOff
```

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).

```
\ExplSyntaxOn
\cs_new:Nn \@@_plaintex_define_renderer_prototypes:
  {
    \seq_map_function:NN
      \g_@@_renderers_seq
      \@@_plaintex_define_renderer_prototype:n
    \let\markdownRendererBlockHtmlCommentBeginPrototype=\iffalse
    \let\markdownRendererBlockHtmlCommentBegin=\iffalse
    \let\markdownRendererBlockHtmlCommentEndPrototype=\fi
    \let\markdownRendererBlockHtmlCommentEnd=\fi
  }
\cs_new:Nn \@@_plaintex_define_renderer_prototype:n
  {
    \@@_renderer_prototype_tl_to_csname:nN
      { #1 }
      \l_tmpa_tl
    \prop_get:NnN
      \g_@@_renderer_arities_prop
      { #1 }
      \l_tmpb_tl
    \@@_plaintex_define_renderer_prototype:cV
      { \l_tmpa_tl }
      \l_tmpb_tl
  }
\cs_new:Nn \@@_renderer_prototype_tl_to_csname:nN
  {
    \tl_set:Nn
      \l_tmpa_tl
      { \str_uppercase:n { #1 } }
    \tl_set:Nx
      #2
      {
        markdownRenderer
        \tl_head:f { \l_tmpa_tl }
        \tl_tail:n { #1 }
        Prototype
      }
  }
\cs_new:Nn \@@_plaintex_define_renderer_prototype:Nn
  {
    \cs_generate_from_arg_count:NNnn
      #1
      \cs_set:Npn
      { #2 }
```

```
      { }
  }
\cs_generate_variant:Nn
  \@@_plaintex_define_renderer_prototype:Nn
  { cV }
\@@_plaintex_define_renderer_prototypes:
\ExplSyntaxOff
```

2.2.5 Logging Facilities

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

2.2.6 Miscellanea

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

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

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

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

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

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

The macro is exposed in the interface, so that the user can create their own markdown environments. Due to the way the arguments are passed to Lua (see Section 3.2.6),

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
- `3` – The lt3luabridge Lua package

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.

The `\markdownMode` macro has been deprecated and will be removed in Markdown 3.0.0. The code that corresponds to `\markdownMode` value of `3` will be the only implementation.

```
\ExplSyntaxOn
\cs_if_exist:NF
  \markdownMode
  {
    \file_if_exist:nTF
      { lt3luabridge.tex }
      {
        \cs_new:Npn
          \markdownMode
          { 3 }
      }
      {
        \cs_if_exist:NTF
          \directlua
          {
            \cs_new:Npn
              \markdownMode
              { 2 }
          }
          {
            \cs_new:Npn
              \markdownMode
              { 0 }
          }
      }
  }
```

The `\markdownLuaRegisterIBCallback` and `\markdownLuaUnregisterIBCallback` macros have been deprecated and will be removed in Markdown 3.0.0:

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

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

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 2.3.2.5) and `markdownRendererPrototypes` (see Section 2.3.2.6) 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 influence this markdown document fragment.

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

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

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

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

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

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

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

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

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

2.3.2 Options

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

Except for the `plain` option described in Section 2.3.2.1, and the LATEX themes described in Section 2.3.2.2, and the LATEX setup snippets described in Section 2.3.2.3, 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, when using the `markdown*` LATEX environment or the `\markdownInput` macro (see Section 2.3), or via the `\markdownSetup` macro. The `\markdownSetup` macro receives the options to set up as its only argument:

```
1827 \ExplSyntaxOn
```

```
\cs_new:Nn
  \@@_setup:n
  {
    \keys_set:nn
      { markdown/latex-options }
      { #1 }
  }
\let\markdownSetup=\@@_setup:n
\ExplSyntaxOff
```

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

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

To decide whether a setup snippet exists, we can use the `\markdownIfSnippetExists` macro:

```
\newcommand\markdownIfSnippetExists[3]{%
  \@ifundefined
    {markdownLaTeXSetupSnippet\markdownLaTeXThemeName#1}%
    {#3}{#2}}%
```

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

To enable the enumeration of LaTeX options, we will maintain the `\g_@@_latex_options_seq` sequence.

```
\ExplSyntaxOn
\seq_new:N \g_@@_latex_options_seq
```

To enable the reflection of default LaTeX options and their types, we will maintain the `\g_@@_default_latex_options_prop` and `\g_@@_latex_option_types_prop` property lists, respectively.

```
\prop_new:N \g_@@_latex_option_types_prop
\prop_new:N \g_@@_default_latex_options_prop
\tl_const:Nn \c_@@_option_layer_latex_tl { latex }
\seq_put_right:NV \g_@@_option_layers_seq \c_@@_option_layer_latex_tl
```

```
\cs_new:Nn
  \@@_add_latex_option:nnn
  {
    \@@_add_option:Vnnn
      \c_@@_option_layer_latex_tl
      { #1 }
      { #2 }
      { #3 }
  }
```

2.3.2.1 No default token renderer prototypes

Default token renderer prototypes require LaTeX packages that may clash with other packages used in a document. Additionally, if we redefine token renderers and renderer prototypes ourselves, the default definitions will bring no benefit to us. Using the `plain` package option, we can keep the default definitions from the plain TeX implementation (see Section 3.2.2) and prevent the soft LaTeX prerequisites in Section 1.1.3 from being loaded: The plain option must be set before or when loading the package. Setting the option after loading the package will have no effect.

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

```
\@@_add_latex_option:nnn
  { plain }
  { boolean }
  { false }
\ExplSyntaxOff
```

2.3.2.2 LaTeX themes

User-contributed LaTeX themes for the Markdown package provide a domain-specific interpretation of some Markdown tokens. Similarly to LaTeX packages, themes allow the authors to achieve a specific look and other high-level goals without low-level programming.

The LaTeX option with key `theme` loads a LaTeX package (further referred to as *a theme*) named `markdowntheme`⟨*munged theme name*⟩`.sty`, where the *munged theme name* is the *theme name* after a substitution of all forward slashes (`/`) for an underscore (`_`), the theme name is a value that is *qualified* and contains no underscores, and a value is qualified if and only if it contains at least one forward slash. Themes are inspired by the Beamer LaTeX package, which provides similar functionality with its `\usetheme` macro [6, Section 15.1].

Theme names must be qualified to minimize naming conflicts between different themes intended for a single LaTeX document class or for a single LaTeX package. The preferred format of a theme name is ⟨*theme author*⟩`/`⟨*target LaTeX document class or package*⟩`/`⟨*private naming scheme*⟩, where the *private naming scheme* may

contain additional forward slashes. For example, a theme by a user `witiko` for the MU theme of the Beamer document class may have the name `witiko/beamer/MU`.

Theme names are munged, because LaTeX packages are identified only by their filenames, not by their pathnames. [7] Therefore, we can't store the qualified theme names directly using directories, but we must encode the individual segments of the qualified theme in the filename. For example, loading a theme named `witiko/beamer/MU` would load a LaTeX package named `markdownthemewitiko_beamer_MU.sty`.

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

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

```
\newif\ifmarkdownLaTeXLoaded
  \markdownLaTeXLoadedfalse
\AtEndOfPackage{\markdownLaTeXLoadedtrue}
\ExplSyntaxOn
\tl_new:N \markdownLaTeXThemePackageName
\cs_new:Nn
  \@@_set_latex_theme:n
  {
    \str_if_in:NnF
      { #1 }
      { / }
      {
        \markdownError
        { Won't load theme with unqualified name #1 }
        { Theme names must contain at least one forward slash }
      }
    \tl_set:Nn \markdownLaTeXThemePackageName { #1 }
    \str_replace_all:Nnn
      \markdownLaTeXThemePackageName
      { / }
      { _ }
    \edef\markdownLaTeXThemePackageName{
```

```
      markdowntheme\markdownLaTeXThemePackageName}
    \expandafter\markdownLaTeXThemeLoad\expandafter{
      \markdownLaTeXThemePackageName}{#1/}
  }
\keys_define:nn
  { markdown/latex-options }
  {
    theme .code:n = { \@@_set_latex_theme:n { #1 } },
  }
\ExplSyntaxOff
```

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

```
\ExplSyntaxOn
\@onlypreamble
  \@@_set_latex_theme:n
\ExplSyntaxOff
```

Example themes provided with the Markdown package include:

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

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

  latex -> pmml;
  latex -> cmml;
  pmml -> slt;
```
```

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

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

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

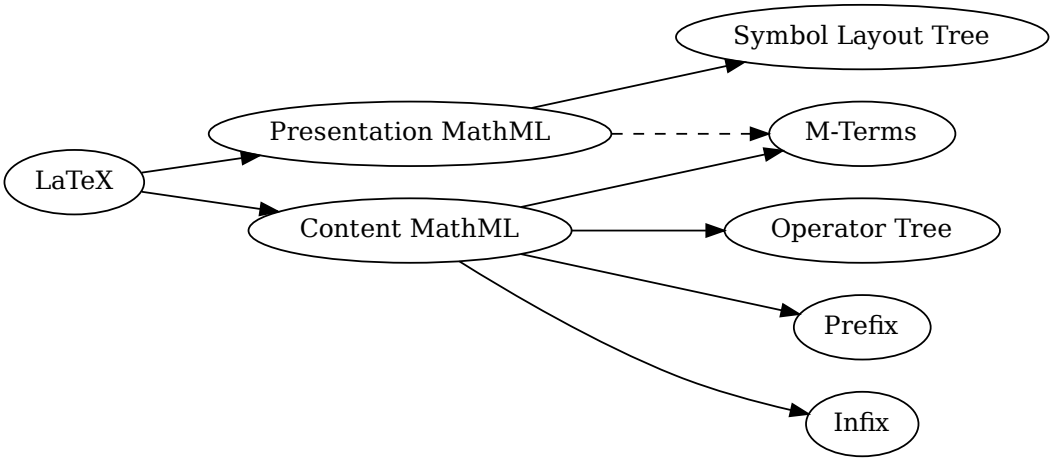

Figure 4: Various formats of mathemathical formulae

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

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

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

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

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

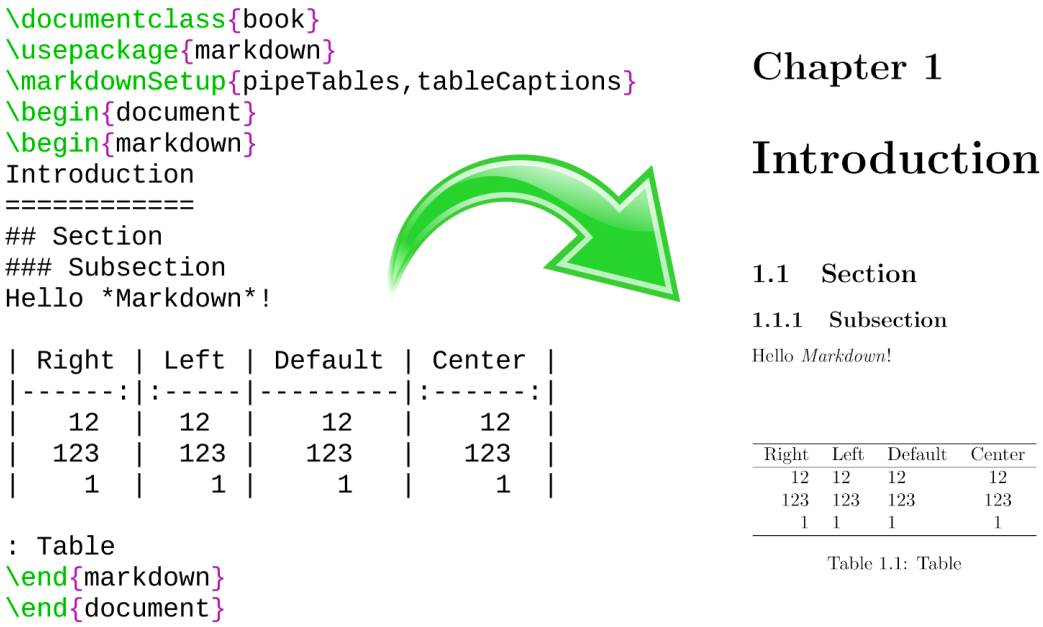

Figure 5: The banner of the Markdown package

theme requires the catchfile LaTeX package and a Unix-like operating system with GNU Coreutils `md5sum` and either GNU Wget or cURL installed. The theme also requires shell access unless the `\markdownOptionFrozenCache` plain TeX option is enabled.

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

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

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

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

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

Please, see Section 3.3.2.1 for implementation details of the example themes.

2.3.2.3 LaTeX setup snippets

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

```
\ExplSyntaxOn
\keys_define:nn
  { markdown/latex-options }
  {
    snippet .code:n = {
      \markdownIfSnippetExists{#1}
        {
          \expandafter\markdownSetup\expandafter{
            \the\csname markdownLaTeXSetupSnippet
            \markdownLaTeXThemeName#1\endcsname}
        }{
          \markdownError
            {Can't~invoke~setup~snippet~#1}
            {The~setup~snippet~is~undefined}
        }
    }
  }
\ExplSyntaxOff
```

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

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

```
The following ordered list will be preceded by arabic numerals:

1. wahid
2. aithnayn

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

The following ordered list will be preceded by roman numerals:

3. tres
4. quattuor

\end{markdown*}
```

2.3.2.4 Plain TEX Interface Options

Here, we automatically define plain TEX macros and the ⟨*key*⟩=⟨*value*⟩ interface for the above LATEX options.

```
\ExplSyntaxOn
\cs_new:Nn \@@_latex_define_option_commands_and_keyvals:
  {
    \seq_map_inline:Nn
      \g_@@_latex_options_seq
      {
          \@@_plain_tex_define_option_command:n
            { ##1 }
      }
```

Furthermore, we also define the ⟨*key*⟩=⟨*value*⟩ interface for all option macros recognized by the Lua and plain TEX interfaces.

```
    \seq_map_inline:Nn
      \g_@@_option_layers_seq
      {
        \seq_map_inline:cn
          { g_@@_ ##1 _options_seq }
          {
              \@@_latex_define_option_keyval:nn
                { ##1 }
                { ####1 }
          }
      }
  }
\cs_new:Nn \@@_latex_define_option_keyval:nn
  {
```

```
    \prop_get:cnN
      { g_@@_ #1 _option_types_prop }
      { #2 }
      \l_tmpa_tl
    \keys_define:nn
      { markdown/latex-options }
      {
        #2 .code:n = {
          \@@_set_option_value:nn
            { #2 }
            { ##1 }
        },
      }
    \str_if_eq:VVT
      \l_tmpa_tl
      \c_@@_option_type_boolean_tl
      {
        \keys_define:nn
          { markdown/latex-options }
          {
            #2 .default:n = { true },
          }
      }
  }
\@@_latex_define_option_commands_and_keyvals:
\ExplSyntaxOff
```

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

To ensure compatibility with the `minted` package [8, Section 5.1], which supports the `finalizecache` and `frozencache` package options with similar semantics, the Markdown package also recognizes these as aliases and recognizes them as document class options. By passing `finalizecache` and `frozencache` as document class options, you may conveniently control the behavior of both packages at once:

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

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

```
\DeclareOption{finalizecache}{\markdownSetup{finalizeCache}}
\DeclareOption{frozencache}{\markdownSetup{frozenCache}}
```

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

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

2.3.2.5 Plain TeX Markdown Token Renderers

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

```
\ExplSyntaxOn
\cs_new:Nn \@@_latex_define_renderers:
  {
    \seq_map_function:NN
      \g_@@_renderers_seq
      \@@_latex_define_renderer:n
  }
\cs_new:Nn \@@_latex_define_renderer:n
  {
    \@@_renderer_tl_to_csname:nN
      { #1 }
      \l_tmpa_tl
    \prop_get:NnN
      \g_@@_renderer_arities_prop
      { #1 }
      \l_tmpb_tl
    \@@_latex_define_renderer:ncV
      { #1 }
      { \l_tmpa_tl }
      \l_tmpb_tl
  }
\cs_new:Nn \@@_renderer_tl_to_csname:nN
  {
    \tl_set:Nn
      \l_tmpa_tl
      { \str_uppercase:n { #1 } }
    \tl_set:Nx
      #2
      {
        markdownRenderer
        \tl_head:f { \l_tmpa_tl }
```

```
        \tl_tail:n { #1 }
      }
  }
\cs_new:Nn \@@_latex_define_renderer:nNn
  {
    \keys_define:nn
      { markdown/latex-options/renderers }
      {
        #1 .code:n = {
          \cs_generate_from_arg_count:NNnn
            #2
            \cs_set:Npn
            { #3 }
            { ##1 }
        },
      }
  }
\cs_generate_variant:Nn
  \@@_latex_define_renderer:nNn
  { ncV }
\ExplSyntaxOff
```

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`.
  }
}
```

2.3.2.6 Plain TeX Markdown Token Renderer Prototypes

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

```
\ExplSyntaxOn
\cs_new:Nn \@@_latex_define_renderer_prototypes:
  {
    \seq_map_function:NN
      \g_@@_renderers_seq
      \@@_latex_define_renderer_prototype:n
  }
\cs_new:Nn \@@_latex_define_renderer_prototype:n
```

```
  {
    \@@_renderer_prototype_tl_to_csname:nN
      { #1 }
      \l_tmpa_tl
    \prop_get:NnN
      \g_@@_renderer_arities_prop
      { #1 }
      \l_tmpb_tl
    \@@_latex_define_renderer_prototype:ncV
      { #1 }
      { \l_tmpa_tl }
      \l_tmpb_tl
  }
\cs_new:Nn \@@_latex_define_renderer_prototype:nNn
  {
    \keys_define:nn
      { markdown/latex-options/renderer-prototypes }
      {
        #1 .code:n = {
          \cs_generate_from_arg_count:NNnn
            #2
            \cs_set:Npn
            { #3 }
            { ##1 }
        },
      }
  }
\cs_generate_variant:Nn
  \@@_latex_define_renderer_prototype:nNn
  { ncV }
\ExplSyntaxOff
```

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 mark-

down input from within ConTEXt and facilities for setting Lua, plain TEX, and ConTEXt options used during the conversion from markdown to plain TEX. The rest of the interface is inherited from the plain TEX interface (see Section 2.2).

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

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.}}%
\def\dospecials{\do\ \do\\\do\{\do\}\do\$\do\&%
  \do\#\do\^\do\_\do\%\do\~}%
\input markdown/markdown
```

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, and defines the `\inputmarkdown` command.

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

The \inputmarkdown 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 ConTEXt interface options (see Section 2.4.2) as its optional argument. These options will only influnce this markdown document.

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

```
\usemodule[t][markdown]
\starttext
\inputmarkdown[smartEllipses]{hello.md}
\stoptext
```

2.4.2 Options

The ConTEXt 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 (or, equivalently, ⟨*key*⟩=yes) if the =⟨*value*⟩ part has been omitted.

ConTEXt options map directly to the options recognized by the plain TEX interface (see Section 2.2.2).

The ConTEXt options may be specified when using the \inputmarkdown macro (see Section 2.4), or via the \setupmarkdown macro. The \setupmarkdown macro receives the options to set up as its only argument:

```
\ExplSyntaxOn
\cs_new:Nn
  \@@_setup:n
  {
    \keys_set:nn
      { markdown/context-options }
      { #1 }
  }
\long\def\setupmarkdown[#1]
  {
    \@@_setup:n
      { #1 }
  }
\ExplSyntaxOff
```

2.4.2.1 ConTEXt Interface Options

We define the ⟨*key*⟩=⟨*value*⟩ interface for all option macros recognized by the Lua and plain TEX interfaces.

```
\ExplSyntaxOn
\cs_new:Nn \@@_context_define_option_commands_and_keyvals:
  {
    \seq_map_inline:Nn
      \g_@@_option_layers_seq
      {
        \seq_map_inline:cn
          { g_@@_ ##1 _options_seq }
          {
              \@@_context_define_option_keyval:nn
                { ##1 }
                { ####1 }
          }
      }
  }
\cs_new:Nn \@@_context_define_option_keyval:nn
  {
    \prop_get:cnN
      { g_@@_ #1 _option_types_prop }
      { #2 }
      \l_tmpa_tl
    \keys_define:nn
      { markdown/context-options }
      {
        #2 .code:n = {
          \tl_set:Nx
            \l_tmpa_tl
            {
              \str_case:nnF
                { ##1 }
                {
                  { yes } { true }
                  { no } { false }
                }
                { ##1 }
            }
          \@@_set_option_value:nV
            { #2 }
            \l_tmpa_tl
        },
      }
    \str_if_eq:VVT
      \l_tmpa_tl
      \c_@@_option_type_boolean_tl
      {
```

```
        \keys_define:nn
          { markdown/context-options }
          {
            #2 .default:n = { true },
          }
      }
  }
\cs_generate_variant:Nn
  \@@_set_option_value:nn
  { nV }
\@@_context_define_option_commands_and_keyvals:
\ExplSyntaxOff
```

3 Implementation

This part of the documentation 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.

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

3.1 Lua Implementation

The Lua implementation implements `writer` and `reader` objects, which provide the conversion from markdown to plain TEX, and `extensions` objects, which provide syntax extensions for the `writer` and `reader` objects.

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 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.
    file = assert(io.open(name, "w"),
      [[could not open file "]] .. name .. [[" for writing]])
    local result = string
    if transform ~= nil then
      result = transform(result)
    end
    assert(file:write(result))
    assert(file:close())
  end
  return name
end
```

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

```
function util.table_copy(t)
  local u = { }
  for k, v in pairs(t) do u[k] = v end
  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 Ierusalimschy [9, 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 $1 \leqslant$ `i` $\leqslant$ `#ary`.

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

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

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

```
  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 = {
  ["Tab"] = 9,
  ["NewLine"] = 10,
  ["excl"] = 33,
  ["quot"] = 34,
  ["QUOT"] = 34,
  ["num"] = 35,
  ["dollar"] = 36,
  ["percnt"] = 37,
  ["amp"] = 38,
  ["AMP"] = 38,
  ["apos"] = 39,
  ["lpar"] = 40,
  ["rpar"] = 41,
  ["ast"] = 42,
  ["midast"] = 42,
  ["plus"] = 43,
  ["comma"] = 44,
  ["period"] = 46,
  ["sol"] = 47,
  ["colon"] = 58,
  ["semi"] = 59,
  ["lt"] = 60,
  ["LT"] = 60,
  ["equals"] = 61,
  ["gt"] = 62,
  ["GT"] = 62,
  ["quest"] = 63,
  ["commat"] = 64,
  ["lsqb"] = 91,
  ["lbrack"] = 91,
  ["bsol"] = 92,
  ["rsqb"] = 93,
  ["rbrack"] = 93,
```

```
2325    ["Hat"] = 94,
2326    ["lowbar"] = 95,
2327    ["grave"] = 96,
2328    ["DiacriticalGrave"] = 96,
2329    ["lcub"] = 123,
2330    ["lbrace"] = 123,
2331    ["verbar"] = 124,
2332    ["vert"] = 124,
2333    ["VerticalLine"] = 124,
2334    ["rcub"] = 125,
2335    ["rbrace"] = 125,
2336    ["nbsp"] = 160,
2337    ["NonBreakingSpace"] = 160,
2338    ["iexcl"] = 161,
2339    ["cent"] = 162,
2340    ["pound"] = 163,
2341    ["curren"] = 164,
2342    ["yen"] = 165,
2343    ["brvbar"] = 166,
2344    ["sect"] = 167,
2345    ["Dot"] = 168,
2346    ["die"] = 168,
2347    ["DoubleDot"] = 168,
2348    ["uml"] = 168,
2349    ["copy"] = 169,
2350    ["COPY"] = 169,
2351    ["ordf"] = 170,
2352    ["laquo"] = 171,
2353    ["not"] = 172,
2354    ["shy"] = 173,
2355    ["reg"] = 174,
2356    ["circledR"] = 174,
2357    ["REG"] = 174,
2358    ["macr"] = 175,
2359    ["OverBar"] = 175,
2360    ["strns"] = 175,
2361    ["deg"] = 176,
2362    ["plusmn"] = 177,
2363    ["pm"] = 177,
2364    ["PlusMinus"] = 177,
2365    ["sup2"] = 178,
2366    ["sup3"] = 179,
2367    ["acute"] = 180,
2368    ["DiacriticalAcute"] = 180,
2369    ["micro"] = 181,
2370    ["para"] = 182,
2371    ["middot"] = 183,
```

```
2372    ["centerdot"] = 183,
2373    ["CenterDot"] = 183,
2374    ["cedil"] = 184,
2375    ["Cedilla"] = 184,
2376    ["sup1"] = 185,
2377    ["ordm"] = 186,
2378    ["raquo"] = 187,
2379    ["frac14"] = 188,
2380    ["frac12"] = 189,
2381    ["half"] = 189,
2382    ["frac34"] = 190,
2383    ["iquest"] = 191,
2384    ["Agrave"] = 192,
2385    ["Aacute"] = 193,
2386    ["Acirc"] = 194,
2387    ["Atilde"] = 195,
2388    ["Auml"] = 196,
2389    ["Aring"] = 197,
2390    ["AElig"] = 198,
2391    ["Ccedil"] = 199,
2392    ["Egrave"] = 200,
2393    ["Eacute"] = 201,
2394    ["Ecirc"] = 202,
2395    ["Euml"] = 203,
2396    ["Igrave"] = 204,
2397    ["Iacute"] = 205,
2398    ["Icirc"] = 206,
2399    ["Iuml"] = 207,
2400    ["ETH"] = 208,
2401    ["Ntilde"] = 209,
2402    ["Ograve"] = 210,
2403    ["Oacute"] = 211,
2404    ["Ocirc"] = 212,
2405    ["Otilde"] = 213,
2406    ["Ouml"] = 214,
2407    ["times"] = 215,
2408    ["Oslash"] = 216,
2409    ["Ugrave"] = 217,
2410    ["Uacute"] = 218,
2411    ["Ucirc"] = 219,
2412    ["Uuml"] = 220,
2413    ["Yacute"] = 221,
2414    ["THORN"] = 222,
2415    ["szlig"] = 223,
2416    ["agrave"] = 224,
2417    ["aacute"] = 225,
2418    ["acirc"] = 226,
```

```
2419    ["atilde"] = 227,
2420    ["auml"] = 228,
2421    ["aring"] = 229,
2422    ["aelig"] = 230,
2423    ["ccedil"] = 231,
2424    ["egrave"] = 232,
2425    ["eacute"] = 233,
2426    ["ecirc"] = 234,
2427    ["euml"] = 235,
2428    ["igrave"] = 236,
2429    ["iacute"] = 237,
2430    ["icirc"] = 238,
2431    ["iuml"] = 239,
2432    ["eth"] = 240,
2433    ["ntilde"] = 241,
2434    ["ograve"] = 242,
2435    ["oacute"] = 243,
2436    ["ocirc"] = 244,
2437    ["otilde"] = 245,
2438    ["ouml"] = 246,
2439    ["divide"] = 247,
2440    ["div"] = 247,
2441    ["oslash"] = 248,
2442    ["ugrave"] = 249,
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3874  ["rHar"] = 10596,
3875  ["dHar"] = 10597,
```

```
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```

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  ["bigodot"] = 10752,
  ["xoplus"] = 10753,
  ["bigoplus"] = 10753,
```

```
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3977  ["iiiint"] = 10764,
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3979  ["cirfnint"] = 10768,
3980  ["awint"] = 10769,
3981  ["rppolint"] = 10770,
3982  ["scpolint"] = 10771,
3983  ["npolint"] = 10772,
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```

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```

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```

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```

```
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4203  ["Vscr"] = 119985,
4204  ["Wscr"] = 119986,
```

```
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  ["bscr"] = 119991,
  ["cscr"] = 119992,
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  ["sscr"] = 120008,
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  ["zscr"] = 120015,
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  ["Ufr"] = 120088,
  ["Vfr"] = 120089,
  ["Wfr"] = 120090,
  ["Xfr"] = 120091,
  ["Yfr"] = 120092,
```

```
4252  ["afr"] = 120094,
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4256  ["efr"] = 120098,
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4258  ["gfr"] = 120100,
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4262  ["kfr"] = 120104,
4263  ["lfr"] = 120105,
4264  ["mfr"] = 120106,
4265  ["nfr"] = 120107,
4266  ["ofr"] = 120108,
4267  ["pfr"] = 120109,
4268  ["qfr"] = 120110,
4269  ["rfr"] = 120111,
4270  ["sfr"] = 120112,
4271  ["tfr"] = 120113,
4272  ["ufr"] = 120114,
4273  ["vfr"] = 120115,
4274  ["wfr"] = 120116,
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4276  ["yfr"] = 120118,
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4288  ["Mopf"] = 120132,
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4290  ["Sopf"] = 120138,
4291  ["Topf"] = 120139,
4292  ["Uopf"] = 120140,
4293  ["Vopf"] = 120141,
4294  ["Wopf"] = 120142,
4295  ["Xopf"] = 120143,
4296  ["Yopf"] = 120144,
4297  ["aopf"] = 120146,
4298  ["bopf"] = 120147,
```

```
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  ["dopf"] = 120149,
  ["eopf"] = 120150,
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  ["gopf"] = 120152,
  ["hopf"] = 120153,
  ["iopf"] = 120154,
  ["jopf"] = 120155,
  ["kopf"] = 120156,
  ["lopf"] = 120157,
  ["mopf"] = 120158,
  ["nopf"] = 120159,
  ["oopf"] = 120160,
  ["popf"] = 120161,
  ["qopf"] = 120162,
  ["ropf"] = 120163,
  ["sopf"] = 120164,
  ["topf"] = 120165,
  ["uopf"] = 120166,
  ["vopf"] = 120167,
  ["wopf"] = 120168,
  ["xopf"] = 120169,
  ["yopf"] = 120170,
  ["zopf"] = 120171,
}
```

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

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

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

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

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

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

3.1.3 Plain TEX Writer

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

Although not specified in the Lua interface (see Section 2.1), 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.

```
4337 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*⟩. All member variables are immutable unless explicitly stated otherwise.

```
4338 function M.writer.new(options)
4339   local self = {}
```

Make `options` available as `writer->options`, so that it is accessible from extensions.

```
4340   self.options = options
```

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

```
4341   local slice_specifiers = {}
4342   for specifier in options.slice:gmatch("[^%s]+") do
4343     table.insert(slice_specifiers, specifier)
4344   end
4345
4346   if #slice_specifiers == 2 then
4347     self.slice_begin, self.slice_end = table.unpack(slice_specifiers)
4348     local slice_begin_type = self.slice_begin:sub(1, 1)
4349     if slice_begin_type ~= "^" and slice_begin_type ~= "$" then
4350       self.slice_begin = "^" .. self.slice_begin
4351     end
4352     local slice_end_type = self.slice_end:sub(1, 1)
4353     if slice_end_type ~= "^" and slice_end_type ~= "$" then
4354       self.slice_end = "$" .. self.slice_end
4355     end
4356   elseif #slice_specifiers == 1 then
4357     self.slice_begin = "^" .. slice_specifiers[1]
```

```
4358    self.slice_end = "$" .. slice_specifiers[1]
4359  end
4360
4361  if self.slice_begin == "^" and self.slice_end ~= "^" then
4362    self.is_writing = true
4363  else
4364    self.is_writing = false
4365  end
```

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

```
4366  self.suffix = ".tex"
```

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

```
4367  self.space = " "
```

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

```
4368  self.nbsp = "\\markdownRendererNbsp{}"
```

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

```
4369  function self.plain(s)
4370    return s
4371  end
```

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

```
4372  function self.paragraph(s)
4373    if not self.is_writing then return "" end
4374    return s
4375  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.

```
4376  function self.pack(name)
4377    return [[\input ]] .. name .. [[\relax]]
4378  end
```

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

```
4379  function self.interblocksep()
4380    if not self.is_writing then return "" end
4381    return "\\markdownRendererInterblockSeparator\n{}"
4382  end
```

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

```
4383  self.linebreak = "\\markdownRendererLineBreak\n{}"
```

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

```
4384  self.ellipsis = "\\markdownRendererEllipsis{}"
```

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

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

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

```
self.escaped_uri_chars = {
  ["{"] = "\\markdownRendererLeftBrace{}",
  ["}"] = "\\markdownRendererRightBrace{}",
  ["%"] = "\\markdownRendererPercentSign{}",
  ["\\"] = "\\markdownRendererBackslash{}",
}
self.escaped_minimal_strings = {
  ["^^"] = "\\markdownRendererCircumflex\\markdownRendererCircumflex ",
  ["☒"] = "\\markdownRendererTickedBox{}",
  ["☐"] = "\\markdownRendererHalfTickedBox{}",
  ["▫"] = "\\markdownRendererUntickedBox{}",
}
```

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

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

Use the `writer->escaped_chars`, `writer->escaped_uri_chars`, and `writer->escaped_minima` tables to create the `writer->escape`, `writer->escape_uri`, and `writer->escape_minimal` escaper functions.

```
self.escape = util.escaper(self.escaped_chars, self.escaped_minimal_strings)
self.escape_uri = util.escaper(self.escaped_uri_chars, self.escaped_minimal_strings)
self.escape_minimal = util.escaper({}, self.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 trans-

form an input URI `u` to the output format. If the `hybrid` option is enabled, use the `writer->escape_minimal`. Otherwise, use the `writer->escape`, and `writer->escape_uri` functions.

```
4417  if options.hybrid then
4418    self.string = self.escape_minimal
4419    self.uri = self.escape_minimal
4420  else
4421    self.string = self.escape
4422    self.uri = self.escape_uri
4423  end
```

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

```
4424  function self.code(s)
4425    return {"\\markdownRendererCodeSpan{",self.escape(s),"}"}
4426  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.

```
4427  function self.link(lab,src,tit)
4428    return {"\\markdownRendererLink{",lab,"}",
4429                           "{",self.escape(src),"}",
4430                           "{",self.uri(src),"}",
4431                           "{",self.string(tit or ""),"}"}
4432  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.

```
4433  function self.image(lab,src,tit)
4434    return {"\\markdownRendererImage{",lab,"}",
4435                            "{",self.string(src),"}",
4436                            "{",self.uri(src),"}",
4437                            "{",self.string(tit or ""),"}"}
4438  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.

```
4439  function self.bulletlist(items,tight)
4440    if not self.is_writing then return "" end
4441    local buffer = {}
4442    for _,item in ipairs(items) do
4443      buffer[#buffer + 1] = self.bulletitem(item)
4444    end
4445    local contents = util.intersperse(buffer,"\n")
```

```
4446    if tight and options.tightLists then
4447      return {"\\markdownRendererUlBeginTight\n",contents,
4448        "\n\\markdownRendererUlEndTight "}
4449    else
4450      return {"\\markdownRendererUlBegin\n",contents,
4451        "\n\\markdownRendererUlEnd "}
4452    end
4453  end
```

Define `writer->bulletitem` as a function that will transform an input bulleted list item to the output format, where `s` is the text of the list item.

```
4454  function self.bulletitem(s)
4455    return {"\\markdownRendererUlItem ",s,
4456            "\\markdownRendererUlItemEnd "}
4457  end
```

Define `writer->orderedlist` 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 is the number of the first list item.

```
4458  function self.orderedlist(items,tight,startnum)
4459    if not self.is_writing then return "" end
4460    local buffer = {}
4461    local num = startnum
4462    for _,item in ipairs(items) do
4463      buffer[#buffer + 1] = self.ordereditem(item,num)
4464      if num ~= nil then
4465        num = num + 1
4466      end
4467    end
4468    local contents = util.intersperse(buffer,"\n")
4469    if tight and options.tightLists then
4470      return {"\\markdownRendererOlBeginTight\n",contents,
4471              "\n\\markdownRendererOlEndTight "}
4472    else
4473      return {"\\markdownRendererOlBegin\n",contents,
4474              "\n\\markdownRendererOlEnd "}
4475    end
4476  end
```

Define `writer->ordereditem` as a function that will transform an input ordered list item to the output format, where `s` is the text of the list item. If the optional parameter `num` is present, it is the number of the list item.

```
4477  function self.ordereditem(s,num)
4478    if num ~= nil then
4479      return {"\\markdownRendererOlItemWithNumber{",num,"}",s,
4480              "\\markdownRendererOlItemEnd "}
4481    else
```

```
4482        return {"\\markdownRendererOlItem ",s,
4483                "\\markdownRendererOlItemEnd "}
4484      end
4485    end
```

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

```
4486    function self.inline_html_comment(contents)
4487      return {"\\markdownRendererInlineHtmlComment{",contents,"}"}
4488    end
```

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

```
4489    function self.block_html_comment(contents)
4490      if not self.is_writing then return "" end
4491      return {"\\markdownRendererBlockHtmlCommentBegin\n",contents,
4492              "\n\\markdownRendererBlockHtmlCommentEnd "}
4493    end
```

Define `writer->inline_html_tag` as a function that will transform the contents of an opening, closing, or empty inline HTML tag to the output format, where `contents` are the contents of the HTML tag.

```
4494    function self.inline_html_tag(contents)
4495      return {"\\markdownRendererInlineHtmlTag{",self.string(contents),"}"}
4496    end
```

Define `writer->block_html_element` as a function that will transform the contents of a block HTML element to the output format, where `s` are the contents of the HTML element.

```
4497    function self.block_html_element(s)
4498      if not self.is_writing then return "" end
4499      local name = util.cache(options.cacheDir, s, nil, nil, ".verbatim")
4500      return {"\\markdownRendererInputBlockHtmlElement{",name,"}"}
4501    end
```

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

```
4502    function self.emphasis(s)
4503      return {"\\markdownRendererEmphasis{",s,"}"}
4504    end
```

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

```
4505    function self.tickbox(f)
4506      if f == 1.0 then
4507        return "☒ "
```

```
4508      elseif f == 0.0 then
4509        return "☐ "
4510      else
4511        return "☒ "
4512      end
4513    end
```

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

```
4514    function self.strong(s)
4515      return {"\\markdownRendererStrongEmphasis{",s,"}"}
4516    end
```

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

```
4517    function self.blockquote(s)
4518      if #util.rope_to_string(s) == 0 then return "" end
4519      return {"\\markdownRendererBlockQuoteBegin\n",s,
4520        "\n\\markdownRendererBlockQuoteEnd "}
4521    end
```

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

```
4522    function self.verbatim(s)
4523      if not self.is_writing then return "" end
4524      s = string.gsub(s, '[\r\n%s]*$', '')
4525      local name = util.cache(options.cacheDir, s, nil, nil, ".verbatim")
4526      return {"\\markdownRendererInputVerbatim{",name,"}"}
4527    end
```

Define `writer->document` as a function that will transform a document `d` to the output format.

```
4528    function self.document(d)
4529      local active_attributes = self.active_attributes
4530      local buf = {"\\markdownRendererDocumentBegin\n", d}
4531
4532      -- pop attributes for sections that have ended
4533      if options.headerAttributes and self.is_writing then
4534        while #active_attributes > 0 do
4535          local attributes = active_attributes[#active_attributes]
4536          if #attributes > 0 then
4537            table.insert(buf, "\\markdownRendererHeaderAttributeContextEnd")
4538          end
4539          table.remove(active_attributes, #active_attributes)
4540        end
4541      end
4542
4543      table.insert(buf, "\\markdownRendererDocumentEnd")
```

```
4544
4545    return buf
4546  end
```

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

```
4547  self.active_attributes = {}
```

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

```
4548  function self.heading(s, level, attributes)
4549    attributes = attributes or {}
4550    for i = 1, #attributes do
4551      attributes[attributes[i]] = true
4552    end
4553
4554    local active_attributes = self.active_attributes
4555    local slice_begin_type = self.slice_begin:sub(1, 1)
4556    local slice_begin_identifier = self.slice_begin:sub(2) or ""
4557    local slice_end_type = self.slice_end:sub(1, 1)
4558    local slice_end_identifier = self.slice_end:sub(2) or ""
4559
4560    local buf = {}
4561
4562    -- push empty attributes for implied sections
4563    while #active_attributes < level-1 do
4564      table.insert(active_attributes, {})
4565    end
4566
4567    -- pop attributes for sections that have ended
4568    while #active_attributes >= level do
4569      local active_identifiers = active_attributes[#active_attributes]
4570      -- tear down all active attributes at slice end
4571      if active_identifiers["#" .. slice_end_identifier] ~= nil
4572          and slice_end_type == "$" then
4573        for header_level = #active_attributes, 1, -1 do
4574          if options.headerAttributes and #active_attributes[header_level] > 0 then
4575            table.insert(buf, "\\markdownRendererHeaderAttributeContextEnd")
4576          end
4577        end
4578        self.is_writing = false
4579      end
4580      table.remove(active_attributes, #active_attributes)
4581      if self.is_writing and options.headerAttributes and #active_identifiers > 0 then
4582        table.insert(buf, "\\markdownRendererHeaderAttributeContextEnd")
4583      end
4584      -- apply all active attributes at slice beginning
4585      if active_identifiers["#" .. slice_begin_identifier] ~= nil
```

```
        and slice_begin_type == "$" then
      for header_level = 1, #active_attributes do
        if options.headerAttributes and #active_attributes[header_level] > 0 then
          table.insert(buf, "\\markdownRendererHeaderAttributeContextBegin")
        end
      end
      self.is_writing = true
    end
  end

  -- tear down all active attributes at slice end
  if attributes["#" .. slice_end_identifier] ~= nil
      and slice_end_type == "^" then
    for header_level = #active_attributes, 1, -1 do
      if options.headerAttributes and #active_attributes[header_level] > 0 then
        table.insert(buf, "\\markdownRendererHeaderAttributeContextEnd")
      end
    end
    self.is_writing = false
  end

  -- push attributes for the new section
  table.insert(active_attributes, attributes)
  if self.is_writing and options.headerAttributes and #attributes > 0 then
    table.insert(buf, "\\markdownRendererHeaderAttributeContextBegin")
  end

  -- apply all active attributes at slice beginning
  if attributes["#" .. slice_begin_identifier] ~= nil
      and slice_begin_type == "^" then
    for header_level = 1, #active_attributes do
      if options.headerAttributes and #active_attributes[header_level] > 0 then
        table.insert(buf, "\\markdownRendererHeaderAttributeContextBegin")
      end
    end
    self.is_writing = true
  end

  if self.is_writing then
    table.sort(attributes)
    local key, value
    for i = 1, #attributes do
      if attributes[i]:sub(1, 1) == "#" then
        table.insert(buf, {"\\markdownRendererAttributeIdentifier{",
                           attributes[i]:sub(2), "}"})
      elseif attributes[i]:sub(1, 1) == "." then
        table.insert(buf, {"\\markdownRendererAttributeClassName{",
```

```
                              attributes[i]:sub(2), "}"})
        else
          key, value = attributes[i]:match("([^= ]+)%s*=%s*(.*)")
          table.insert(buf, {"\\markdownRendererAttributeKeyValue{",
                             key, "}{", value, "}"})
        end
      end
    end

    local cmd
    level = level + options.shiftHeadings
    if level <= 1 then
      cmd = "\\markdownRendererHeadingOne"
    elseif level == 2 then
      cmd = "\\markdownRendererHeadingTwo"
    elseif level == 3 then
      cmd = "\\markdownRendererHeadingThree"
    elseif level == 4 then
      cmd = "\\markdownRendererHeadingFour"
    elseif level == 5 then
      cmd = "\\markdownRendererHeadingFive"
    elseif level >= 6 then
      cmd = "\\markdownRendererHeadingSix"
    else
      cmd = ""
    end
    if self.is_writing then
      table.insert(buf, {cmd, "{", s, "}"})
    end

    return buf
  end
```

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

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

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

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

```
    end
    return previous_state
  end
```

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

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

  return self
end
```

3.1.4 Parsers

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

```
local parsers                 = {}
```

3.1.4.1 Basic Parsers

```
parsers.percent               = P("%")
parsers.at                    = P("@")
parsers.comma                 = P(",")
parsers.asterisk              = P("*")
parsers.dash                  = P("-")
parsers.plus                  = P("+")
parsers.underscore            = P("_")
parsers.period                = P(".")
parsers.hash                  = P("#")
parsers.ampersand             = P("&")
parsers.backtick              = P("`")
parsers.less                  = P("<")
parsers.more                  = P(">")
parsers.space                 = P(" ")
parsers.squote                = P("'")
parsers.dquote                = P('"')
parsers.lparent               = P("(")
parsers.rparent               = P(")")
parsers.lbracket              = P("[")
```

```
parsers.rbracket               = P("]")
parsers.lbrace                 = P("{")
parsers.rbrace                 = P("}")
parsers.circumflex             = P("^")
parsers.slash                  = P("/")
parsers.equal                  = P("=")
parsers.colon                  = P(":")
parsers.semicolon              = P(";")
parsers.exclamation            = P("!")
parsers.pipe                   = P("|")
parsers.tilde                  = P("~")
parsers.backslash              = P("\\")
parsers.tab                    = P("\t")
parsers.newline                = P("\n")
parsers.tightblocksep          = P("\001")

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.internal_punctuation   = S(":;,.?")

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

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

parsers.escapable              = S("!\"#$%&'()*+,-./:;<=>?@[\\]^_`{|}~")
parsers.anyescaped             = parsers.backslash / "" * 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.normalchar             = parsers.any - (V("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.nonemptyline              = parsers.line - parsers.blankline
```

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

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

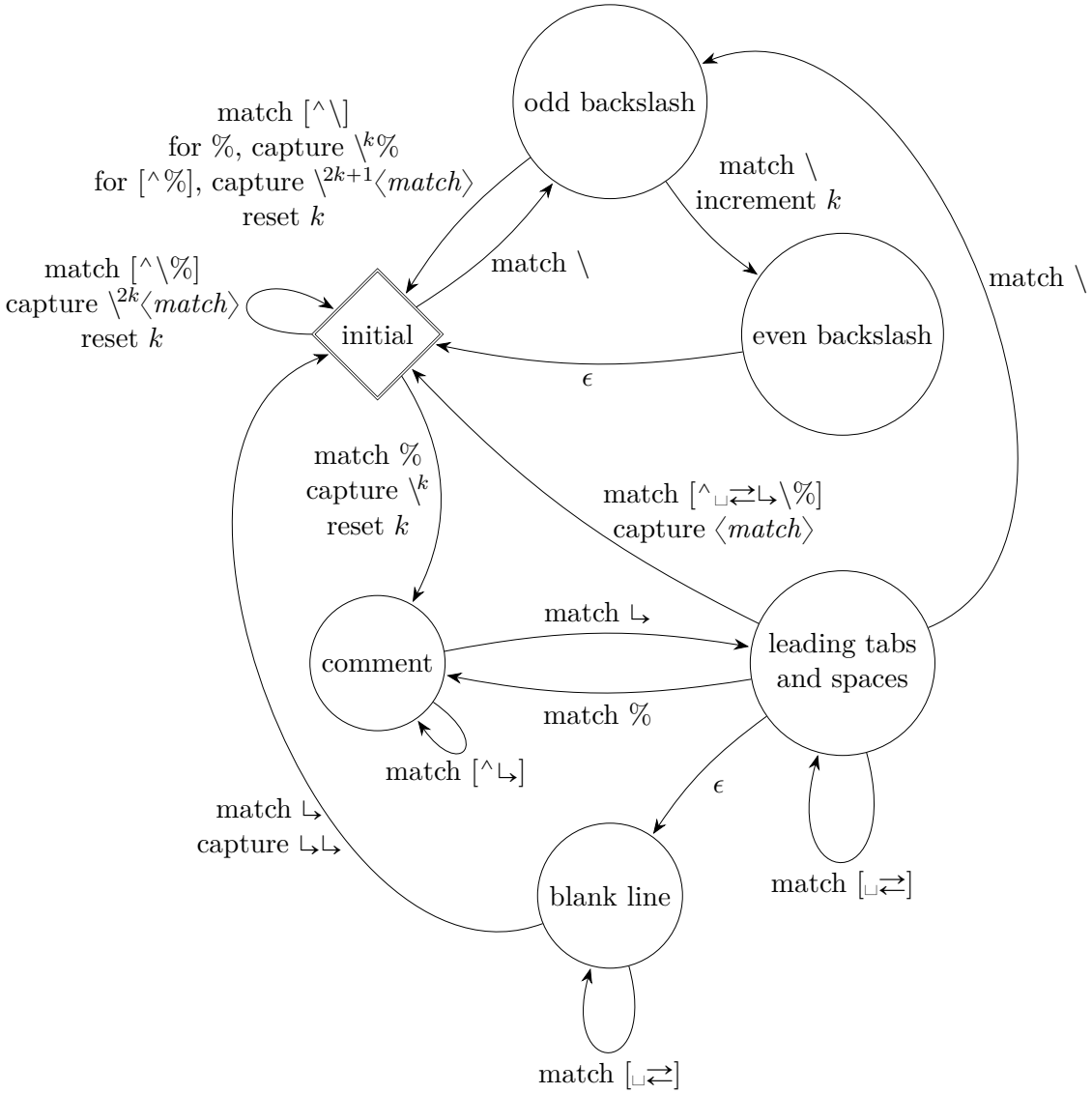

Figure 6: A pushdown automaton that recognizes TEX comments

```
                                    * Cg(Cc(""), "backslashes")))^0
                                  * (#parsers.percent
                                    * Cb("backslashes")
                                    / function(backslashes)
                                      return string.rep("\\", #backslashes / 2)
                                    end
                                    * ((parsers.percent  -- comment
                                       * parsers.line
                                       * #parsers.blankline) -- blank line
                                      / "\n"
                                      + parsers.percent  -- comment
                                      * parsers.line
                                      * parsers.optionalspace)  -- leading tabs and spaces
                                    + #(parsers.newline)
                                    * Cb("backslashes")
                                    * C(parsers.newline))

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

parsers.attribute_key_char        = parsers.alphanumeric + S("_-")
parsers.attribute_key             = (parsers.attribute_key_char
                                    - parsers.dash - parsers.digit)
                                  * parsers.attribute_key_char^0
parsers.attribute_value           = ( (parsers.dquote / "")
                                    * (parsers.anyescaped - parsers.dquote)^0
                                    * (parsers.dquote / ""))
                                  + ( parsers.anyescaped - parsers.dquote - parsers.rbrace
                                    - parsers.space)^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
                  )

local function tickbox(interior)
  return parsers.optionalspace * parsers.lbracket
       * interior * parsers.rbracket * parsers.spacechar^1
end

parsers.ticked_box = tickbox(S("xX")) * Cc(1.0)
parsers.halfticked_box = tickbox(S("./")) * Cc(0.5)
parsers.unticked_box = tickbox(parsers.spacechar^1) * Cc(0.0)

```

3.1.4.3 Parsers Used for Markdown Code Spans

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

local function captures_equal_length(_,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(_,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)
                          local i = 1
                          local remaining = fenceindent
                          while true do
                            local 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.backslash / "" * parsers.rbracket
                            + parsers.any - (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.backslash / "" * parsers.rbracket
                           + parsers.any
                           - (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 HTML

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

parsers.block_keyword =
    parsers.keyword_exact("address") + parsers.keyword_exact("blockquote") +
    parsers.keyword_exact("center") + parsers.keyword_exact("del") +
    parsers.keyword_exact("dir") + parsers.keyword_exact("div") +
    parsers.keyword_exact("p") + parsers.keyword_exact("pre") +
    parsers.keyword_exact("li") + parsers.keyword_exact("ol") +
    parsers.keyword_exact("ul") + parsers.keyword_exact("dl") +
    parsers.keyword_exact("dd") + parsers.keyword_exact("form") +
    parsers.keyword_exact("fieldset") + parsers.keyword_exact("isindex") +
    parsers.keyword_exact("ins") + parsers.keyword_exact("menu") +
    parsers.keyword_exact("noframes") + parsers.keyword_exact("frameset") +
    parsers.keyword_exact("h1") + parsers.keyword_exact("h2") +
    parsers.keyword_exact("h3") + parsers.keyword_exact("h4") +
    parsers.keyword_exact("h5") + parsers.keyword_exact("h6") +
    parsers.keyword_exact("hr") + parsers.keyword_exact("script") +
    parsers.keyword_exact("noscript") + parsers.keyword_exact("table") +
    parsers.keyword_exact("tbody") + parsers.keyword_exact("tfoot") +
    parsers.keyword_exact("thead") + parsers.keyword_exact("th") +
    parsers.keyword_exact("td") + parsers.keyword_exact("tr")

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

```
                                                          + parsers.dquote))^0
                                          * parsers.dquote

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

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

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

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

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

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

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

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

parsers.emptyelt_any = parsers.less * parsers.sp * parsers.keyword
                     * parsers.htmlattribute^0 * parsers.sp * parsers.slash
                     * parsers.more

parsers.emptyelt_block = parsers.less * parsers.sp * parsers.block_keyword
                       * parsers.htmlattribute^0 * parsers.sp * parsers.slash
                       * parsers.more

parsers.displaytext = (parsers.any - parsers.less)^1

-- return content between two matched HTML tags
parsers.in_matched = function(s)
```

```
  return { parsers.openelt_exact(s)
         * (V(1) + parsers.displaytext
           + (parsers.less - parsers.closeelt_exact(s)))^0
         * parsers.closeelt_exact(s) }
end

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)

```

3.1.4.7 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
```

3.1.4.8 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
```

3.1.4.9 Inline Elements

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

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

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

3.1.4.10 Block Elements

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

```
5103              + parsers.newline^-1 * parsers.eof))
5104 end
```

3.1.4.11 Lists

3.1.4.12 Headings

```
5105 parsers.heading_attribute = (parsers.dash * Cc(".unnumbered"))
5106                           + C((parsers.hash + parsers.period)
5107                              * parsers.attribute_key)
5108                           + Cs( parsers.attribute_key
5109                               * parsers.optionalspace * parsers.equal * parsers.optional
5110                               * parsers.attribute_value)
5111 parsers.HeadingAttributes = parsers.lbrace
5112                           * parsers.optionalspace
5113                           * parsers.heading_attribute
5114                           * (parsers.spacechar^1
5115                             * parsers.heading_attribute)^0
5116                           * parsers.optionalspace
5117                           * parsers.rbrace
5118
5119 -- parse Atx heading start and return level
5120 parsers.HeadingStart = #parsers.hash * C(parsers.hash^-6)
5121                      * -parsers.hash / length
5122
5123 -- parse setext header ending and return level
5124 parsers.HeadingLevel = parsers.equal^1 * Cc(1) + parsers.dash^1 * Cc(2)
5125
5126 local function strip_atx_end(s)
5127   return s:gsub("[#%s]*\n$","")
5128 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*⟩.

```
M.reader = {}
function M.reader.new(writer, options, extensions)
  local self = {}
```

Make the `writer` and `options` parameters available as `reader->writer` and `reader->options`, respectively, so that they are accessible from extensions.

```
  self.writer = writer
  self.options = options
```

Create a `reader->parsers` hash table that stores PEG patterns that depend on the received `options`. Make `reader->parsers` inherit from the global `parsers` table.

```
  self.parsers = {}
  (function(parsers)
    setmetatable(self.parsers, {
      __index = function (_, key)
        return parsers[key]
      end
    })
  end)(parsers)
```

Make `reader->parsers` available as a local `parsers` variable that will shadow the global `parsers` table and will make `reader->parsers` easier to type in the rest of the reader code.

```
  local parsers = self.parsers
```

3.1.5.1 Top-Level Helper Functions

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

```
  function self.normalize_tag(tag)
    return string.lower(
      gsub(util.rope_to_string(tag), "[ \n\r\t]+", " "))
  end
```

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

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

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

```
  if options.preserveTabs then
```

```
    self.expandtabs = function(s) return s end
  else
    self.expandtabs = function(s)
                        if s:find("\t") then
                          return iterlines(s, util.expand_tabs_in_line)
                        else
                          return s
                        end
                      end
  end
```

3.1.5.2 High-Level Parser Functions

Create a `reader->parser_functions` hash table that stores high-level parser functions. Define `reader->create_parser` as a function that will create a high-level parser function `reader->parser_functions.name`, that matches input using grammar `grammar`. If `toplevel` is true, the input is expected to come straight from the user, not from a recursive call, and will be preprocessed.

```
  self.parser_functions = {}
  self.create_parser = function(name, grammar, toplevel)
    self.parser_functions[name] = function(str)
```

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

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

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

```
5183      if toplevel and (options.texComments or options.hybrid) then
5184          str = lpeg.match(Ct(parsers.commented_line^1), str)
5185          str = util.rope_to_string(str)
5186      end
5187      local res = lpeg.match(grammar(), str)
5188      if res == nil then
5189        error(format("%s failed on:\n%s", name, str:sub(1,20)))
5190      else
5191        return res
5192      end
5193    end
5194  end
5195
5196  self.create_parser("parse_blocks",
5197                     function()
5198                       return parsers.blocks
5199                     end, true)
5200
5201  self.create_parser("parse_blocks_nested",
5202                     function()
5203                       return parsers.blocks_nested
5204                     end, false)
5205
5206  self.create_parser("parse_inlines",
5207                     function()
5208                       return parsers.inlines
5209                     end, false)
5210
5211  self.create_parser("parse_inlines_no_link",
5212                     function()
5213                       return parsers.inlines_no_link
5214                     end, false)
5215
5216  self.create_parser("parse_inlines_no_inline_note",
5217                     function()
5218                       return parsers.inlines_no_inline_note
5219                     end, false)
5220
5221  self.create_parser("parse_inlines_no_html",
5222                     function()
5223                       return parsers.inlines_no_html
5224                     end, false)
5225
5226  self.create_parser("parse_inlines_nbsp",
```

```
                      function()
                        return parsers.inlines_nbsp
                      end, false)
```

3.1.5.3 Parsers Used for Markdown Lists (local)

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

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

3.1.5.4 Parsers Used for Blockquotes (local)

```
  -- strip off leading > and indents, and run through blocks
  parsers.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
    parsers.blockquote_body = parsers.blockquote_body
                           * (parsers.blankline^0 / "")
  end
```

3.1.5.5 Parsers Used for Footnotes (local)

3.1.5.6 Helpers for Links and References (local)

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

  -- add a reference to the list
```

```
5263  local function register_link(tag,url,title)
5264      references[self.normalize_tag(tag)] = { url = url, title = title }
5265      return ""
5266  end
5267
5268  -- lookup link reference and return either
5269  -- the link or nil and fallback text.
5270  local function lookup_reference(label,sps,tag)
5271      local tagpart
5272      if not tag then
5273          tag = label
5274          tagpart = ""
5275      elseif tag == "" then
5276          tag = label
5277          tagpart = "[]"
5278      else
5279          tagpart = {"[",
5280            self.parser_functions.parse_inlines(tag),
5281            "]"}
5282      end
5283      if sps then
5284        tagpart = {sps, tagpart}
5285      end
5286      local r = references[self.normalize_tag(tag)]
5287      if r then
5288        return r
5289      else
5290        return nil, {"[",
5291          self.parser_functions.parse_inlines(label),
5292          "]", tagpart}
5293      end
5294  end
5295
5296  -- lookup link reference and return a link, if the reference is found,
5297  -- or a bracketed label otherwise.
5298  local function indirect_link(label,sps,tag)
5299    return writer.defer_call(function()
5300      local r,fallback = lookup_reference(label,sps,tag)
5301      if r then
5302        return writer.link(
5303          self.parser_functions.parse_inlines_no_link(label),
5304          r.url, r.title)
5305      else
5306        return fallback
5307      end
5308    end)
5309  end
```

```
5310
5311  -- lookup image reference and return an image, if the reference is found,
5312  -- or a bracketed label otherwise.
5313  local function indirect_image(label,sps,tag)
5314    return writer.defer_call(function()
5315      local r,fallback = lookup_reference(label,sps,tag)
5316      if r then
5317        return writer.image(writer.string(label), r.url, r.title)
5318      else
5319        return {"!", fallback}
5320      end
5321    end)
5322  end
```

3.1.5.7 Inline Elements (local)

```
5323  parsers.Str      = (parsers.normalchar * (parsers.normalchar + parsers.at)^0)
5324                     / writer.string
5325
5326  parsers.Symbol   = (V("SpecialChar") - parsers.tightblocksep)
5327                     / writer.string
5328
5329  parsers.Ellipsis = P("...") / writer.ellipsis
5330
5331  parsers.Smart    = parsers.Ellipsis
5332
5333  parsers.Code     = parsers.inticks / writer.code
5334
5335  if options.blankBeforeBlockquote then
5336    parsers.bqstart = parsers.fail
5337  else
5338    parsers.bqstart = parsers.more
5339  end
5340
5341  if options.blankBeforeHeading then
5342    parsers.headerstart = parsers.fail
5343  else
5344    parsers.headerstart = parsers.hash
5345                        + (parsers.line * (parsers.equal^1 + parsers.dash^1)
5346                        * parsers.optionalspace * parsers.newline)
5347  end
5348
5349  parsers.EndlineExceptions
5350                      = parsers.blankline -- paragraph break
5351                      + parsers.tightblocksep  -- nested list
5352                      + parsers.eof       -- end of document
5353                      + parsers.bqstart
```

```
                    + parsers.headerstart

parsers.Endline   = parsers.newline
                  * -V("EndlineExceptions")
                  * parsers.spacechar^0
                  / (options.hardLineBreaks and writer.linebreak
                                            or writer.space)

parsers.OptionalIndent
                    = parsers.spacechar^1 / writer.space

parsers.Space     = parsers.spacechar^2 * parsers.Endline / writer.linebreak
                  + parsers.spacechar^1 * parsers.Endline^-1 * parsers.eof / ""
                  + parsers.spacechar^1 * parsers.Endline
                                        * parsers.optionalspace
                                        / (options.hardLineBreaks
                                           and writer.linebreak
                                            or writer.space)
                  + parsers.spacechar^1 * parsers.optionalspace
                                        / writer.space

parsers.NonbreakingEndline
                  = parsers.newline
                  * -V("EndlineExceptions")
                  * parsers.spacechar^0
                  / (options.hardLineBreaks and writer.linebreak
                                            or writer.nbsp)

parsers.NonbreakingSpace
                = parsers.spacechar^2 * parsers.Endline / writer.linebreak
                + parsers.spacechar^1 * parsers.Endline^-1 * parsers.eof / ""
                + parsers.spacechar^1 * parsers.Endline
                                      * parsers.optionalspace
                                      / (options.hardLineBreaks
                                         and writer.linebreak
                                          or writer.nbsp)
                + parsers.spacechar^1 * parsers.optionalspace
                                      / writer.nbsp

if options.underscores then
  parsers.Strong = ( parsers.between(parsers.Inline, parsers.doubleasterisks,
                                     parsers.doubleasterisks)
                   + parsers.between(parsers.Inline, parsers.doubleunderscores,
                                     parsers.doubleunderscores)
                   ) / writer.strong

  parsers.Emph   = ( parsers.between(parsers.Inline, parsers.asterisk,
```

```
                                    parsers.asterisk)
                  + parsers.between(parsers.Inline, parsers.underscore,
                                    parsers.underscore)
                  ) / writer.emphasis
else
  parsers.Strong = ( parsers.between(parsers.Inline, parsers.doubleasterisks,
                                    parsers.doubleasterisks)
                  ) / writer.strong

  parsers.Emph   = ( parsers.between(parsers.Inline, parsers.asterisk,
                                    parsers.asterisk)
                  ) / writer.emphasis
end

parsers.AutoLinkUrl    = parsers.less
                       * C(parsers.alphanumeric^1 * P("://") * parsers.urlchar^1)
                       * parsers.more
                       / function(url)
                           return writer.link(writer.escape(url), url)
                         end

parsers.AutoLinkEmail = parsers.less
                      * C((parsers.alphanumeric + S("-._+"))^1
                      * P("@") * parsers.urlchar^1)
                      * parsers.more
                      / function(email)
                          return writer.link(writer.escape(email),
                                             "mailto:"..email)
                        end

parsers.AutoLinkRelativeReference
                       = parsers.less
                       * C(parsers.urlchar^1)
                       * parsers.more
                       / function(url)
                           return writer.link(writer.escape(url), url)
                         end

parsers.DirectLink    = (parsers.tag / self.parser_functions.parse_inlines_no_link)
                      * parsers.spnl
                      * parsers.lparent
                      * (parsers.url + Cc(""))  -- link can be empty [foo]()
                      * parsers.optionaltitle
                      * parsers.rparent
                      / writer.link

```

```
5447   parsers.IndirectLink  = parsers.tag * (C(parsers.spnl) * parsers.tag)^-
    1
5448                         / indirect_link
5449
5450   -- parse a link or image (direct or indirect)
5451   parsers.Link          = parsers.DirectLink + parsers.IndirectLink
5452
5453   parsers.DirectImage   = parsers.exclamation
5454                         * (parsers.tag / self.parser_functions.parse_inlines)
5455                         * parsers.spnl
5456                         * parsers.lparent
5457                         * (parsers.url + Cc("")  -- link can be empty [foo]()
5458                         * parsers.optionaltitle
5459                         * parsers.rparent
5460                         / writer.image
5461
5462   parsers.IndirectImage = parsers.exclamation * parsers.tag
5463                         * (C(parsers.spnl) * parsers.tag)^-1 / indirect_image
5464
5465   parsers.Image         = parsers.DirectImage + parsers.IndirectImage
5466
5467   -- avoid parsing long strings of * or _ as emph/strong
5468   parsers.UlOrStarLine  = parsers.asterisk^4 + parsers.underscore^4
5469                         / writer.string
5470
5471   parsers.EscapedChar   = parsers.backslash * C(parsers.escapable) / writer.string
5472
5473   parsers.InlineHtml    = parsers.emptyelt_any / writer.inline_html_tag
5474                         + (parsers.htmlcomment / self.parser_functions.parse_inlines_no_
5475                         / writer.inline_html_comment
5476                         + parsers.htmlinstruction
5477                         + parsers.openelt_any / writer.inline_html_tag
5478                         + parsers.closeelt_any / writer.inline_html_tag
5479
5480   parsers.HtmlEntity    = parsers.hexentity / entities.hex_entity  / writer.string
5481                         + parsers.decentity / entities.dec_entity  / writer.string
5482                         + parsers.tagentity / entities.char_entity / writer.string
```

3.1.5.8 Block Elements (local)

```
5483   parsers.DisplayHtml  = (parsers.htmlcomment / self.parser_functions.parse_blocks_neste
5484                        / writer.block_html_comment
5485                        + parsers.emptyelt_block / writer.block_html_element
5486                        + parsers.openelt_exact("hr") / writer.block_html_element
5487                        + parsers.in_matched_block_tags / writer.block_html_element
5488                        + parsers.htmlinstruction
5489
```

```
  parsers.Verbatim     = Cs( (parsers.blanklines
                           * ((parsers.indentedline - parsers.blankline))^1)^1
                           ) / self.expandtabs / writer.verbatim

  parsers.Blockquote   = Cs(parsers.blockquote_body^1)
                       / self.parser_functions.parse_blocks_nested
                       / writer.blockquote

  parsers.HorizontalRule = ( parsers.lineof(parsers.asterisk)
                           + parsers.lineof(parsers.dash)
                           + parsers.lineof(parsers.underscore)
                           ) / writer.hrule

  parsers.Reference    = parsers.define_reference_parser / register_link

  parsers.Paragraph    = parsers.nonindentspace * Ct(parsers.Inline^1)
                       * ( parsers.newline
                       * ( parsers.blankline^1
                         + #parsers.hash
                         + #(parsers.leader * parsers.more * parsers.space^-
1)
                         + parsers.eof
                         )
                       + parsers.eof )
                       / writer.paragraph

  parsers.Plain        = parsers.nonindentspace * Ct(parsers.Inline^1)
                       / writer.plain
```

3.1.5.9 Lists (local)

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

  if options.taskLists then
    parsers.tickbox = ( parsers.ticked_box
                      + parsers.halfticked_box
                      + parsers.unticked_box
                      ) / writer.tickbox
  else
     parsers.tickbox = parsers.fail
  end

  -- we use \001 as a separator between a tight list item and a
  -- nested list under it.
  parsers.NestedList            = Cs((parsers.optionallyindentedline
                                    - parsers.starter)^1)
                                / function(a) return "\001"..a end
```

```
5533
5534  parsers.ListBlockLine         = parsers.optionallyindentedline
5535                                - parsers.blankline - (parsers.indent^-1
5536                                                     * parsers.starter)
5537
5538  parsers.ListBlock             = parsers.line * parsers.ListBlockLine^0
5539
5540  parsers.ListContinuationBlock = parsers.blanklines * (parsers.indent / "")
5541                                * parsers.ListBlock
5542
5543  parsers.TightListItem = function(starter)
5544      return -parsers.HorizontalRule
5545             * (Cs(starter / "" * parsers.tickbox^-1 * parsers.ListBlock * parsers.Neste
    1)
5546               / self.parser_functions.parse_blocks_nested)
5547             * -(parsers.blanklines * parsers.indent)
5548  end
5549
5550  parsers.LooseListItem = function(starter)
5551      return -parsers.HorizontalRule
5552             * Cs( starter / "" * parsers.tickbox^-1 * parsers.ListBlock * Cc("\n")
5553               * (parsers.NestedList + parsers.ListContinuationBlock^0)
5554               * (parsers.blanklines / "\n\n")
5555               ) / self.parser_functions.parse_blocks_nested
5556  end
5557
5558  parsers.BulletList = ( Ct(parsers.TightListItem(parsers.bullet)^1) * Cc(true)
5559                       * parsers.skipblanklines * -parsers.bullet
5560                       + Ct(parsers.LooseListItem(parsers.bullet)^1) * Cc(false)
5561                       * parsers.skipblanklines )
5562                     / writer.bulletlist
5563
5564  local function ordered_list(items,tight,startnum)
5565    if options.startNumber then
5566      startnum = tonumber(startnum) or 1  -- fallback for '#'
5567      if startnum ~= nil then
5568        startnum = math.floor(startnum)
5569      end
5570    else
5571      startnum = nil
5572    end
5573    return writer.orderedlist(items,tight,startnum)
5574  end
5575
5576  parsers.OrderedList = Cg(parsers.enumerator, "listtype") *
5577                       ( Ct(parsers.TightListItem(Cb("listtype"))
5578                           * parsers.TightListItem(parsers.enumerator)^0)
```

```
                      * Cc(true) * parsers.skipblanklines * -parsers.enumerator
                      + Ct(parsers.LooseListItem(Cb("listtype"))
                          * parsers.LooseListItem(parsers.enumerator)^0)
                      * Cc(false) * parsers.skipblanklines
                      ) * Cb("listtype") / ordered_list
```

3.1.5.10 Blank (local)

```
parsers.Blank        = parsers.blankline / ""
                     + parsers.Reference
                     + (parsers.tightblocksep / "\n")
```

3.1.5.11 Headings (local)

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

parsers.SetextHeading = #(parsers.line * S("=-"))
                        * Ct(parsers.linechar^1
                            / self.parser_functions.parse_inlines)
                        * parsers.newline
                        * parsers.HeadingLevel
                        * parsers.optionalspace
                        * parsers.newline
                        / writer.heading

parsers.Heading = parsers.AtxHeading + parsers.SetextHeading
```

3.1.5.12 Syntax Specification

Create a `reader->syntax` hash table that stores the PEG grammar.

```
self.syntax =
  { "Blocks",

    Blocks                = ( V("ExpectedJekyllData")
                            * (V("Blank")^0 / writer.interblocksep)
                            )^-1
                          * V("Blank")^0
                          * V("Block")^-1
                          * (V("Blank")^0 / writer.interblocksep
                            * V("Block"))^0
                          * V("Blank")^0 * parsers.eof,
```

```
5617
5618        Blank                 = parsers.Blank,
5619
5620        UnexpectedJekyllData  = parsers.fail,
5621        ExpectedJekyllData    = parsers.fail,
5622
5623        Block                 = V("ContentBlock")
5624                              + V("UnexpectedJekyllData")
5625                              + V("Blockquote")
5626                              + V("PipeTable")
5627                              + V("Verbatim")
5628                              + V("FencedCode")
5629                              + V("HorizontalRule")
5630                              + V("BulletList")
5631                              + V("OrderedList")
5632                              + V("Heading")
5633                              + V("DefinitionList")
5634                              + V("DisplayHtml")
5635                              + V("Paragraph")
5636                              + V("Plain"),
5637
5638        ContentBlock          = parsers.fail,
5639        Blockquote            = parsers.Blockquote,
5640        Verbatim              = parsers.Verbatim,
5641        FencedCode            = parsers.fail,
5642        HorizontalRule        = parsers.HorizontalRule,
5643        BulletList            = parsers.BulletList,
5644        OrderedList           = parsers.OrderedList,
5645        Heading               = parsers.Heading,
5646        DefinitionList        = parsers.fail,
5647        DisplayHtml           = parsers.DisplayHtml,
5648        Paragraph             = parsers.Paragraph,
5649        PipeTable             = parsers.fail,
5650        Plain                 = parsers.Plain,
5651        EndlineExceptions     = parsers.EndlineExceptions,
5652
5653        Inline                = V("Str")
5654                              + V("Space")
5655                              + V("Endline")
5656                              + V("UlOrStarLine")
5657                              + V("Strong")
5658                              + V("Emph")
5659                              + V("StrikeThrough")
5660                              + V("Superscript")
5661                              + V("Subscript")
5662                              + V("InlineNote")
5663                              + V("NoteRef")
```

```
                            + V("Citations")
                            + V("Link")
                            + V("Image")
                            + V("Code")
                            + V("AutoLinkUrl")
                            + V("AutoLinkEmail")
                            + V("AutoLinkRelativeReference")
                            + V("InlineHtml")
                            + V("HtmlEntity")
                            + V("EscapedChar")
                            + V("Smart")
                            + V("Symbol"),

    IndentedInline          = V("Str")
                            + V("OptionalIndent")
                            + V("Endline")
                            + V("UlOrStarLine")
                            + V("Strong")
                            + V("Emph")
                            + V("StrikeThrough")
                            + V("Superscript")
                            + V("Subscript")
                            + V("InlineNote")
                            + V("NoteRef")
                            + V("Citations")
                            + V("Link")
                            + V("Image")
                            + V("Code")
                            + V("AutoLinkUrl")
                            + V("AutoLinkEmail")
                            + V("AutoLinkRelativeReference")
                            + V("InlineHtml")
                            + V("HtmlEntity")
                            + V("EscapedChar")
                            + V("Smart")
                            + V("Symbol"),

    Str                     = parsers.Str,
    Space                   = parsers.Space,
    OptionalIndent          = parsers.OptionalIndent,
    Endline                 = parsers.Endline,
    UlOrStarLine            = parsers.UlOrStarLine,
    Strong                  = parsers.Strong,
    Emph                    = parsers.Emph,
    StrikeThrough           = parsers.fail,
    Superscript             = parsers.fail,
    Subscript               = parsers.fail,
```

```
      InlineNote            = parsers.fail,
      NoteRef               = parsers.fail,
      Citations             = parsers.fail,
      Link                  = parsers.Link,
      Image                 = parsers.Image,
      Code                  = parsers.Code,
      AutoLinkUrl           = parsers.AutoLinkUrl,
      AutoLinkEmail         = parsers.AutoLinkEmail,
      AutoLinkRelativeReference
                            = parsers.AutoLinkRelativeReference,
      InlineHtml            = parsers.InlineHtml,
      HtmlEntity            = parsers.HtmlEntity,
      EscapedChar           = parsers.EscapedChar,
      Smart                 = parsers.Smart,
      Symbol                = parsers.Symbol,
      SpecialChar           = parsers.fail,
    }
```

Define a hash table of all characters with special meaning and add method `reader->add_special_character` that extends the hash table and updates the PEG grammar.

```
  local special_characters = {"*", "`", "[", "]", "<", "!", "\\"}
  self.add_special_character = function(c)
    table.insert(special_characters, c)
    self.syntax.SpecialChar = S(table.concat(special_characters, ""))
  end
  self.syntax.SpecialChar = S(table.concat(special_characters, ""))
```

Apply syntax extensions.

```
  for _, extension in ipairs(extensions) do
    extension.extend_writer(writer)
    extension.extend_reader(self)
  end

  if options.underscores then
    self.add_special_character("_")
  end

  if not options.codeSpans then
    self.syntax.Code = parsers.fail
  end

  if not options.html then
    self.syntax.DisplayHtml = parsers.fail
    self.syntax.InlineHtml = parsers.fail
    self.syntax.HtmlEntity  = parsers.fail
  else
    self.add_special_character("&")
```

```
5753   end
5754
5755   if options.preserveTabs then
5756     options.stripIndent = false
5757   end
5758
5759   if not options.smartEllipses then
5760     self.syntax.Smart = parsers.fail
5761   else
5762     self.add_special_character(".")
5763   end
5764
5765   if not options.relativeReferences then
5766     self.syntax.AutoLinkRelativeReference = parsers.fail
5767   end
5768
5769   local blocks_nested_t = util.table_copy(self.syntax)
5770   blocks_nested_t.ExpectedJekyllData = parsers.fail
5771   parsers.blocks_nested = Ct(blocks_nested_t)
5772
5773   parsers.blocks = Ct(self.syntax)
5774
5775   local inlines_t = util.table_copy(self.syntax)
5776   inlines_t[1] = "Inlines"
5777   inlines_t.Inlines = parsers.Inline^0 * (parsers.spacing^0 * parsers.eof / "")
5778   parsers.inlines = Ct(inlines_t)
5779
5780   local inlines_no_link_t = util.table_copy(inlines_t)
5781   inlines_no_link_t.Link = parsers.fail
5782   parsers.inlines_no_link = Ct(inlines_no_link_t)
5783
5784   local inlines_no_inline_note_t = util.table_copy(inlines_t)
5785   inlines_no_inline_note_t.InlineNote = parsers.fail
5786   parsers.inlines_no_inline_note = Ct(inlines_no_inline_note_t)
5787
5788   local inlines_no_html_t = util.table_copy(inlines_t)
5789   inlines_no_html_t.DisplayHtml = parsers.fail
5790   inlines_no_html_t.InlineHtml = parsers.fail
5791   inlines_no_html_t.HtmlEntity = parsers.fail
5792   parsers.inlines_no_html = Ct(inlines_no_html_t)
5793
5794   local inlines_nbsp_t = util.table_copy(inlines_t)
5795   inlines_nbsp_t.Endline = parsers.NonbreakingEndline
5796   inlines_nbsp_t.Space = parsers.NonbreakingSpace
5797   parsers.inlines_nbsp = Ct(inlines_nbsp_t)
```

3.1.5.13 Exported Conversion Function

Define `reader->convert` as a function

that converts markdown string `input` into a plain TEX output and returns it. Note that the converter assumes that the input has UNIX line endings.

```
function self.convert(input)
  references = {}
```

When determining the name of the cache file, create salt for the hashing function out of the package version and the passed options recognized by the Lua interface (see Section 2.1.2). The `cacheDir` option is disregarded.

```
  local opt_string = {}
  for k,_ in pairs(defaultOptions) do
    local v = options[k]
    if k ~= "cacheDir" then
      opt_string[#opt_string+1] = k .. "=" .. tostring(v)
    end
  end
  table.sort(opt_string)
  local salt = table.concat(opt_string, ",") .. "," .. metadata.version
  local output
```

If we cache markdown documents, produce the cache file and transform its filename to plain TEX output via the `writer->pack` method.

```
  local function convert(input)
    local document = self.parser_functions.parse_blocks(input)
    return util.rope_to_string(writer.document(document))
  end
  if options.eagerCache or options.finalizeCache then
    local name = util.cache(options.cacheDir, input, salt, convert, ".md" .. writer.su
    output = writer.pack(name)
```

Otherwise, return the result of the conversion directly.

```
  else
    output = convert(input)
  end
```

If the `finalizeCache` option is enabled, populate the frozen cache in the file `frozenCacheFileName` with an entry for markdown document number `frozenCacheCounter`.

```
  if options.finalizeCache then
    local file, mode
    if options.frozenCacheCounter > 0 then
      mode = "a"
    else
      mode = "w"
    end
    file = assert(io.open(options.frozenCacheFileName, mode),
      [[could not open file "]] .. options.frozenCacheFileName
      .. [[" for writing]])
    assert(file:write([[\expandafter\global\expandafter\def\csname ]]
```

```
        .. [[markdownFrozenCache]] .. options.frozenCacheCounter
        .. [[\endcsname{]] .. output .. [[}]] .. "\n"))
      assert(file:close())
    end
    return output
  end
  return self
end
```

3.1.6 Syntax Extensions for Markdown

Create `extensions` hash table that contains syntax extensions. Syntax extensions are functions that produce objects with two methods: `extend_writer` and `extend_reader`. The `extend_writer` object takes a `writer` object as the only parameter and mutates it. Similarly, `extend_reader` takes a `reader` object as the only parameter and mutates it.

```
M.extensions = {}
```

3.1.6.1 Citations

The `extensions.citations` function implements the Pandoc citation syntax extension. When the `citation_nbsps` parameter is enabled, the syntax extension will replace regular spaces with non-breaking spaces inside the prenotes and postnotes of citations.

```
M.extensions.citations = function(citation_nbsps)
```

Define table `escaped_citation_chars` containing the characters to escape in citations.

```
  local escaped_citation_chars = {
    ["{"] = "\\markdownRendererLeftBrace{}",
    ["}"] = "\\markdownRendererRightBrace{}",
    ["%"] = "\\markdownRendererPercentSign{}",
    ["\\"] = "\\markdownRendererBackslash{}",
    ["#"] = "\\markdownRendererHash{}",
  }
  return {
    extend_writer = function(self)
      local options = self.options

```

Use the `escaped_citation_chars` to create the `escape_citation` escaper functions.

```
      local escape_citation = util.escaper(
        escaped_citation_chars,
        self.escaped_minimal_strings)
```

Define `writer->citation` as a function that will transform an input citation name `c` to the output format. If `writer->hybrid` is `true`, use the `writer->escape_minimal` function. Otherwise, use the `escape_citation` function.

```
5855       if options.hybrid then
5856         self.citation = self.escape_minimal
5857       else
5858         self.citation = escape_citation
5859       end
```

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

- `suppress_author` – If the value of the key is true, then the author of the work should be omitted in the citation, when applicable.
- `prenote` – The value of the key is either `nil` or a rope that should be inserted before the citation.
- `postnote` – The value of the key is either `nil` or a rope that should be inserted after the citation.
- `name` – The value of this key is the citation name.

```
5860       function self.citations(text_cites, cites)
5861         local buffer = {"\\markdownRenderer", text_cites and "TextCite" or "Cite",
5862           "{", #cites, "}"}
5863         for _,cite in ipairs(cites) do
5864           buffer[#buffer+1] = {cite.suppress_author and "-" or "+", "{",
5865             cite.prenote or "", "}{", cite.postnote or "", "}{", cite.name, "}"}
5866         end
5867         return buffer
5868       end
5869     end, extend_reader = function(self)
5870       local parsers = self.parsers
5871       local syntax = self.syntax
5872       local writer = self.writer
5873
5874       local citation_chars
5875                     = parsers.alphanumeric
5876                     + S("#$%&-+<>~/_")
5877
5878       local citation_name
5879                     = Cs(parsers.dash^-1) * parsers.at
5880                     * Cs(citation_chars
5881                         * (((citation_chars + parsers.internal_punctuation
```

```
                            - parsers.comma - parsers.semicolon)
                           * -#((parsers.internal_punctuation - parsers.comma
                                - parsers.semicolon)^0
                              * -(citation_chars + parsers.internal_punctuation
                                 - parsers.comma - parsers.semicolon)))^0
                         * citation_chars)^-1)

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

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

    local citation_body_chunk
                  = citation_body_prenote
                  * parsers.spnl * citation_name
                  * (parsers.internal_punctuation - parsers.semicolon)^-
1
                  * parsers.spnl * citation_body_postnote

    local citation_body
                  = citation_body_chunk
                  * (parsers.semicolon * parsers.spnl
                    * citation_body_chunk)^0

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

    local citation_headless_body
                  = citation_headless_body_postnote
```

```
                * (parsers.sp * parsers.semicolon * parsers.spnl
                  * citation_body_chunk)^0

    local citations
                = function(text_cites, raw_cites)
        local function normalize(str)
            if str == "" then
                str = nil
            else
                str = (citation_nbsps and
                  self.parser_functions.parse_inlines_nbsp or
                  self.parser_functions.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

    local TextCitations
                = Ct((parsers.spnl
                * Cc("")
                * citation_name
                * ((parsers.spnl
                    * parsers.lbracket
                    * citation_headless_body
                    * parsers.rbracket) + Cc("")))^1)
                / function(raw_cites)
                    return citations(true, raw_cites)
                  end

    local ParenthesizedCitations
                = Ct((parsers.spnl
                * parsers.lbracket
                * citation_body
                * parsers.rbracket)^1)
                / function(raw_cites)
                    return citations(false, raw_cites)
```

```
                        end

      local Citations = TextCitations + ParenthesizedCitations

      syntax.Citations = Citations

      self.add_special_character("@")
      self.add_special_character("-")
    end
  }
end
```

3.1.6.2 Content Blocks

The `extensions.content_blocks` function implements the iA,Writer content blocks syntax extension. The `language_map` parameter specifies the filename of the JSON file that maps filename extensions to programming language names.

```
M.extensions.content_blocks = function(language_map)
```

The `languages_json` table maps programming language filename extensions to fence infostrings. All `language_map` files located by the KPathSea library are loaded into a chain of tables. `languages_json` corresponds to the first table and is chained with the rest via Lua metatables.

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

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

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

```
          setmetatable(prev, { __index = curr })
        end
        prev = curr
      end
      ::continue::
    end
    return base or {}
  end)()

  return {
    extend_writer = function(self)
```

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

```
      function self.contentblock(src,suf,type,tit)
        if not self.is_writing then return "" end
        src = src.."."..suf
        suf = suf:lower()
        if type == "onlineimage" then
          return {"\\markdownRendererContentBlockOnlineImage{",suf,"}",
                                  "{",self.string(src),"}",
                                  "{",self.uri(src),"}",
                                  "{",self.string(tit or ""),"}"}
        elseif languages_json[suf] then
          return {"\\markdownRendererContentBlockCode{",suf,"}",
                                  "{",self.string(languages_json[suf]),"}",
                                  "{",self.string(src),"}",
                                  "{",self.uri(src),"}",
                                  "{",self.string(tit or ""),"}"}
        else
          return {"\\markdownRendererContentBlock{",suf,"}",
                                  "{",self.string(src),"}",
                                  "{",self.uri(src),"}",
                                  "{",self.string(tit or ""),"}"}
        end
      end
    end, extend_reader = function(self)
      local parsers = self.parsers
      local syntax = self.syntax
      local writer = self.writer

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

```

```
6049        -- case insensitive online image suffix:
6050        local onlineimagesuffix
6051                      = (function(...)
6052                          local parser = nil
6053                          for _, suffix in ipairs({...}) do
6054                            local pattern=nil
6055                            for i=1,#suffix do
6056                              local char=suffix:sub(i,i)
6057                              char = S(char:lower()..char:upper())
6058                              if pattern == nil then
6059                                pattern = char
6060                              else
6061                                pattern = pattern * char
6062                              end
6063                            end
6064                            if parser == nil then
6065                              parser = pattern
6066                            else
6067                              parser = parser + pattern
6068                            end
6069                          end
6070                          return parser
6071                        end)("png", "jpg", "jpeg", "gif", "tif", "tiff")
6072
6073        -- online image url for iA Writer content blocks with mandatory suffix,
6074        -- allowing nested brackets:
6075        local onlineimageurl
6076                      = (parsers.less
6077                        * Cs((parsers.anyescaped
6078                             - parsers.more
6079                             - #(parsers.period
6080                                * onlineimagesuffix
6081                                * parsers.more
6082                                * contentblock_tail))^0)
6083                        * parsers.period
6084                        * Cs(onlineimagesuffix)
6085                        * parsers.more
6086                        + (Cs((parsers.inparens
6087                              + (parsers.anyescaped
6088                                - parsers.spacing
6089                                - parsers.rparent
6090                                - #(parsers.period
6091                                   * onlineimagesuffix
6092                                   * contentblock_tail)))^0)
6093                        * parsers.period
6094                        * Cs(onlineimagesuffix))
6095                        ) * Cc("onlineimage")
```

```
6096
6097        -- filename for iA Writer content blocks with mandatory suffix:
6098        local localfilepath
6099                      = parsers.slash
6100                      * Cs((parsers.anyescaped
6101                           - parsers.tab
6102                           - parsers.newline
6103                           - #(parsers.period
6104                              * parsers.alphanumeric^1
6105                              * contentblock_tail))^1)
6106                      * parsers.period
6107                      * Cs(parsers.alphanumeric^1)
6108                      * Cc("localfile")
6109
6110        local ContentBlock
6111                      = parsers.leader
6112                      * (localfilepath + onlineimageurl)
6113                      * contentblock_tail
6114                      / writer.contentblock
6115
6116        syntax.ContentBlock = ContentBlock
6117      end
6118    }
6119  end
```

3.1.6.3 Definition Lists

The `extensions.definition_lists` function implements the definition list syntax extension. If the `tight_lists` parameter is `true`, tight lists will produce special right item renderers.

```
6120  M.extensions.definition_lists = function(tight_lists)
6121    return {
6122      extend_writer = function(self)
```

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.

```
6123        local function dlitem(term, defs)
6124          local retVal = {"\\markdownRendererDlItem{",term,"}"}
6125          for _, def in ipairs(defs) do
6126            retVal[#retVal+1] = {"\\markdownRendererDlDefinitionBegin ",def,
6127                                 "\\markdownRendererDlDefinitionEnd "}
6128          end
6129          retVal[#retVal+1] = "\\markdownRendererDlItemEnd "
6130          return retVal
6131        end
6132
```

```
6133      function self.definitionlist(items,tight)
6134        if not self.is_writing then return "" end
6135        local buffer = {}
6136        for _,item in ipairs(items) do
6137          buffer[#buffer + 1] = dlitem(item.term, item.definitions)
6138        end
6139        if tight and tight_lists then
6140          return {"\\markdownRendererDlBeginTight\n", buffer,
6141            "\n\\markdownRendererDlEndTight"}
6142        else
6143          return {"\\markdownRendererDlBegin\n", buffer,
6144            "\n\\markdownRendererDlEnd"}
6145        end
6146      end
6147    end, extend_reader = function(self)
6148      local parsers = self.parsers
6149      local syntax = self.syntax
6150      local writer = self.writer
6151
6152      local defstartchar = S("~:")
6153
6154      local defstart = ( defstartchar * #parsers.spacing
6155                                      * (parsers.tab + parsers.space^-3)
6156                       + parsers.space * defstartchar * #parsers.spacing
6157                                       * (parsers.tab + parsers.space^-2)
6158                       + parsers.space * parsers.space * defstartchar
6159                                       * #parsers.spacing
6160                                       * (parsers.tab + parsers.space^-1)
6161                       + parsers.space * parsers.space * parsers.space
6162                                       * defstartchar * #parsers.spacing
6163                       )
6164
6165      local dlchunk = Cs(parsers.line * (parsers.indentedline - parsers.blankline)^0)
6166
6167      local function definition_list_item(term, defs, _)
6168        return { term = self.parser_functions.parse_inlines(term),
6169                 definitions = defs }
6170      end
6171
6172      local DefinitionListItemLoose
6173                  = C(parsers.line) * parsers.skipblanklines
6174                  * Ct((defstart
6175                       * parsers.indented_blocks(dlchunk)
6176                       / self.parser_functions.parse_blocks_nested)^1)
6177                  * Cc(false) / definition_list_item
6178
6179      local DefinitionListItemTight
```

```
                    = C(parsers.line)
                    * Ct((defstart * dlchunk
                         / self.parser_functions.parse_blocks_nested)^1)
                    * Cc(true) / definition_list_item

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

    syntax.DefinitionList = DefinitionList
  end
 }
end
```

3.1.6.4 Fenced Code

The `extensions.fenced_code` function implements the commonmark fenced code block syntax extension. When the `blank_before_code_fence` parameter is `true`, the syntax extension requires between a paragraph and the following fenced code block.

```
M.extensions.fenced_code = function(blank_before_code_fence)
  return {
    extend_writer = function(self)
      local options = self.options

```

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

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

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

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

```
6218
6219        local fenceindent
6220        local fencehead    = function(char)
6221          return             C(parsers.nonindentspace) / function(s) fenceindent = #s end
6222                           * Cg(char^3, "fencelength")
6223                           * parsers.optionalspace * C(infostring)
6224                           * parsers.optionalspace * (parsers.newline + parsers.eof)
6225        end
6226
6227        local fencetail    = function(char)
6228          return             parsers.nonindentspace
6229                           * Cmt(C(char^3) * Cb("fencelength"), captures_geq_length)
6230                           * parsers.optionalspace * (parsers.newline + parsers.eof)
6231                           + parsers.eof
6232        end
6233
6234        local fencedline   = function(char)
6235          return             C(parsers.line - fencetail(char))
6236                           / function(s)
6237                               local i = 1
6238                               local remaining = fenceindent
6239                               while true do
6240                                 local c = s:sub(i, i)
6241                                 if c == " " and remaining > 0 then
6242                                   remaining = remaining - 1
6243                                   i = i + 1
6244                                 elseif c == "\t" and remaining > 3 then
6245                                   remaining = remaining - 4
6246                                   i = i + 1
6247                                 else
6248                                   break
6249                                 end
6250                               end
6251                               return s:sub(i)
6252                             end
6253        end
6254
6255        local TildeFencedCode
6256               = fencehead(parsers.tilde)
6257               * Cs(fencedline(parsers.tilde)^0)
6258               * fencetail(parsers.tilde)
6259
6260        local BacktickFencedCode
6261               = fencehead(parsers.backtick)
6262               * Cs(fencedline(parsers.backtick)^0)
6263               * fencetail(parsers.backtick)
6264
```

```
      local FencedCode = (TildeFencedCode
                            + BacktickFencedCode)
                          / function(infostring, code)
                              return writer.fencedCode(writer.string(infostring),
                                                       self.expandtabs(code))
                            end

      syntax.FencedCode = FencedCode

      local fencestart
      if blank_before_code_fence then
        fencestart = parsers.fail
      else
        fencestart = fencehead(parsers.backtick)
                   + fencehead(parsers.tilde)
      end

      parsers.EndlineExceptions = parsers.EndlineExceptions + fencestart
      syntax.EndlineExceptions = parsers.EndlineExceptions

      self.add_special_character("~")
    end
  }
end
```

3.1.6.5 Footnotes

The `extensions.footnotes` function implements the Pandoc footnote and inline footnote syntax extensions. When the `footnote` parameter is `true`, the Pandoc footnote syntax extension will be enabled. When the `inline_footnotes` parameter is `true`, the Pandoc inline footnote syntax extension will be enabled.

```
M.extensions.footnotes = function(footnotes, inline_footnotes)
  assert(footnotes or inline_footnotes)
  return {
    extend_writer = function(self)
```

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
    end, extend_reader = function(self)
      local parsers = self.parsers
      local syntax = self.syntax
      local writer = self.writer

      if footnotes then
```

```
6302        local function strip_first_char(s)
6303          return s:sub(2)
6304        end
6305
6306        local RawNoteRef
6307                    = #(parsers.lbracket * parsers.circumflex)
6308                    * parsers.tag / strip_first_char
6309
6310        local rawnotes = {}
6311
6312        -- like indirect_link
6313        local function lookup_note(ref)
6314          return writer.defer_call(function()
6315            local found = rawnotes[self.normalize_tag(ref)]
6316            if found then
6317              return writer.note(
6318                self.parser_functions.parse_blocks_nested(found))
6319            else
6320              return {"[",
6321                self.parser_functions.parse_inlines("^" .. ref), "]"}
6322            end
6323          end)
6324        end
6325
6326        local function register_note(ref,rawnote)
6327          rawnotes[self.normalize_tag(ref)] = rawnote
6328          return ""
6329        end
6330
6331        local NoteRef = RawNoteRef / lookup_note
6332
6333        local NoteBlock
6334                    = parsers.leader * RawNoteRef * parsers.colon
6335                    * parsers.spnl * parsers.indented_blocks(parsers.chunk)
6336                    / register_note
6337
6338        parsers.Blank = NoteBlock + parsers.Blank
6339        syntax.Blank = parsers.Blank
6340
6341        syntax.NoteRef = NoteRef
6342      end
6343      if inline_footnotes then
6344        local InlineNote
6345                    = parsers.circumflex
6346                    * (parsers.tag / self.parser_functions.parse_inlines_no_inline_note)
6347                    / writer.note
6348        syntax.InlineNote = InlineNote
```

```
      end

      self.add_special_character("^")
    end
  }
end
```

3.1.6.6 Header Attributes

The `extensions.header_attributes` function implements a syntax extension that enables the assignment of HTML attributes to headings.

```
M.extensions.header_attributes = function()
  return {
    extend_writer = function()
    end, extend_reader = function(self)
      local parsers = self.parsers
      local syntax = self.syntax
      local writer = self.writer

      parsers.AtxHeading = Cg(parsers.HeadingStart,"level")
                           * parsers.optionalspace
                           * (C(((parsers.linechar
                                 - ((parsers.hash^1
                                    * parsers.optionalspace
                                    * parsers.HeadingAttributes^-1
                                    + parsers.HeadingAttributes)
                                   * parsers.optionalspace
                                   * parsers.newline))
                                * (parsers.linechar
                                  - parsers.hash
                                  - parsers.lbrace)^0)^1)
                               / self.parser_functions.parse_inlines)
                           * Cg(Ct(parsers.newline
                                  + (parsers.hash^1
                                    * parsers.optionalspace
                                    * parsers.HeadingAttributes^-1
                                    + parsers.HeadingAttributes)
                                  * parsers.optionalspace
                                  * parsers.newline), "attributes")
                           * Cb("level")
                           * Cb("attributes")
                           / writer.heading

      parsers.SetextHeading = #(parsers.line * S("=-"))
                              * (C(((parsers.linechar
                                    - (parsers.HeadingAttributes
                                      * parsers.optionalspace
                                      * parsers.newline))
```

```
                                    * (parsers.linechar
                                      - parsers.lbrace)^0)^1)
                                   / self.parser_functions.parse_inlines)
                                * Cg(Ct(parsers.newline
                                       + (parsers.HeadingAttributes
                                         * parsers.optionalspace
                                         * parsers.newline)), "attributes")
                                * parsers.HeadingLevel
                                * Cb("attributes")
                                * parsers.optionalspace
                                * parsers.newline
                                / writer.heading

      parsers.Heading = parsers.AtxHeading + parsers.SetextHeading
      syntax.Heading = parsers.Heading
    end
  }
end
```

3.1.6.7 YAML Metadata

The `extensions.jekyll_data` function implements the Pandoc `yaml_metadata_block` syntax extension for entering metadata in YAML. When the `expect_jekyll_data` parameter is `true`, then a markdown document may begin directly with YAML metadata and may contain nothing but YAML metadata

```
M.extensions.jekyll_data = function(expect_jekyll_data)
  return {
    extend_writer = function(self)
```

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

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

        local buf = {}

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

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

```
6427
6428        if #d > 0 then
6429            table.insert(buf, "\\markdownRendererJekyllDataSequenceBegin{")
6430            table.insert(buf, self.uri(p or "null"))
6431            table.insert(buf, "}{")
6432            table.insert(buf, #keys)
6433            table.insert(buf, "}")
6434        else
6435            table.insert(buf, "\\markdownRendererJekyllDataMappingBegin{")
6436            table.insert(buf, self.uri(p or "null"))
6437            table.insert(buf, "}{")
6438            table.insert(buf, #keys)
6439            table.insert(buf, "}")
6440        end
6441
6442        for _, k in ipairs(keys) do
6443          local v = d[k]
6444          local typ = type(v)
6445          k = tostring(k or "null")
6446          if typ == "table" and next(v) ~= nil then
6447            table.insert(
6448              buf,
6449              self.jekyllData(v, t, k)
6450            )
6451          else
6452            k = self.uri(k)
6453            v = tostring(v)
6454            if typ == "boolean" then
6455              table.insert(buf, "\\markdownRendererJekyllDataBoolean{")
6456              table.insert(buf, k)
6457              table.insert(buf, "}{")
6458              table.insert(buf, v)
6459              table.insert(buf, "}")
6460            elseif typ == "number" then
6461              table.insert(buf, "\\markdownRendererJekyllDataNumber{")
6462              table.insert(buf, k)
6463              table.insert(buf, "}{")
6464              table.insert(buf, v)
6465              table.insert(buf, "}")
6466            elseif typ == "string" then
6467              table.insert(buf, "\\markdownRendererJekyllDataString{")
6468              table.insert(buf, k)
6469              table.insert(buf, "}{")
6470              table.insert(buf, t(v))
6471              table.insert(buf, "}")
6472            elseif typ == "table" then
6473              table.insert(buf, "\\markdownRendererJekyllDataEmpty{")
```

```
              table.insert(buf, k)
              table.insert(buf, "}")
            else
              error(format("Unexpected type %s for value of " ..
                           "YAML key %s", typ, k))
            end
          end
        end

        if #d > 0 then
          table.insert(buf, "\\markdownRendererJekyllDataSequenceEnd")
        else
          table.insert(buf, "\\markdownRendererJekyllDataMappingEnd")
        end

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

        return buf
      end
    end, extend_reader = function(self)
      local parsers = self.parsers
      local syntax = self.syntax
      local writer = self.writer

      local JekyllData
                   = Cmt( C((parsers.line - P("---") - P("..."))^0)
                        , function(s, i, text) -- luacheck: ignore s i
                            local data
                            local ran_ok, _ = pcall(function()
                              local tinyyaml = require("markdown-tinyyaml")
                              data = tinyyaml.parse(text, {timestamps=false})
                            end)
                            if ran_ok and data ~= nil then
                              return true, writer.jekyllData(data, function(s)
                                return self.parser_functions.parse_blocks_nested(s)
                              end, nil)
                            else
                              return false
                            end
                          end
                        )

      local UnexpectedJekyllData
                   = P("---")
                   * parsers.blankline / 0
```

```
                    * #(-parsers.blankline)  -- if followed by blank, it's an hrule
                    * JekyllData
                    * (P("---") + P("..."))

      local ExpectedJekyllData
                    = ( P("---")
                      * parsers.blankline / 0
                      * #(-parsers.blankline)  -- if followed by blank, it's an hrule
                      )^-1
                    * JekyllData
                    * (P("---") + P("..."))^-1

      syntax.UnexpectedJekyllData = UnexpectedJekyllData
      if expect_jekyll_data then
        syntax.ExpectedJekyllData = ExpectedJekyllData
      end
    end
  }
end
```

3.1.6.8 Pipe Tables

The `extensions.pipe_table` function implements the PHP Markdown table syntax extension (affectionately known as pipe tables). When the `table_captions` parameter is `true`, the function also implements the Pandoc `table_captions` syntax extension for table captions.

```
M.extensions.pipe_tables = function(table_captions)

  local function make_pipe_table_rectangular(rows)
    local num_columns = #rows[2]
    local rectangular_rows = {}
    for i = 1, #rows do
      local row = rows[i]
      local rectangular_row = {}
      for j = 1, num_columns do
        rectangular_row[j] = row[j] or ""
      end
      table.insert(rectangular_rows, rectangular_row)
    end
    return rectangular_rows
  end

  local function pipe_table_row(allow_empty_first_column
                                , nonempty_column
                                , column_separator
                                , column)
    local row_beginning
    if allow_empty_first_column then
```

```
      row_beginning = -- empty first column
                      #(parsers.spacechar^4
                       * column_separator)
                    * parsers.optionalspace
                    * column
                    * parsers.optionalspace
                    -- non-empty first column
                    + parsers.nonindentspace
                    * nonempty_column^-1
                    * parsers.optionalspace
    else
      row_beginning = parsers.nonindentspace
                    * nonempty_column^-1
                    * parsers.optionalspace
    end

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

  return {
    extend_writer = function(self)
```

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

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

```
          table.insert(buffer, "{")
          for _, column in ipairs(row) do
            if i > 1 then -- do not use braces for alignments
              table.insert(buffer, "{")
            end
            table.insert(buffer, column)
            if i > 1 then
              table.insert(buffer, "}")
            end
          end
          table.insert(buffer, "}")
        end
        return buffer
      end
    end, extend_reader = function(self)
      local parsers = self.parsers
      local syntax = self.syntax
      local writer = self.writer

      local table_hline_separator = parsers.pipe + parsers.plus

      local table_hline_column = (parsers.dash
                                  - #(parsers.dash
                                     * (parsers.spacechar
                                       + table_hline_separator
                                       + parsers.newline)))^1
                               * (parsers.colon * Cc("r")
                                 + parsers.dash * Cc("d"))
                               + parsers.colon
                               * (parsers.dash
                                 - #(parsers.dash
                                    * (parsers.spacechar
                                      + table_hline_separator
                                      + parsers.newline)))^1
                               * (parsers.colon * Cc("c")
                                 + parsers.dash * Cc("l"))

      local table_hline = pipe_table_row(false
                                         , table_hline_column
                                         , table_hline_separator
                                         , table_hline_column)

      local table_caption_beginning = parsers.skipblanklines
                                    * parsers.nonindentspace
                                    * (P("Table")^-1 * parsers.colon)
                                    * parsers.optionalspace

```

```
      local table_row = pipe_table_row(true
                                       , (C((parsers.linechar - parsers.pipe)^1)
                                         / self.parser_functions.parse_inlines)
                                       , parsers.pipe
                                       , (C((parsers.linechar - parsers.pipe)^0)
                                         / self.parser_functions.parse_inlines))

      local table_caption
      if table_captions then
        table_caption = #table_caption_beginning
                      * table_caption_beginning
                      * Ct(parsers.IndentedInline^1)
                      * parsers.newline
      else
        table_caption = parsers.fail
      end

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

      syntax.PipeTable = PipeTable
    end
  }
end
```

3.1.6.9 Strike-Through

The `extensions.strike_through` function implements the Pandoc strike-through syntax extension.

```
M.extensions.strike_through = function()
  return {
    extend_writer = function(self)
```

Define `writer->strike_through` as a function that will transform a strike-through span `s` of input text to the output format.

```
      function self.strike_through(s)
        return {"\\markdownRendererStrikeThrough{",s,"}"}
      end
    end, extend_reader = function(self)
      local parsers = self.parsers
      local syntax = self.syntax
      local writer = self.writer

      local StrikeThrough = (
        parsers.between(parsers.Inline, parsers.doubletildes,
```

```
                          parsers.doubletildes)
      ) / writer.strike_through

      syntax.StrikeThrough = StrikeThrough

      self.add_special_character("~")
    end
  }
end
```

3.1.6.10 Superscripts

The `extensions.superscripts` function implements the Pandoc superscript syntax extension.

```
M.extensions.superscripts = function()
  return {
    extend_writer = function(self)
```

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

```
      function self.superscript(s)
        return {"\\markdownRendererSuperscript{",s,"}"}
      end
    end, extend_reader = function(self)
      local parsers = self.parsers
      local syntax = self.syntax
      local writer = self.writer

      local Superscript = (
        parsers.between(parsers.Str, parsers.circumflex, parsers.circumflex)
      ) / writer.superscript

      syntax.Superscript = Superscript

      self.add_special_character("^")
    end
  }
end
```

3.1.6.11 Subscripts

The `extensions.subscripts` function implements the Pandoc subscript syntax extension.

```
M.extensions.subscripts = function()
  return {
    extend_writer = function(self)
```

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

```
      function self.subscript(s)
```

```
6727          return {"\\markdownRendererSubscript{",s,"}"}
6728        end
6729      end, extend_reader = function(self)
6730        local parsers = self.parsers
6731        local syntax = self.syntax
6732        local writer = self.writer
6733
6734        local Subscript = (
6735          parsers.between(parsers.Str, parsers.tilde, parsers.tilde)
6736        ) / writer.subscript
6737
6738        syntax.Subscript = Subscript
6739
6740        self.add_special_character("~")
6741      end
6742    }
6743  end
```

3.1.6.12 Fancy Lists

The `extensions.fancy_lists` function implements the Pandoc fancy list extension.

```
6744  M.extensions.fancy_lists = function()
6745    return {
6746      extend_writer = function(self)
6747        local options = self.options
6748
```

Define `writer->fancylist` as a function that will transform an input ordered list to the output format, where:

- `items` is an array of the list items,
- `tight` specifies, whether the list is tight or not,
- `startnum` is the number of the first list item,
- `numstyle` is the style of the list item labels from among the following:
  - `Decimal` – decimal arabic numbers,
  - `LowerRoman` – lower roman numbers,
  - `UpperRoman` – upper roman numbers,
  - `LowerAlpha` – lower ASCII alphabetic characters, and
  - `UpperAlpha` – upper ASCII alphabetic characters, and
- `numdelim` is the style of delimiters between list item labels and texts from among the following:
  - `Default` – default style,
  - `OneParen` – parentheses, and
  - `Period` – periods.

```
6749        function self.fancylist(items,tight,startnum,numstyle,numdelim)
6750          if not self.is_writing then return "" end
6751          local buffer = {}
```

```
6752          local num = startnum
6753          for _,item in ipairs(items) do
6754            buffer[#buffer + 1] = self.fancyitem(item,num)
6755            if num ~= nil then
6756              num = num + 1
6757            end
6758          end
6759          local contents = util.intersperse(buffer,"\n")
6760          if tight and options.tightLists then
6761            return {"\\markdownRendererFancyOlBeginTight{",
6762                    numstyle,"}{",numdelim,"}",contents,
6763                    "\n\\markdownRendererFancyOlEndTight "}
6764          else
6765            return {"\\markdownRendererFancyOlBegin{",
6766                    numstyle,"}{",numdelim,"}",contents,
6767                    "\n\\markdownRendererFancyOlEnd "}
6768          end
6769        end
```

Define `writer->fancyitem` as a function that will transform an input fancy ordered list item to the output format, where `s` is the text of the list item. If the optional parameter `num` is present, it is the number of the list item.

```
6770        function self.fancyitem(s,num)
6771          if num ~= nil then
6772            return {"\\markdownRendererFancyOlItemWithNumber{",num,"}",s,
6773                    "\\markdownRendererFancyOlItemEnd "}
6774          else
6775            return {"\\markdownRendererFancyOlItem ",s,"\\markdownRendererFancyOlItemEnd "
6776          end
6777        end
6778      end, extend_reader = function(self)
6779        local parsers = self.parsers
6780        local options = self.options
6781        local syntax = self.syntax
6782        local writer = self.writer
6783
6784        local label = parsers.dig + parsers.letter
6785        local numdelim = parsers.period + parsers.rparent
6786        local enumerator = C(label^3 * numdelim) * #parsers.spacing
6787                         + C(label^2 * numdelim) * #parsers.spacing
6788                                                 * (parsers.tab + parsers.space^1)
6789                         + C(label * numdelim) * #parsers.spacing
6790                                               * (parsers.tab + parsers.space^-2)
6791                         + parsers.space * C(label^2 * numdelim)
6792                                         * #parsers.spacing
6793                         + parsers.space * C(label * numdelim)
6794                                         * #parsers.spacing
```

```
                                      * (parsers.tab + parsers.space^-1)
                        + parsers.space * parsers.space * C(label^1
                                      * numdelim) * #parsers.spacing
    local starter = parsers.bullet + enumerator

    local NestedList = Cs((parsers.optionallyindentedline
                          - starter)^1)
                        / function(a) return "\001"..a end

    local ListBlockLine  = parsers.optionallyindentedline
                         - parsers.blankline - (parsers.indent^-1
                                               * starter)

    local ListBlock = parsers.line * ListBlockLine^0

    local ListContinuationBlock = parsers.blanklines * (parsers.indent / "")
                                * ListBlock

    local TightListItem = function(starter)
        return -parsers.HorizontalRule
               * (Cs(starter / "" * parsers.tickbox^-1 * ListBlock * NestedList^-
1)
                 / self.parser_functions.parse_blocks_nested)
               * -(parsers.blanklines * parsers.indent)
    end

    local LooseListItem = function(starter)
        return -parsers.HorizontalRule
               * Cs( starter / "" * parsers.tickbox^-1 * ListBlock * Cc("\n")
                 * (NestedList + ListContinuationBlock^0)
                 * (parsers.blanklines / "\n\n")
                 ) / self.parser_functions.parse_blocks_nested
    end

    local function roman2number(roman)
      local romans = { ["L"] = 50, ["X"] = 10, ["V"] = 5, ["I"] = 1 }
      local numeral = 0

      local i = 1
      local len = string.len(roman)
      while i < len do
        local z1, z2 = romans[ string.sub(roman, i, i) ], romans[ string.sub(roman, i+
        if z1 < z2 then
            numeral = numeral + (z2 - z1)
            i = i + 2
        else
            numeral = numeral + z1
```

```
6841              i = i + 1
6842            end
6843          end
6844          if i <= len then numeral = numeral + romans[ string.sub(roman,i,i) ] end
6845          return numeral
6846        end
6847
6848        local function sniffstyle(itemprefix)
6849          local numstr, delimend = itemprefix:match("^([A-Za-z0-9]*)([.)]*)")
6850          local numdelim
6851          if delimend == ")" then
6852            numdelim = "OneParen"
6853          elseif delimend == "." then
6854            numdelim = "Period"
6855          else
6856            numdelim = "Default"
6857          end
6858          numstr = numstr or itemprefix
6859
6860          local num
6861          num = numstr:match("^([IVXL]+)")
6862          if num then
6863            return roman2number(num), "UpperRoman", numdelim
6864          end
6865          num = numstr:match("^([ivxl]+)")
6866          if num then
6867            return roman2number(string.upper(num)), "LowerRoman", numdelim
6868          end
6869          num = numstr:match("^([A-Z])")
6870          if num then
6871            return string.byte(num) - string.byte("A") + 1, "UpperAlpha", numdelim
6872          end
6873          num = numstr:match("^([a-z])")
6874          if num then
6875            return string.byte(num) - string.byte("a") + 1, "LowerAlpha", numdelim
6876          end
6877          return math.floor(tonumber(numstr) or 1), "Decimal", numdelim
6878        end
6879
6880        local function fancylist(items,tight,start)
6881          local startnum, numstyle, numdelim = sniffstyle(start)
6882          return writer.fancylist(items,tight,
6883                                  options.startNumber and startnum,
6884                                  numstyle or "Decimal",
6885                                  numdelim or "Default")
6886        end
6887
```

```
      local FancyList = Cg(enumerator, "listtype") *
                        ( Ct(TightListItem(Cb("listtype"))
                            * TightListItem(enumerator)^0)
                        * Cc(true) * parsers.skipblanklines * -enumerator
                        + Ct(LooseListItem(Cb("listtype"))
                            * LooseListItem(enumerator)^0)
                        * Cc(false) * parsers.skipblanklines
                        ) * Cb("listtype") / fancylist

      syntax.OrderedList = FancyList

    end
  }
end
```

3.1.7 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)
```

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

```
  options = options or {}
  setmetatable(options, { __index = function (_, key)
    return defaultOptions[key] end })
% \par
% \begin{markdown}
%
% Apply syntax extensions based on `options`.
%
% \end{markdown}
%  \begin{macrocode}
  local extensions = {}

  if options.citations then
    local citations_extension = M.extensions.citations(options.citationNbsps)
    table.insert(extensions, citations_extension)
  end

  if options.contentBlocks then
    local content_blocks_extension = M.extensions.content_blocks(
      options.contentBlocksLanguageMap)
    table.insert(extensions, content_blocks_extension)
  end

  if options.definitionLists then
```

```
6927    local definition_lists_extension = M.extensions.definition_lists(
6928      options.tightLists)
6929    table.insert(extensions, definition_lists_extension)
6930  end
6931
6932  if options.fencedCode then
6933    local fenced_code_extension = M.extensions.fenced_code(
6934      options.blankBeforeCodeFence)
6935    table.insert(extensions, fenced_code_extension)
6936  end
6937
6938  if options.footnotes or options.inlineFootnotes then
6939    local footnotes_extension = M.extensions.footnotes(
6940      options.footnotes, options.inlineFootnotes)
6941    table.insert(extensions, footnotes_extension)
6942  end
6943
6944  if options.headerAttributes then
6945    local header_attributes_extension = M.extensions.header_attributes()
6946    table.insert(extensions, header_attributes_extension)
6947  end
6948
6949  if options.jekyllData then
6950    local jekyll_data_extension = M.extensions.jekyll_data(
6951      options.expectJekyllData)
6952    table.insert(extensions, jekyll_data_extension)
6953  end
6954
6955  if options.pipeTables then
6956    local pipe_tables_extension = M.extensions.pipe_tables(
6957      options.tableCaptions)
6958    table.insert(extensions, pipe_tables_extension)
6959  end
6960
6961  if options.strikeThrough then
6962    local strike_through_extension = M.extensions.strike_through()
6963    table.insert(extensions, strike_through_extension)
6964  end
6965
6966  if options.subscripts then
6967    local subscript_extension = M.extensions.subscripts()
6968    table.insert(extensions, subscript_extension)
6969  end
6970
6971  if options.superscripts then
6972    local superscript_extension = M.extensions.superscripts()
6973    table.insert(extensions, superscript_extension)
```

```
  end

  if options.fancyLists then
    local fancy_lists_extension = M.extensions.fancy_lists()
    table.insert(extensions, fancy_lists_extension)
  end

  local writer = M.writer.new(options)
  local reader = M.reader.new(writer, options, extensions)

  return reader.convert
end

return M
```

3.1.8 Command-Line Implementation

The command-line implementation provides the actual conversion routine for the command-line interface described in Section 2.1.5.

```
local input
if input_filename then
  local input_file = assert(io.open(input_filename, "r"),
    [[could not open file "]] .. input_filename .. [[" for reading]])
  input = assert(input_file:read("*a"))
  assert(input_file:close())
else
  input = assert(io.read("*a"))
end
```

First, ensure that the `options.cacheDir` directory exists.

```
local lfs = require("lfs")
if options.cacheDir and not lfs.isdir(options.cacheDir) then
  assert(lfs.mkdir(options["cacheDir"]))
end

local ran_ok, kpse = pcall(require, "kpse")
if ran_ok then kpse.set_program_name("luatex") end
local md = require("markdown")
```

Since we are loading the rest of the Lua implementation dynamically, check that both the `markdown` module and the command line implementation are the same version.

```
if metadata.version ~= md.metadata.version then
  warn("markdown-cli.lua " .. metadata.version .. " used with " ..
       "markdown.lua " .. md.metadata.version .. ".")
end
```

```
local convert = md.new(options)
```

Since the Lua converter expects UNIX line endings, normalize the input. Also add a line ending at the end of the file in case the input file has none.

```
local output = convert(input:gsub("\r\n?", "\n") .. "\n")

if output_filename then
  local output_file = assert(io.open(output_filename, "w"),
    [[could not open file "]] .. output_filename .. [[" for writing]])
  assert(output_file:write(output))
  assert(output_file:close())
else
  assert(io.write(output))
end
```

3.2 Plain TEX Implementation

The plain TEX implementation provides macros for the interfacing between TEX and Lua and for the buffering of input text. These macros are then used to implement the macros for the conversion from markdown to plain TEX exposed by the plain TEX interface (see Section 2.2).

3.2.1 Logging Facilities

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

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{\&}%
\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\markdownRendererFancyOlBeginPrototype#1#2{\markdownRendererOlBegin}%
\def\markdownRendererFancyOlBeginTightPrototype#1#2{\markdownRendererOlBeginTight}%
\def\markdownRendererOlItemPrototype{}%
\def\markdownRendererOlItemWithNumberPrototype#1{}%
\def\markdownRendererOlItemEndPrototype{}%
\def\markdownRendererFancyOlItemPrototype{\markdownRendererOlItem}%
\def\markdownRendererFancyOlItemWithNumberPrototype{\markdownRendererOlItemWithNumber}%
\def\markdownRendererFancyOlItemEndPrototype{}%
\def\markdownRendererOlEndPrototype{}%
\def\markdownRendererOlEndTightPrototype{}%
\def\markdownRendererFancyOlEndPrototype{\markdownRendererOlEnd}%
\def\markdownRendererFancyOlEndTightPrototype{\markdownRendererOlEndTight}%
\def\markdownRendererDlBeginPrototype{}%
\def\markdownRendererDlBeginTightPrototype{}%
\def\markdownRendererDlItemPrototype#1{#1}%
\def\markdownRendererDlItemEndPrototype{}%
\def\markdownRendererDlDefinitionBeginPrototype{}%
\def\markdownRendererDlDefinitionEndPrototype{\par}%
\def\markdownRendererDlEndPrototype{}%
\def\markdownRendererDlEndTightPrototype{}%
\def\markdownRendererEmphasisPrototype#1{{\it#1}}%
```

```
\def\markdownRendererStrongEmphasisPrototype#1{{\bf#1}}%
\def\markdownRendererBlockQuoteBeginPrototype{\par\begingroup\it}%
\def\markdownRendererBlockQuoteEndPrototype{\endgroup\par}%
\def\markdownRendererInputVerbatimPrototype#1{%
  \par{\tt\input#1\relax{}}\par}%
\def\markdownRendererInputFencedCodePrototype#1#2{%
  \markdownRendererInputVerbatimPrototype{#1}}%
\def\markdownRendererHeadingOnePrototype#1{#1}%
\def\markdownRendererHeadingTwoPrototype#1{#1}%
\def\markdownRendererHeadingThreePrototype#1{#1}%
\def\markdownRendererHeadingFourPrototype#1{#1}%
\def\markdownRendererHeadingFivePrototype#1{#1}%
\def\markdownRendererHeadingSixPrototype#1{#1}%
\def\markdownRendererHorizontalRulePrototype{}%
\def\markdownRendererFootnotePrototype#1{#1}%
\def\markdownRendererCitePrototype#1{}%
\def\markdownRendererTextCitePrototype#1{}%
\def\markdownRendererTickedBoxPrototype{[X]}%
\def\markdownRendererHalfTickedBoxPrototype{[/]}%
\def\markdownRendererUntickedBoxPrototype{[ ]}%
\def\markdownRendererStrikeThroughPrototype#1{#1}%
\def\markdownRendererSuperscriptPrototype#1{#1}%
\def\markdownRendererSubscriptPrototype#1{#1}%
```

3.2.2.1 YAML Metadata Renderer Prototypes

To keep track of the current type of structure we inhabit when we are traversing a YAML document, we will maintain the `\g_@@_jekyll_data_datatypes_seq` stack. At every step of the traversal, the stack will contain one of the following constants at any position p:

`\c_@@_jekyll_data_sequence_tl` The currently traversed branch of the YAML document contains a sequence at depth p.

`\c_@@_jekyll_data_mapping_tl` The currently traversed branch of the YAML document contains a mapping at depth p.

`\c_@@_jekyll_data_scalar_tl` The currently traversed branch of the YAML document contains a scalar value at depth p.

```
\ExplSyntaxOn
\seq_new:N   \g_@@_jekyll_data_datatypes_seq
\tl_const:Nn \c_@@_jekyll_data_sequence_tl   { sequence }
\tl_const:Nn \c_@@_jekyll_data_mapping_tl    { mapping  }
\tl_const:Nn \c_@@_jekyll_data_scalar_tl     { scalar   }
```

To keep track of our current place when we are traversing a YAML document, we will maintain the `\g_@@_jekyll_data_wildcard_absolute_address_seq` stack of keys using the `\markdown_jekyll_data_push_address_segment:n` macro.

```
\seq_new:N \g_@@_jekyll_data_wildcard_absolute_address_seq
\cs_new:Nn \markdown_jekyll_data_push_address_segment:n
  {
    \seq_if_empty:NF
      \g_@@_jekyll_data_datatypes_seq
      {
        \seq_get_right:NN
          \g_@@_jekyll_data_datatypes_seq
          \l_tmpa_tl
```

If we are currently in a sequence, we will put an asterisk (`*`) instead of a key into `\g_@@_jekyll_data_wildcard_absolute_address_seq` to make it represent a *wildcard*. Keeping a wildcard instead of a precise address makes it easy for the users to react to *any* item of a sequence regardless of how many there are, which can often be useful.

```
      \str_if_eq:NNTF
        \l_tmpa_tl
        \c_@@_jekyll_data_sequence_tl
        {
          \seq_put_right:Nn
            \g_@@_jekyll_data_wildcard_absolute_address_seq
            { * }
        }
        {
          \seq_put_right:Nn
            \g_@@_jekyll_data_wildcard_absolute_address_seq
            { #1 }
        }
      }
  }
```

Out of `\g_@@_jekyll_data_wildcard_absolute_address_seq`, we will construct the following two token lists:

`\g_@@_jekyll_data_wildcard_absolute_address_tl` An *absolute wildcard*: The wildcard from the root of the document prefixed with a slash (`/`) with individual keys and asterisks also delimited by slashes. Allows the users to react to complex context-sensitive structures with ease.

For example, the `name` key in the following YAML document would correspond to the `/*/person/name` absolute wildcard:

```
[{person: {name: Elon, surname: Musk}}]
```

`\g_@@_jekyll_data_wildcard_relative_address_tl` A *relative wildcard*: The rightmost segment of the wildcard. Allows the users to react to simple context-free structures.

For example, the `name` key in the following YAML document would correspond to the `name` relative wildcard:

```
[{person: {name: Elon, surname: Musk}}]
```

We will construct `\g_@@_jekyll_data_wildcard_absolute_address_tl` using the `\markdown_jekyll_data_concatenate_address:NN` macro and we will construct both token lists using the `\markdown_jekyll_data_update_address_tls:` macro.

```
\tl_new:N  \g_@@_jekyll_data_wildcard_absolute_address_tl
\tl_new:N  \g_@@_jekyll_data_wildcard_relative_address_tl
\cs_new:Nn \markdown_jekyll_data_concatenate_address:NN
  {
    \seq_pop_left:NN #1 \l_tmpa_tl
    \tl_set:Nx #2 { / \seq_use:Nn #1 { / } }
    \seq_put_left:NV #1 \l_tmpa_tl
  }
\cs_new:Nn \markdown_jekyll_data_update_address_tls:
  {
    \markdown_jekyll_data_concatenate_address:NN
      \g_@@_jekyll_data_wildcard_absolute_address_seq
      \g_@@_jekyll_data_wildcard_absolute_address_tl
    \seq_get_right:NN
      \g_@@_jekyll_data_wildcard_absolute_address_seq
      \g_@@_jekyll_data_wildcard_relative_address_tl
  }
```

To make sure that the stacks and token lists stay in sync, we will use the `\markdown_jekyll_data_push:nN` and `\markdown_jekyll_data_pop:` macros.

```
\cs_new:Nn \markdown_jekyll_data_push:nN
  {
    \markdown_jekyll_data_push_address_segment:n
      { #1 }
    \seq_put_right:NV
     \g_@@_jekyll_data_datatypes_seq
     #2
    \markdown_jekyll_data_update_address_tls:
  }
\cs_new:Nn \markdown_jekyll_data_pop:
  {
    \seq_pop_right:NN
      \g_@@_jekyll_data_wildcard_absolute_address_seq
      \l_tmpa_tl
    \seq_pop_right:NN
      \g_@@_jekyll_data_datatypes_seq
      \l_tmpa_tl
```

```
    \markdown_jekyll_data_update_address_tls:
  }
```

To set a single key–value, we will use the `\markdown_jekyll_data_set_keyval:Nn` macro, ignoring unknown keys. To set key–values for both absolute and relative wildcards, we will use the `\markdown_jekyll_data_set_keyvals:nn` macro.

```
\cs_new:Nn \markdown_jekyll_data_set_keyval:nn
  {
    \keys_set_known:nn
      { markdown/jekyllData }
      { { #1 } = { #2 } }
  }
\cs_generate_variant:Nn
  \markdown_jekyll_data_set_keyval:nn
  { Vn }
\cs_new:Nn \markdown_jekyll_data_set_keyvals:nn
  {
    \markdown_jekyll_data_push:nN
      { #1 }
      \c_@@_jekyll_data_scalar_tl
    \markdown_jekyll_data_set_keyval:Vn
      \g_@@_jekyll_data_wildcard_absolute_address_tl
      { #2 }
    \markdown_jekyll_data_set_keyval:Vn
      \g_@@_jekyll_data_wildcard_relative_address_tl
      { #2 }
    \markdown_jekyll_data_pop:
  }
```

Finally, we will register our macros as token renderer prototypes to be able to react to the traversal of a YAML document.

```
\def\markdownRendererJekyllDataSequenceBeginPrototype#1#2{
  \markdown_jekyll_data_push:nN
    { #1 }
    \c_@@_jekyll_data_sequence_tl
}
\def\markdownRendererJekyllDataMappingBeginPrototype#1#2{
  \markdown_jekyll_data_push:nN
    { #1 }
    \c_@@_jekyll_data_mapping_tl
}
\def\markdownRendererJekyllDataSequenceEndPrototype{
  \markdown_jekyll_data_pop:
}
\def\markdownRendererJekyllDataMappingEndPrototype{
  \markdown_jekyll_data_pop:
}
\def\markdownRendererJekyllDataBooleanPrototype#1#2{
```

```
  \markdown_jekyll_data_set_keyvals:nn
    { #1 }
    { #2 }
}
\def\markdownRendererJekyllDataEmptyPrototype#1{}
\def\markdownRendererJekyllDataNumberPrototype#1#2{
  \markdown_jekyll_data_set_keyvals:nn
    { #1 }
    { #2 }
}
\def\markdownRendererJekyllDataStringPrototype#1#2{
  \markdown_jekyll_data_set_keyvals:nn
    { #1 }
    { #2 }
}
\ExplSyntaxOff
```

3.2.3 Lua Snippets

After the `\markdownPrepareLuaOptions` macro has been fully expanded, the `\markdownLuaOptions` macro will 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).

```
\ExplSyntaxOn
\tl_new:N \g_@@_formatted_lua_options_tl
\cs_new:Nn \@@_format_lua_options:
  {
    \tl_gclear:N
      \g_@@_formatted_lua_options_tl
    \seq_map_function:NN
      \g_@@_lua_options_seq
      \@@_format_lua_option:n
  }
\cs_new:Nn \@@_format_lua_option:n
  {
    \@@_typecheck_option:n
      { #1 }
    \@@_get_option_type:nN
      { #1 }
      \l_tmpa_tl
    \bool_if:nTF
      {
        \str_if_eq_p:VV
          \l_tmpa_tl
          \c_@@_option_type_boolean_tl ||
        \str_if_eq_p:VV
          \l_tmpa_tl
```

```
          \c_@@_option_type_number_tl ||
        \str_if_eq_p:VV
          \l_tmpa_tl
          \c_@@_option_type_counter_tl
      }
      {
        \@@_get_option_value:nN
          { #1 }
          \l_tmpa_tl
        \tl_gput_right:Nx
          \g_@@_formatted_lua_options_tl
          { #1~=~  \l_tmpa_tl   ,~ }
      }
      {
        \@@_get_option_value:nN
          { #1 }
          \l_tmpa_tl
        \tl_gput_right:Nx
          \g_@@_formatted_lua_options_tl
          { #1~=~ " \l_tmpa_tl " ,~ }
      }
  }
\let\markdownPrepareLuaOptions=\@@_format_lua_options:
\def\markdownLuaOptions{{ \g_@@_formatted_lua_options_tl }}
\ExplSyntaxOff
```

The `\markdownPrepare` macro contains the Lua code that is executed prior to any conversion from markdown to plain TEX. It exposes the `convert` function for the use by any further Lua code.

```
\def\markdownPrepare{%
```

First, ensure that the `\markdownOptionCacheDir` directory exists.

```
  local lfs = require("lfs")
  local cacheDir = "\markdownOptionCacheDir"
  if not lfs.isdir(cacheDir) then
    assert(lfs.mkdir(cacheDir))
  end
```

Next, load the `markdown` module and create a converter function using the plain TEX options, which were serialized to a Lua table via the `\markdownLuaOptions` macro.

```
  local md = require("markdown")
  local convert = md.new(\markdownLuaOptions)
}%
```

3.2.4 Buffering Markdown Input

The `\markdownIfOption{`⟨*name*⟩`}{`⟨*iftrue*⟩`}{`⟨*iffalse*⟩`}` macro is provided for testing,

whether the value of `\markdownOption`⟨*name*⟩ is `true`. If the value is `true`, then ⟨*iftrue*⟩ is expanded, otherwise ⟨*iffalse*⟩ is expanded.

```
\ExplSyntaxOn
\cs_new:Nn
  \@@_if_option:nTF
  {
    \@@_get_option_type:nN
      { #1 }
      \l_tmpa_tl
    \str_if_eq:NNF
      \l_tmpa_tl
      \c_@@_option_type_boolean_tl
      {
        \msg_error:nnxx
          { @@ }
          { expected-boolean-option }
          { #1 }
          { \l_tmpa_tl }
      }
    \@@_get_option_value:nN
      { #1 }
      \l_tmpa_tl
    \str_if_eq:NNTF
      \l_tmpa_tl
      \c_@@_option_value_true_tl
      { #2 }
      { #3 }
  }
\msg_new:nnn
  { @@ }
  { expected-boolean-option }
  {
    Option~#1~has~type~#2,~
    but~a~boolean~was~expected.
  }
\let\markdownIfOption=\@@_if_option:nTF
\ExplSyntaxOff
```

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. Likewise, swap the character codes of the percent sign (`%`) and the ampersand (`@`), so that we can remove percent signs from the beginning of lines when `\markdownOptionStripPercentSigns` is enabled.

```
  \catcode`\^^M=13%
  \catcode`\^^I=13%
  \catcode`|=0%
  \catcode`\\=12%
  |catcode`@=14%
  |catcode`|%=12@
  |gdef|markdownReadAndConvert#1#2{@
    |begingroup@
```

If we are not reading markdown documents from the frozen cache, open the `\markdownOptionInputTempFileName` file for writing.

```
    |markdownIfOption{frozenCache}{}{@
      |immediate|openout|markdownOutputFileStream@
        |markdownOptionInputTempFileName|relax@
      |markdownInfo{Buffering markdown input into the temporary @
        input file "|markdownOptionInputTempFileName" and scanning @
        for the closing token sequence "#1"}@
    }@
```

Locally change the category of the special plain TeX characters to *other* in order to prevent unwanted interpretation of the input. Change also the category of the space character, so that we can retrieve it unaltered.

```
    |def|do##1{|catcode`##1=12}|dospecials@
    |catcode`| =12@
    |markdownMakeOther@
```

The `\markdownReadAndConvertStripPercentSigns` macro will process the individual lines of output, stipping away leading percent signs (`%`) when `\markdownOptionStripPercentSigns` is enabled. Notice the use of the comments (`@`) to ensure that the entire macro is at a single line and therefore no (active) newline symbols (`^^M`) are produced.

```
    |def|markdownReadAndConvertStripPercentSign##1{@
      |markdownIfOption{stripPercentSigns}{@
        |if##1%@
          |expandafter|expandafter|expandafter@
            |markdownReadAndConvertProcessLine@
```

```
      |else@
        |expandafter|expandafter|expandafter@
          |markdownReadAndConvertProcessLine@
          |expandafter|expandafter|expandafter##1@
      |fi@
    }{@
      |expandafter@
        |markdownReadAndConvertProcessLine@
        |expandafter##1@
    }@
  }@
```

The `\markdownReadAndConvertProcessLine` macro will process the individual lines of output. Notice the use of the comments (`@`) to ensure that the entire macro is at a single line and therefore no (active) newline symbols (`^^M`) are produced.

```
  |def|markdownReadAndConvertProcessLine##1#1##2#1##3|relax{@
```

If we are not reading markdown documents from the frozen cache and the ending token sequence does not appear in the line, store the line in the `\markdownOptionInputTempFileName` file. If we are reading markdown documents from the frozen cache and the ending token sequence does not appear in the line, gobble the line.

```
    |ifx|relax##3|relax@
      |markdownIfOption{frozenCache}{}{@
        |immediate|write|markdownOutputFileStream{##1}@
      }@
    |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.

```
      |def^^M{@
        |markdownInfo{The ending token sequence was found}@
        |markdownIfOption{frozenCache}{}{@
          |immediate|closeout|markdownOutputFileStream@
        }@
        |endgroup@
        |markdownInput{@
          |markdownOptionOutputDir@
          /|markdownOptionInputTempFileName@
        }@
        #2}@
    |fi@
```

Repeat with the next line.

```
    ^^M}@
```

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

```
    |catcode`|^^I=13@
    |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.

```
    |catcode`|^^M=13@
    |def^^M##1^^M{@
      |def^^M####1^^M{@
        |markdownReadAndConvertStripPercentSign####1#1#1|relax}@
      ^^M}@
    ^^M}@
```

Reset the character categories back to the former state.

```
|endgroup
```

The following two sections of the implementation have been deprecated and will be removed in Markdown 3.0.0. The code that corresponds to `\markdownMode` value of `3` will be the only implementation.

```
\ExplSyntaxOn
\int_compare:nT
  { \markdownMode = 3 }
  {
    \markdownInfo{Using~mode~3:~The~lt3luabridge~package}
    \file_input:n { lt3luabridge.tex }
    \cs_new:Npn
      \markdownLuaExecute
      { \luabridgeExecute }
  }
\ExplSyntaxOff
```

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 [1, Section 3.1.1].

```
\ifnum\markdownMode<2\relax
\ifnum\markdownMode=0\relax
  \markdownWarning{Using mode 0: Shell escape via write18
```

```
                    (deprecated, to be removed in Markdown 3.0.0)}%
\else
  \markdownWarning{Using mode 1: Shell escape via os.execute
                    (deprecated, to be removed in Markdown 3.0.0)}%
\fi
```

The `\markdownExecuteShellEscape` macro contains the numeric value indicating whether the shell access is enabled (`1`), disabled (`0`), or restricted (`2`).

Inherit the value of the the `\pdfshellescape` (LuaTeX, PdfTeX) or the `\shellescape` (XeTeX) commands. If neither of these commands is defined and Lua is available, attempt to access the `status.shell_escape` configuration item.

If you cannot detect, whether the shell access is enabled, act as if it were.

```
\ifx\pdfshellescape\undefined
  \ifx\shellescape\undefined
    \ifnum\markdownMode=0\relax
      \def\markdownExecuteShellEscape{1}%
    \else
      \def\markdownExecuteShellEscape{%
        \directlua{tex.sprint(status.shell_escape or "1")}}%
    \fi
  \else
    \let\markdownExecuteShellEscape\shellescape
  \fi
\else
  \let\markdownExecuteShellEscape\pdfshellescape
\fi
```

The `\markdownExecuteDirect` macro executes the code it has received as its first argument by writing it to the output file stream 18, if Lua is unavailable, or by using the Lua `os.execute` method otherwise.

```
\ifnum\markdownMode=0\relax
  \def\markdownExecuteDirect#1{\immediate\write18{#1}}%
\else
  \def\markdownExecuteDirect#1{%
    \directlua{os.execute("\luaescapestring{#1}")}}%
\fi
```

The `\markdownExecute` macro is a wrapper on top of `\markdownExecuteDirect` that checks the value of `\markdownExecuteShellEscape` and prints an error message if the shell is inaccessible.

```
\def\markdownExecute#1{%
  \ifnum\markdownExecuteShellEscape=1\relax
    \markdownExecuteDirect{#1}%
  \else
    \markdownError{I can not access the shell}{Either run the TeX
      compiler with the --shell-escape or the --enable-write18 flag,
      or set shell_escape=t in the texmf.cnf file}%
```

```
\fi}%
```

The `\markdownLuaExecute` macro executes the Lua code it has received as its first argument. The Lua code may not directly interact with the TEX engine, but it can use the `print` function in the same manner it would use the `tex.print` method.

```
\begingroup
```

Swap the category code of the backslash symbol and the pipe symbol, so that we may use the backslash symbol freely inside the Lua code.

```
\catcode`|=0%
\catcode`\\=12%
|gdef|markdownLuaExecute#1{%
```

Create the file `\markdownOptionHelperScriptFileName` and fill it with the input Lua code prepended with kpathsea initialization, so that Lua modules from the TEX distribution are available.

```
  |immediate|openout|markdownOutputFileStream=%
    |markdownOptionHelperScriptFileName
  |markdownInfo{Writing a helper Lua script to the file
    "|markdownOptionHelperScriptFileName"}%
  |immediate|write|markdownOutputFileStream{%
    local ran_ok, error = pcall(function()
      local ran_ok, kpse = pcall(require, "kpse")
      if ran_ok then kpse.set_program_name("luatex") end
      #1
    end)
```

If there was an error, use the file `\markdownOptionErrorTempFileName` to store the error message.

```
    if not ran_ok then
      local file = io.open("%
        |markdownOptionOutputDir
        /|markdownOptionErrorTempFileName", "w")
      if file then
        file:write(error .. "\n")
        file:close()
      end
      print('\\markdownError{An error was encountered while executing
            Lua code}{For further clues, examine the file
            "|markdownOptionOutputDir
            /|markdownOptionErrorTempFileName"}')
    end}%
  |immediate|closeout|markdownOutputFileStream
```

Execute the generated `\markdownOptionHelperScriptFileName` Lua script using the TEXLua binary and store the output in the `\markdownOptionOutputTempFileName` file.

```
  |markdownInfo{Executing a helper Lua script from the file
```

```
      "|markdownOptionHelperScriptFileName" and storing the result in the
      file "|markdownOptionOutputTempFileName"}%
    |markdownExecute{texlua "|markdownOptionOutputDir
      /|markdownOptionHelperScriptFileName" > %
      "|markdownOptionOutputDir
      /|markdownOptionOutputTempFileName"}%
```

\input the generated \markdownOptionOutputTempFileName file.

```
    |input|markdownOptionOutputTempFileName|relax}%
|endgroup
```

3.2.6 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.

```
\fi
\ifnum\markdownMode=2\relax
  \markdownWarning{Using mode 2: Direct Lua access
                   (deprecated, to be removed in Markdown 3.0.0)}%
```

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,

```
\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{%
    |directlua{%
      local function print(input)
        local output = {}
        for line in input:gmatch("[^\r\n]+") do
          table.insert(output, line)
        end
        tex.print(output)
      end
      #1
    }%
  }%
|endgroup
\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{%
```

Change the category code of the percent sign (`%`) to other, so that a user of the `hybrid` Lua option or a malevolent actor can't produce TeX comments in the plain TeX output of the Markdown package.

```
    |begingroup
    |catcode`|%=12
```

If we are reading from the frozen cache, input it, expand the corresponding `\markdownFrozenCache`⟨*number*⟩ macro, and increment `frozenCacheCounter`.

```
    |markdownIfOption{frozenCache}{%
      |ifnum|markdownOptionFrozenCacheCounter=0|relax
        |markdownInfo{Reading frozen cache from
          "|markdownOptionFrozenCacheFileName"}%
        |input|markdownOptionFrozenCacheFileName|relax
      |fi
      |markdownInfo{Including markdown document number
        "|the|markdownOptionFrozenCacheCounter" from frozen cache}%
      |csname markdownFrozenCache|the|markdownOptionFrozenCacheCounter|endcsname
      |global|advance|markdownOptionFrozenCacheCounter by 1|relax
    }{%
      |markdownInfo{Including markdown document "#1"}%
```

Attempt to open the markdown document to record it in the `.log` and `.fls` files. This allows external programs such as LATEXMk to track changes to the markdown document.

```
      |openin|markdownInputFileStream#1
      |closein|markdownInputFileStream
      |markdownPrepareLuaOptions
      |markdownLuaExecute{%
        |markdownPrepare
        local file = assert(io.open("#1", "r"),
          [[could not open file "#1" for reading]])
        local input = assert(file:read("*a"))
        assert(file:close())
```

Since the Lua converter expects UNIX line endings, normalize the input. Also add a line ending at the end of the file in case the input file has none.

```
        print(convert(input:gsub("\r\n?", "\n") .. "\n"))}%
```

In case we were finalizing the frozen cache, increment `frozenCacheCounter`.

```
      |global|advance|markdownOptionFrozenCacheCounter by 1|relax
    }%
    |endgroup
  }%
|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 [10, Section 9]. As a consequence, we can directly reuse the existing plain TeX implementation.

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

Use reflection to define the `renderers` and `rendererPrototypes` keys of `\markdownSetup` as well as the keys that correspond to Lua options.

```
\ExplSyntaxOn
\@@_latex_define_renderers:
\@@_latex_define_renderer_prototypes:
\ExplSyntaxOff
```

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.

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

Locally swap the category code of the backslash symbol with the pipe symbol, and of the left (`{`) and right brace (`}`) with the less-than (`<`) and greater-than (`>`) signs. This is required in order that all the special symbols that appear in the first argument of the `markdownReadAndConvert` macro have the category code *other*.

```
  \catcode`\|=0\catcode`\<=1\catcode`\>=2%
  \catcode`\\=12|catcode`|{=12|catcode`|}=12%
  |gdef|markdownReadAndConvert@markdown#1<%
    |markdownReadAndConvert<\end{markdown#1}>%
                           <|end<markdown#1>>>%
|endgroup
```

3.3.2.1 LaTeX Themes

This section implements the theme-loading mechanism and the example themes provided with the Markdown package.

```
\ExplSyntaxOn
```

To keep track of our current place when packages themes have been nested, we will maintain the `\g_@@_latex_themes_seq` stack of theme names.

```
\newcommand\markdownLaTeXThemeName{}
\seq_new:N \g_@@_latex_themes_seq
\seq_put_right:NV
  \g_@@_latex_themes_seq
  \markdownLaTeXThemeName
\newcommand\markdownLaTeXThemeLoad[2]{
  \def\@tempa{%
    \def\markdownLaTeXThemeName{#2}
    \seq_put_right:NV
      \g_@@_latex_themes_seq
      \markdownLaTeXThemeName
    \RequirePackage{#1}
    \seq_pop_right:NN
      \g_@@_latex_themes_seq
      \l_tmpa_tl
    \seq_get_right:NN
      \g_@@_latex_themes_seq
      \l_tmpa_tl
```

```
    \exp_args:NNV
      \def
      \markdownLaTeXThemeName
      \l_tmpa_tl}
  \ifmarkdownLaTeXLoaded
    \@tempa
  \else
    \exp_args:No
      \AtEndOfPackage
      { \@tempa }
  \fi}
\ExplSyntaxOff
```

The `witiko/dot` theme enables the `fencedCode` Lua option:

```
\markdownSetup{fencedCode}%
```

We load the ifthen and grffile packages, see also Section 1.1.3:

```
\RequirePackage{ifthen,grffile}
```

We store the previous definition of the fenced code token renderer prototype:

```
\let\markdown@witiko@dot@oldRendererInputFencedCodePrototype
  \markdownRendererInputFencedCodePrototype
```

If the infostring starts with `dot …`, we redefine the fenced code block token renderer prototype, so that it typesets the code block via Graphviz tools if and only if the `\markdownOptionFrozenCache` plain TEX option is disabled and the code block has not been previously typeset:

```
\renewcommand\markdownRendererInputFencedCode[2]{%
  \def\next##1 ##2\relax{%
    \ifthenelse{\equal{##1}{dot}}{%
      \markdownIfOption{frozenCache}{}{%
        \immediate\write18{%
          if ! test -e #1.pdf.source || ! diff #1 #1.pdf.source;
          then
            dot -Tpdf -o #1.pdf #1;
            cp #1 #1.pdf.source;
          fi}}%
```

We include the typeset image using the image token renderer:

```
      \markdownRendererImage{Graphviz image}{#1.pdf}{#1.pdf}{##2}%
```

If the infostring does not start with `dot …`, we use the previous definition of the fenced code token renderer prototype:

```
    }{%
      \markdown@witiko@dot@oldRendererInputFencedCodePrototype{#1}{#2}%
    }%
  }%
  \next#2 \relax}%
```

The witiko/graphicx/http theme stores the previous definition of the image token renderer prototype:

```
\let\markdown@witiko@graphicx@http@oldRendererImagePrototype
  \markdownRendererImagePrototype
```

We load the catchfile and grffile packages, see also Section 1.1.3:

```
\RequirePackage{catchfile,grffile}
```

We define the \markdown@witiko@graphicx@http@counter counter to enumerate the images for caching and the \markdown@witiko@graphicx@http@filename command, which will store the pathname of the file containing the pathname of the downloaded image file.

```
\newcount\markdown@witiko@graphicx@http@counter
\markdown@witiko@graphicx@http@counter=0
\newcommand\markdown@witiko@graphicx@http@filename{%
  \markdownOptionCacheDir/witiko_graphicx_http%
  .\the\markdown@witiko@graphicx@http@counter}%
```

We define the \markdown@witiko@graphicx@http@download command, which will receive two arguments that correspond to the URL of the online image and to the pathname, where the online image should be downloaded. The command will produce a shell command that tries to downloads the online image to the pathname.

```
\newcommand\markdown@witiko@graphicx@http@download[2]{%
  wget -O #2 #1 || curl --location -o #2 #1 || rm -f #2}
```

We locally swap the category code of the percentage sign with the line feed control character, so that we can use percentage signs in the shell code:

```
\begingroup
\catcode`\%=12
\catcode`\^^A=14
```

We redefine the image token renderer prototype, so that it tries to download an online image.

```
\global\def\markdownRendererImagePrototype#1#2#3#4{^^A
  \begingroup
    \edef\filename{\markdown@witiko@graphicx@http@filename}^^A
```

The image will be downloaded only if the image URL has the http or https protocols and the \markdownOptionFrozenCache plain TEX option is disabled:

```
    \markdownIfOption{frozenCache}{}{^^A
      \immediate\write18{^^A
        mkdir -p "\markdownOptionCacheDir";
        if printf '%s' "#3" | grep -q -E '^https?:';
        then
```

The image will be downloaded to the pathname \markdownOptionCacheDir/⟨*the MD5 digest of the image URL*⟩.⟨*the suffix of the image URL*⟩:

```
          OUTPUT_PREFIX="\markdownOptionCacheDir";
```

```
          OUTPUT_BODY="$(printf '%s' '#3' | md5sum | cut -d' ' -f1)";
          OUTPUT_SUFFIX="$(printf '%s' '#3' | sed 's/.*[.]//')";
          OUTPUT="$OUTPUT_PREFIX/$OUTPUT_BODY.$OUTPUT_SUFFIX";
```

The image will be downloaded only if it has not already been downloaded:

```
          if ! [ -e "$OUTPUT" ];
          then
            \markdown@witiko@graphicx@http@download{'#3'}{"$OUTPUT"};
            printf '%s' "$OUTPUT" > "\filename";
          fi;
```

If the image does not have the http or https protocols or the image has already been downloaded, the URL will be stored as-is:

```
        else
          printf '%s' '#3' > "\filename";
        fi}}^^A
```

We load the pathname of the downloaded image and we typeset the image using the previous definition of the image renderer prototype:

```
    \CatchFileDef{\filename}{\filename}{\endlinechar=-1}^^A
    \markdown@witiko@graphicx@http@oldRendererImagePrototype^^A
      {#1}{#2}{\filename}{#4}^^A
  \endgroup
  \global\advance\markdown@witiko@graphicx@http@counter by 1\relax}^^A
\endgroup
```

The witiko/tilde theme redefines the tilde token renderer prototype, so that it expands to a non-breaking space:

```
\renewcommand\markdownRendererTildePrototype{~}%
```

3.3.3 Options

The supplied package options are processed using the \markdownSetup macro.

```
\DeclareOption*{%
  \expandafter\markdownSetup\expandafter{\CurrentOption}}%
\ProcessOptions\relax
```

After processing the options, activate the jekyllDataRenderes, renderers, rendererPrototypes, and code keys.

```
\ExplSyntaxOn
\keys_define:nn
  { markdown/latex-options }
  {
    renderers .code:n = {
      \keys_set:nn
        { markdown/latex-options/renderers }
        { #1 }
    },
```

```
    rendererPrototypes .code:n = {
      \keys_set:nn
        { markdown/latex-options/renderer-prototypes }
        { #1 }
    },
```

The `code` key is used to immediately expand and execute code, which can be especially useful in LaTeX setup snippets.

```
    code .code:n = { #1 },
```

The `jekyllDataRenderers` key can be used as a syntactic sugar for setting the `markdown/jekyllData` key–values (see Section 2.2.4.1) without using the expl3 language.

```
    jekyllDataRenderers .code:n = {
      \keys_set:nn
        { markdown/latex-options/jekyll-data-renderers }
        { #1 }
    },
  }
\keys_define:nn
  { markdown/latex-options/jekyll-data-renderers }
  {
    unknown .code:n = {
      \tl_set_eq:NN
        \l_tmpa_tl
        \l_keys_key_str
      \tl_put_right:Nn
        \l_tmpa_tl
        {
          .code:n = { #1 }
        }
      \keys_define:nV
        { markdown/jekyllData }
        \l_tmpa_tl
    }
  }
\cs_generate_variant:Nn
  \keys_define:nn
  { nV }
\ExplSyntaxOff
```

3.3.4 Token Renderer Prototypes

The following configuration should be considered placeholder. If the `plain` package option has been enabled (see Section 2.3.2.1), none of it will take effect.

```
\markdownIfOption{plain}{\iffalse}{\iftrue}
```

If the `tightLists` Lua option is disabled or the current document class is beamer, do not load the paralist package.

```
\markdownIfOption{tightLists}{
  \@ifclassloaded{beamer}{}{\RequirePackage{paralist}}%
}{}
```

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.

```
\ExplSyntaxOn
\@ifpackageloaded{paralist}{
  \tl_new:N
    \l_@@_latex_fancy_list_item_label_number_style_tl
  \tl_new:N
    \l_@@_latex_fancy_list_item_label_delimiter_style_tl
  \cs_new:Nn
    \@@_latex_fancy_list_item_label_number:nn
    {
      \str_case:nn
        { #1 }
        {
          { Decimal } { #2 }
          { LowerRoman } { \int_to_roman:n { #2 } }
          { UpperRoman } { \int_to_Roman:n { #2 } }
          { LowerAlpha } { \int_to_alph:n { #2 } }
          { UpperAlpha } { \int_to_alph:n { #2 } }
        }
    }
  \cs_new:Nn
    \@@_latex_fancy_list_item_label_delimiter:n
    {
      \str_case:nn
        { #1 }
        {
          { Default } { . }
          { OneParen } { ) }
          { Period } { - }
        }
    }
  \cs_new:Nn
    \@@_latex_fancy_list_item_label:nnn
    {
      \@@_latex_fancy_list_item_label_delimiter:n
        { #2 }
      \@@_latex_fancy_list_item_label_number:nn
        { #1 }
        { #3 }
```

```
  }
\cs_new:Nn
  \@@_latex_paralist_style:nn
  {
    \str_case:nn
      { #1 }
      {
        { Decimal } { 1 }
        { LowerRoman } { i }
        { UpperRoman } { I }
        { LowerAlpha } { a }
        { UpperAlpha } { A }
      }
    \@@_latex_fancy_list_item_label_delimiter:n
      { #2 }
  }
\markdownSetup{rendererPrototypes={
  ulBeginTight = {\begin{compactitem}},
  ulEndTight = {\end{compactitem}},
  fancyOlBegin = {
    \group_begin:
    \tl_set:Nn
      \l_@@_latex_fancy_list_item_label_number_style_tl
      { #1 }
    \tl_set:Nn
      \l_@@_latex_fancy_list_item_label_delimiter_style_tl
      { #2 }
    \begin{enumerate}[ \@@_latex_paralist_style:nn { #1 } { #2 } ]
  },
  fancyOlEnd = {
    \end{enumerate}
    \group_end:
  },
  olBeginTight = {\begin{compactenum}},
  olEndTight = {\end{compactenum}},
  fancyOlBeginTight = {
    \group_begin:
    \tl_set:Nn
      \l_@@_latex_fancy_list_item_label_number_style_tl
      { #1 }
    \tl_set:Nn
      \l_@@_latex_fancy_list_item_label_delimiter_style_tl
      { #2 }
    \begin{compactenum}[ \@@_latex_paralist_style:nn { #1 } { #2 } ]
  },
  fancyOlEndTight = {
    \end{compactenum}
```

```
      \group_end:
    },
    fancyOlItemWithNumber = {
      \markdownRendererOlItemWithNumber
        {
          \@@_latex_fancy_list_item_label:VVn
            \l_@@_latex_fancy_list_item_label_number_style_tl
            \l_@@_latex_fancy_list_item_label_delimiter_style_tl
            { #1 }
        }
    },
    dlBeginTight = {\begin{compactdesc}},
    dlEndTight = {\end{compactdesc}}}}
  \cs_generate_variant:Nn
    \@@_latex_fancy_list_item_label:nnn
    { VVn }
}{
  \markdownSetup{rendererPrototypes={
    ulBeginTight = {\markdownRendererUlBegin},
    ulEndTight = {\markdownRendererUlEnd},
    fancyOlBegin = {\markdownRendererOlBegin},
    fancyOlEnd = {\markdownRendererOlEnd},
    olBeginTight = {\markdownRendererOlBegin},
    olEndTight = {\markdownRendererOlEnd},
    fancyOlBeginTight = {\markdownRendererOlBegin},
    fancyOlEndTight = {\markdownRendererOlEnd},
    dlBeginTight = {\markdownRendererDlBegin},
    dlEndTight = {\markdownRendererDlEnd}}}
}
\ExplSyntaxOff
\RequirePackage{amsmath,ifthen}
```

Unless the unicode-math package has been loaded, load the amssymb package with symbols to be used for tickboxes.

```
\@ifpackageloaded{unicode-math}{
  \markdownSetup{rendererPrototypes={
    untickedBox = {$\mdlgwhtsquare$},
  }}
}{
  \RequirePackage{amssymb}
  \markdownSetup{rendererPrototypes={
    untickedBox = {$\square$},
  }}
}
\RequirePackage{csvsimple}
\RequirePackage{fancyvrb}
\RequirePackage{graphicx}
```

```
\markdownSetup{rendererPrototypes={
  lineBreak = {\\},
  leftBrace = {\textbraceleft},
  rightBrace = {\textbraceright},
  dollarSign = {\textdollar},
  underscore = {\textunderscore},
  circumflex = {\textasciicircum},
  backslash = {\textbackslash},
  tilde = {\textasciitilde},
  pipe = {\textbar},
```

We can capitalize on the fact that the expansion of renderers is performed by TEX during the typesetting. Therefore, even if we don't know whether a span of text is part of math formula or not when we are parsing markdown,[8] we can reliably detect math mode inside the renderer.

Here, we will redefine the code span renderer prototype to typeset upright text in math formulae and typewriter text outside math formulae.

```
  codeSpan = {%
    \ifmmode
      \text{#1}%
    \else
      \texttt{#1}%
    \fi
  },
  contentBlock = {%
    \ifthenelse{\equal{#1}{csv}}{%
      \begin{table}%
        \begin{center}%
          \csvautotabular{#3}%
        \end{center}
        \ifx\empty#4\empty\else
          \caption{#4}%
        \fi
      \end{table}%
    }{%
      \ifthenelse{\equal{#1}{tex}}{%
        \catcode`\%=14\relax
        \input #3\relax
        \catcode`\%=12\relax
      }{%
        \markdownInput{#3}%
      }%
    }%
```

[8] This property may actually be undecidable. Suppose a span of text is a part of a macro definition. Then, whether the span of text is part of a math formula or not depends on where the macro is later used, which may easily be *both* inside and outside a math formula.

```
  },
  image = {%
    \begin{figure}%
      \begin{center}%
        \includegraphics{#3}%
      \end{center}%
      \ifx\empty#4\empty\else
        \caption{#4}%
      \fi
    \end{figure}},
  ulBegin = {\begin{itemize}},
  ulEnd = {\end{itemize}},
  olBegin = {\begin{enumerate}},
  olItem = {\item{}},
  olItemWithNumber = {\item[#1.]},
  olEnd = {\end{enumerate}},
  dlBegin = {\begin{description}},
  dlItem = {\item[#1]},
  dlEnd = {\end{description}},
  emphasis = {\emph{#1}},
  tickedBox = {$\boxtimes$},
  halfTickedBox = {$\boxdot$},
```

If identifier attributes appear at the beginning of a section, we make the next heading produce the `\label` macro.

```
  headerAttributeContextBegin = {
    \markdownSetup{
      rendererPrototypes = {
        attributeIdentifier = {%
          \begingroup
          \def\next####1{%
            \def####1########1{%
              \endgroup
              ####1{########1}%
              \label{##1}%
            }%
          }%
          \next\markdownRendererHeadingOne
          \next\markdownRendererHeadingTwo
          \next\markdownRendererHeadingThree
          \next\markdownRendererHeadingFour
          \next\markdownRendererHeadingFive
          \next\markdownRendererHeadingSix
        },
      },
    }%
  },
```

```
  superscript = {\textsuperscript{#1}},
  subscript = {\textsubscript{#1}},
  blockQuoteBegin = {\begin{quotation}},
  blockQuoteEnd = {\end{quotation}},
  inputVerbatim = {\VerbatimInput{#1}},
  inputFencedCode = {%
    \ifx\relax#2\relax
      \VerbatimInput{#1}%
    \else
      \@ifundefined{minted@code}{%
        \@ifundefined{lst@version}{%
          \markdownRendererInputFencedCode{#1}{}%
```

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

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

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

```
      }{%
        \inputminted{#2}{#1}%
      }%
    \fi},
  horizontalRule = {\noindent\rule[0.5ex]{\linewidth}{1pt}},
  footnote = {\footnote{#1}}}}
```

Support the nesting of strong emphasis.

```
\ExplSyntaxOn
\def\markdownLATEXStrongEmphasis#1{%
  \str_if_in:NnTF
    \f@series
    { b }
    { \textnormal{#1} }
    { \textbf{#1} }
}
\ExplSyntaxOff
\markdownSetup{rendererPrototypes={strongEmphasis={%
  \protect\markdownLATEXStrongEmphasis{#1}}}}
```

Support LaTeX document classes that do not provide chapters.

```
\@ifundefined{chapter}{%
  \markdownSetup{rendererPrototypes = {
    headingOne = {\section{#1}},
    headingTwo = {\subsection{#1}},
    headingThree = {\subsubsection{#1}},
    headingFour = {\paragraph{#1}\leavevmode},
    headingFive = {\subparagraph{#1}\leavevmode}}}
}{%
```

```
  \markdownSetup{rendererPrototypes = {
    headingOne = {\chapter{#1}},
    headingTwo = {\section{#1}},
    headingThree = {\subsection{#1}},
    headingFour = {\subsubsection{#1}},
    headingFive = {\paragraph{#1}\leavevmode},
    headingSix = {\subparagraph{#1}\leavevmode}}}
}%
```

3.3.4.1 Tickboxes

If the `taskLists` option is enabled, we will hide bullets in unordered list items with tickboxes.

```
\markdownSetup{
  rendererPrototypes = {
    ulItem = {%
      \futurelet\markdownLaTeXCheckbox\markdownLaTeXUlItem
    },
  },
}
\def\markdownLaTeXUlItem{%
  \ifx\markdownLaTeXCheckbox\markdownRendererTickedBox
    \item[\markdownLaTeXCheckbox]%
    \expandafter\@gobble
  \else
    \ifx\markdownLaTeXCheckbox\markdownRendererHalfTickedBox
      \item[\markdownLaTeXCheckbox]%
      \expandafter\expandafter\expandafter\@gobble
    \else
      \ifx\markdownLaTeXCheckbox\markdownRendererUntickedBox
        \item[\markdownLaTeXCheckbox]%
        \expandafter\expandafter\expandafter\expandafter
          \expandafter\expandafter\expandafter\@gobble
      \else
        \item{}%
      \fi
    \fi
  \fi
}
```

3.3.4.2 HTML elements

If the `html` option is enabled and we are using TEX4ht[9], we will pass HTML elements to the output HTML document unchanged.

```
\@ifundefined{HCode}{}{
  \markdownSetup{
    rendererPrototypes = {
      inlineHtmlTag = {%
```

[9] See https://tug.org/tex4ht/.

```
        \ifvmode
          \IgnorePar
          \EndP
        \fi
        \HCode{#1}%
      },
      inputBlockHtmlElement = {%
        \ifvmode
          \IgnorePar
        \fi
        \EndP
        \special{t4ht*<#1}%
        \par
        \ShowPar
      },
    },
  }
}
```

3.3.4.3 Citations

Here is a basic implementation for citations that uses the LaTeX `\cite` macro. There are also implementations that use the natbib `\citep`, and `\citet` macros, and the BibLaTeX `\autocites` and `\textcites` macros. These implementations will be used, when the respective packages are loaded.

```
\newcount\markdownLaTeXCitationsCounter

% Basic implementation
\RequirePackage{gobble}
\def\markdownLaTeXBasicCitations#1#2#3#4#5#6{%
  \advance\markdownLaTeXCitationsCounter by 1\relax
  \ifx\relax#4\relax
    \ifx\relax#5\relax
      \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
        \cite{#1#2#6}%  Without prenotes and postnotes, just accumulate cites
        \expandafter\expandafter\expandafter
        \expandafter\expandafter\expandafter\expandafter
        \@gobblethree
      \fi
    \else%  Before a postnote (#5), dump the accumulator
      \ifx\relax#1\relax\else
        \cite{#1}%
      \fi
      \cite[#5]{#6}%
      \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
      \else
        \expandafter\expandafter\expandafter
        \expandafter\expandafter\expandafter\expandafter
```

```
        \expandafter\expandafter\expandafter
        \expandafter\expandafter\expandafter\expandafter
        \markdownLaTeXBasicCitations
      \fi
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter{%
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter}%
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter{%
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter}%
      \expandafter\expandafter\expandafter
      \@gobblethree
    \fi
  \else%  Before a prenote (#4), dump the accumulator
    \ifx\relax#1\relax\else
      \cite{#1}%
    \fi
    \ifnum\markdownLaTeXCitationsCounter>1\relax
      \space  % Insert a space before the prenote in later citations
    \fi
    #4~\expandafter\cite\ifx\relax#5\relax{#6}\else[#5]{#6}\fi
    \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
    \else
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter
      \markdownLaTeXBasicCitations
    \fi
    \expandafter\expandafter\expandafter{%
    \expandafter\expandafter\expandafter}%
    \expandafter\expandafter\expandafter{%
    \expandafter\expandafter\expandafter}%
    \expandafter
    \@gobblethree
  \fi\markdownLaTeXBasicCitations{#1#2#6},}
\let\markdownLaTeXBasicTextCitations\markdownLaTeXBasicCitations

% Natbib implementation
\def\markdownLaTeXNatbibCitations#1#2#3#4#5{%
  \advance\markdownLaTeXCitationsCounter by 1\relax
  \ifx\relax#3\relax
    \ifx\relax#4\relax
      \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
        \citep{#1,#5}%  Without prenotes and postnotes, just accumulate cites
        \expandafter\expandafter\expandafter
        \expandafter\expandafter\expandafter\expandafter
```

```
        \@gobbletwo
      \fi
    \else%  Before a postnote (#4), dump the accumulator
      \ifx\relax#1\relax\else
        \citep{#1}%
      \fi
      \citep[][#4]{#5}%
      \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
      \else
        \expandafter\expandafter\expandafter
        \expandafter\expandafter\expandafter\expandafter
        \expandafter\expandafter\expandafter
        \expandafter\expandafter\expandafter\expandafter
        \markdownLaTeXNatbibCitations
      \fi
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter{%
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter}%
      \expandafter\expandafter\expandafter
      \@gobbletwo
    \fi
  \else%  Before a prenote (#3), dump the accumulator
    \ifx\relax#1\relax\relax\else
      \citep{#1}%
    \fi
    \citep[#3][#4]{#5}%
    \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
    \else
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter
      \markdownLaTeXNatbibCitations
    \fi
    \expandafter\expandafter\expandafter{%
    \expandafter\expandafter\expandafter}%
    \expandafter
    \@gobbletwo
  \fi\markdownLaTeXNatbibCitations{#1,#5}}
\def\markdownLaTeXNatbibTextCitations#1#2#3#4#5{%
  \advance\markdownLaTeXCitationsCounter by 1\relax
  \ifx\relax#3\relax
    \ifx\relax#4\relax
      \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
        \citet{#1,#5}%  Without prenotes and postnotes, just accumulate cites
        \expandafter\expandafter\expandafter
        \expandafter\expandafter\expandafter\expandafter
        \@gobbletwo
```

```
      \fi
    \else%  After a prenote or a postnote, dump the accumulator
      \ifx\relax#1\relax\else
        \citet{#1}%
      \fi
      , \citet[#3][#4]{#5}%
      \ifnum\markdownLaTeXCitationsCounter<\markdownLaTeXCitationsTotal\relax
        ,
      \else
        \ifnum\markdownLaTeXCitationsCounter=\markdownLaTeXCitationsTotal\relax
          ,
        \fi
      \fi
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter
      \markdownLaTeXNatbibTextCitations
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter{%
      \expandafter\expandafter\expandafter
      \expandafter\expandafter\expandafter\expandafter}%
      \expandafter\expandafter\expandafter
      \@gobbletwo
    \fi
  \else%  After a prenote or a postnote, dump the accumulator
    \ifx\relax#1\relax\relax\else
      \citet{#1}%
    \fi
    , \citet[#3][#4]{#5}%
    \ifnum\markdownLaTeXCitationsCounter<\markdownLaTeXCitationsTotal\relax
      ,
    \else
      \ifnum\markdownLaTeXCitationsCounter=\markdownLaTeXCitationsTotal\relax
        ,
      \fi
    \fi
    \expandafter\expandafter\expandafter
    \markdownLaTeXNatbibTextCitations
    \expandafter\expandafter\expandafter{%
    \expandafter\expandafter\expandafter}%
    \expandafter
    \@gobbletwo
  \fi\markdownLaTeXNatbibTextCitations{#1,#5}}

% BibLaTeX implementation
\def\markdownLaTeXBibLaTeXCitations#1#2#3#4#5{%
  \advance\markdownLaTeXCitationsCounter by 1\relax
  \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
```

```
    \autocites#1[#3][#4]{#5}%
    \expandafter\@gobbletwo
  \fi\markdownLaTeXBibLaTeXCitations{#1[#3][#4]{#5}}}
\def\markdownLaTeXBibLaTeXTextCitations#1#2#3#4#5{%
  \advance\markdownLaTeXCitationsCounter by 1\relax
  \ifnum\markdownLaTeXCitationsCounter>\markdownLaTeXCitationsTotal\relax
    \textcites#1[#3][#4]{#5}%
    \expandafter\@gobbletwo
  \fi\markdownLaTeXBibLaTeXTextCitations{#1[#3][#4]{#5}}}

\markdownSetup{rendererPrototypes = {
  cite = {%
    \markdownLaTeXCitationsCounter=1%
    \def\markdownLaTeXCitationsTotal{#1}%
    \@ifundefined{autocites}{%
      \@ifundefined{citep}{%
        \expandafter\expandafter\expandafter
        \markdownLaTeXBasicCitations
        \expandafter\expandafter\expandafter{%
        \expandafter\expandafter\expandafter}%
        \expandafter\expandafter\expandafter{%
        \expandafter\expandafter\expandafter}%
      }{%
        \expandafter\expandafter\expandafter
        \markdownLaTeXNatbibCitations
        \expandafter\expandafter\expandafter{%
        \expandafter\expandafter\expandafter}%
      }%
    }{%
      \expandafter\expandafter\expandafter
      \markdownLaTeXBibLaTeXCitations
      \expandafter{\expandafter}%
    }},
  textCite = {%
    \markdownLaTeXCitationsCounter=1%
    \def\markdownLaTeXCitationsTotal{#1}%
    \@ifundefined{autocites}{%
      \@ifundefined{citep}{%
        \expandafter\expandafter\expandafter
        \markdownLaTeXBasicTextCitations
        \expandafter\expandafter\expandafter{%
        \expandafter\expandafter\expandafter}%
        \expandafter\expandafter\expandafter{%
        \expandafter\expandafter\expandafter}%
      }{%
        \expandafter\expandafter\expandafter
        \markdownLaTeXNatbibTextCitations
```

```
        \expandafter\expandafter\expandafter{%
        \expandafter\expandafter\expandafter}%
      }%
    }{%
      \expandafter\expandafter\expandafter
      \markdownLaTeXBibLaTeXTextCitations
      \expandafter{\expandafter}%
    }}}}
```

3.3.4.4 Links

Before consuming the parameters for the hyperlink renderer, we change the category code of the hash sign (#) to other, so that it cannot be mistaken for a parameter character.

```
\RequirePackage{url}
\RequirePackage{expl3}
\ExplSyntaxOn
\def\markdownRendererLinkPrototype{
  \begingroup
  \catcode`\#=12
  \def\next##1##2##3##4{
    \endgroup
```

If the label and the fully-escaped URI are equivalent and the title is empty, assume that the link is an autolink. Otherwise, assume that the link is either direct or indirect.

```
    \tl_set:Nn \l_tmpa_tl { ##1 }
    \tl_set:Nn \l_tmpb_tl { ##2 }
    \bool_set:Nn
      \l_tmpa_bool
      {
        \tl_if_eq_p:NN
          \l_tmpa_tl
          \l_tmpb_tl
      }
    \tl_set:Nn \l_tmpa_tl { ##4 }
    \bool_set:Nn
      \l_tmpb_bool
      {
        \tl_if_empty_p:N
          \l_tmpa_tl
      }
    \bool_if:nTF
      {
        \l_tmpa_bool && \l_tmpb_bool
      }
      {
        \markdownLaTeXRendererAutolink { ##2 } { ##3 }
```

```
      }{
        \markdownLaTeXRendererDirectOrIndirectLink { ##1 } { ##2 } { ##3 } { ##4 }
      }
  }
  \next
}
\def\markdownLaTeXRendererAutolink#1#2{%
```

If the URL begins with a hash sign, then we assume that it is a relative reference. Otherwise, we assume that it is an absolute URL.

```
  \tl_set:Nn
    \l_tmpa_tl
    { #2 }
  \tl_trim_spaces:N
    \l_tmpa_tl
  \tl_set:Nx
    \l_tmpb_tl
    {
      \tl_range:Nnn
        \l_tmpa_tl
        { 1 }
        { 1 }
    }
  \str_if_eq:NNTF
    \l_tmpb_tl
    \c_hash_str
    {
      \tl_set:Nx
        \l_tmpb_tl
        {
          \tl_range:Nnn
            \l_tmpa_tl
            { 2 }
            { -1 }
        }
      \exp_args:NV
        \ref
        \l_tmpb_tl
    }{
      \url { #2 }
    }
}
\ExplSyntaxOff
\def\markdownLaTeXRendererDirectOrIndirectLink#1#2#3#4{%
  #1\footnote{\ifx\empty#4\empty\else#4: \fi\url{#3}}}
```

3.3.4.5 Tables

Here is a basic implementation of tables. If the booktabs package is loaded, then it is used to produce horizontal lines.

```
\newcount\markdownLaTeXRowCounter
\newcount\markdownLaTeXRowTotal
\newcount\markdownLaTeXColumnCounter
\newcount\markdownLaTeXColumnTotal
\newtoks\markdownLaTeXTable
\newtoks\markdownLaTeXTableAlignment
\newtoks\markdownLaTeXTableEnd
\AtBeginDocument{%
  \@ifpackageloaded{booktabs}{%
    \def\markdownLaTeXTopRule{\toprule}%
    \def\markdownLaTeXMidRule{\midrule}%
    \def\markdownLaTeXBottomRule{\bottomrule}%
  }{%
    \def\markdownLaTeXTopRule{\hline}%
    \def\markdownLaTeXMidRule{\hline}%
    \def\markdownLaTeXBottomRule{\hline}%
  }%
}
\markdownSetup{rendererPrototypes={
  table = {%
    \markdownLaTeXTable={}%
    \markdownLaTeXTableAlignment={}%
    \markdownLaTeXTableEnd={%
      \markdownLaTeXBottomRule
      \end{tabular}}%
    \ifx\empty#1\empty\else
      \addto@hook\markdownLaTeXTable{%
        \begin{table}
        \centering}%
      \addto@hook\markdownLaTeXTableEnd{%
        \caption{#1}
        \end{table}}%
    \fi
    \addto@hook\markdownLaTeXTable{\begin{tabular}}%
    \markdownLaTeXRowCounter=0%
    \markdownLaTeXRowTotal=#2%
    \markdownLaTeXColumnTotal=#3%
    \markdownLaTeXRenderTableRow
  }
}}
\def\markdownLaTeXRenderTableRow#1{%
  \markdownLaTeXColumnCounter=0%
  \ifnum\markdownLaTeXRowCounter=0\relax
    \markdownLaTeXReadAlignments#1%
    \markdownLaTeXTable=\expandafter\expandafter\expandafter{%
```

```
      \expandafter\the\expandafter\markdownLaTeXTable\expandafter{%
        \the\markdownLaTeXTableAlignment}}%
    \addto@hook\markdownLaTeXTable{\markdownLaTeXTopRule}%
  \else
    \markdownLaTeXRenderTableCell#1%
  \fi
  \ifnum\markdownLaTeXRowCounter=1\relax
    \addto@hook\markdownLaTeXTable\markdownLaTeXMidRule
  \fi
  \advance\markdownLaTeXRowCounter by 1\relax
  \ifnum\markdownLaTeXRowCounter>\markdownLaTeXRowTotal\relax
    \the\markdownLaTeXTable
    \the\markdownLaTeXTableEnd
    \expandafter\@gobble
  \fi\markdownLaTeXRenderTableRow}
\def\markdownLaTeXReadAlignments#1{%
  \advance\markdownLaTeXColumnCounter by 1\relax
  \if#1d%
    \addto@hook\markdownLaTeXTableAlignment{l}%
  \else
    \addto@hook\markdownLaTeXTableAlignment{#1}%
  \fi
  \ifnum\markdownLaTeXColumnCounter<\markdownLaTeXColumnTotal\relax\else
    \expandafter\@gobble
  \fi\markdownLaTeXReadAlignments}
\def\markdownLaTeXRenderTableCell#1{%
  \advance\markdownLaTeXColumnCounter by 1\relax
  \ifnum\markdownLaTeXColumnCounter<\markdownLaTeXColumnTotal\relax
    \addto@hook\markdownLaTeXTable{#1&}%
  \else
    \addto@hook\markdownLaTeXTable{#1\\}%
    \expandafter\@gobble
  \fi\markdownLaTeXRenderTableCell}
\fi
```

3.3.4.6 YAML Metadata

The default setup of YAML metadata will invoke the `\title`, `\author`, and `\date` macros when scalar values for keys that correspond to the `title`, `author`, and `date` relative wildcards are encountered, respectively.

```
\ExplSyntaxOn
\keys_define:nn
  { markdown/jekyllData }
  {
    author  .code:n = { \author{#1} },
    date    .code:n = { \date{#1}   },
    title   .code:n = { \title{#1}  },
  }
```

To complement the default setup of our key–values, we will use the `\maketitle` macro to typeset the title page of a document at the end of YAML metadata. If we are in the preamble, we will wait macro until after the beginning of the document. Otherwise, we will use the `\maketitle` macro straight away.

```
% TODO: Remove the command definition in TeX Live 2021.
\providecommand\IfFormatAtLeastTF{\@ifl@t@r\fmtversion}
\markdownSetup{
  rendererPrototypes = {
    jekyllDataEnd = {
%     TODO: Remove the else branch in TeX Live 2021.
      \IfFormatAtLeastTF
        { 2020-10-01 }
        { \AddToHook{begindocument/end}{\maketitle} }
        {
          \ifx\@onlypreamble\@notprerr
            % We are in the document
            \maketitle
          \else
            % We are in the preamble
            \RequirePackage{etoolbox}
            \AfterEndPreamble{\maketitle}
          \fi
        }
    },
  },
}
\ExplSyntaxOff
```

3.3.4.7 Strike-Through

If the `strikeThrough` option is enabled, we will load the soulutf8 package and use it to implement strike-throughs.

```
\markdownIfOption{strikeThrough}{%
  \RequirePackage{soulutf8}%
  \markdownSetup{
    rendererPrototypes = {
      strikeThrough = {%
        \st{#1}%
      },
    }
  }
}{}
```

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.

When buffering user input, we should disable the bytes with the high bit set, since these are made active by the `\enableregime` macro. We will do this by redefining the `\markdownMakeOther` macro accordingly. The code is courtesy of Scott Pakin, the creator of the filecontents LATEX package.

```
\def\markdownMakeOther{%
  \count0=128\relax
  \loop
    \catcode\count0=11\relax
    \advance\count0 by 1\relax
  \ifnum\count0<256\repeat
```

On top of that, make the pipe character (`|`) inactive during the scanning. This is necessary, since the character is active in ConTEXt.

```
  \catcode`|=12}%
```

3.4.1 Typesetting Markdown

The `\inputmarkdown` is defined to accept an optional argument with options recognized by the ConTEXt interface (see Section 2.4.2).

```
\long\def\inputmarkdown{%
  \dosingleempty
  \doinputmarkdown}%
\long\def\doinputmarkdown[#1]#2{%
  \begingroup
    \iffirstargument
      \setupmarkdown{#1}%
    \fi
    \markdownInput{#2}%
  \endgroup}%
```

The `\startmarkdown` and `\stopmarkdown` macros are implemented using the `\markdownReadAndConvert` macro.

In Knuth's TEX, trailing spaces are removed very early on when a line is being put to the input buffer. [11, sec. 31]. According to Eijkhout [12, sec. 2.2], this is because "these spaces are hard to see in an editor". At the moment, there is no option to suppress this behavior in (Lua)TEX, but ConTEXt MkIV funnels all input through its own input handler. This makes it possible to suppress the removal of trailing spaces in ConTEXt MkIV and therefore to insert hard line breaks into markdown text.

```
\ifx\startluacode\undefined  % MkII
  \begingroup
    \catcode`\|=0%
    \catcode`\\=12%
    |gdef|startmarkdown{%
      |markdownReadAndConvert{\stopmarkdown}%
                             {|stopmarkdown}}%
    |gdef|stopmarkdown{%
      |markdownEnd}%
  |endgroup
\else  % MkIV
  \startluacode
    document.markdown_buffering = false
    local function preserve_trailing_spaces(line)
      if document.markdown_buffering then
        line = line:gsub("[ \t][ \t]$", "\t\t")
      end
      return line
    end
    resolvers.installinputlinehandler(preserve_trailing_spaces)
  \stopluacode
  \begingroup
    \catcode`\|=0%
    \catcode`\\=12%
    |gdef|startmarkdown{%
      |ctxlua{document.markdown_buffering = true}%
      |markdownReadAndConvert{\stopmarkdown}%
                             {|stopmarkdown}}%
    |gdef|stopmarkdown{%
      |ctxlua{document.markdown_buffering = false}%
      |markdownEnd}%
  |endgroup
\fi
```

3.4.2 Token Renderer Prototypes

The following configuration should be considered placeholder.

```
\def\markdownRendererLineBreakPrototype{\blank}%
```

```
\def\markdownRendererLeftBracePrototype{\textbraceleft}%
\def\markdownRendererRightBracePrototype{\textbraceright}%
\def\markdownRendererDollarSignPrototype{\textdollar}%
\def\markdownRendererPercentSignPrototype{\percent}%
\def\markdownRendererUnderscorePrototype{\textunderscore}%
\def\markdownRendererCircumflexPrototype{\textcircumflex}%
\def\markdownRendererBackslashPrototype{\textbackslash}%
\def\markdownRendererTildePrototype{\textasciitilde}%
\def\markdownRendererPipePrototype{\char`|}%
\def\markdownRendererLinkPrototype#1#2#3#4{%
  \useURL[#1][#3][][#4]#1\footnote[#1]{\ifx\empty#4\empty\else#4:
  \fi\tt<\hyphenatedurl{#3}>}}%
\usemodule[database]
\defineseparatedlist
  [MarkdownConTeXtCSV]
  [separator={,},
   before=\bTABLE,after=\eTABLE,
   first=\bTR,last=\eTR,
   left=\bTD,right=\eTD]
\def\markdownConTeXtCSV{csv}
\def\markdownRendererContentBlockPrototype#1#2#3#4{%
  \def\markdownConTeXtCSV@arg{#1}%
  \ifx\markdownConTeXtCSV@arg\markdownConTeXtCSV
    \placetable[][tab:#1]{#4}{%
      \processseparatedfile[MarkdownConTeXtCSV][#3]}%
  \else
    \markdownInput{#3}%
  \fi}%
\def\markdownRendererImagePrototype#1#2#3#4{%
  \placefigure[][]{#4}{\externalfigure[#3]}}%
\def\markdownRendererUlBeginPrototype{\startitemize}%
\def\markdownRendererUlBeginTightPrototype{\startitemize[packed]}%
\def\markdownRendererUlItemPrototype{\item}%
\def\markdownRendererUlEndPrototype{\stopitemize}%
\def\markdownRendererUlEndTightPrototype{\stopitemize}%
\def\markdownRendererOlBeginPrototype{\startitemize[n]}%
\def\markdownRendererOlBeginTightPrototype{\startitemize[packed,n]}%
\def\markdownRendererOlItemPrototype{\item}%
\def\markdownRendererOlItemWithNumberPrototype#1{\sym{#1.}}%
\def\markdownRendererOlEndPrototype{\stopitemize}%
\def\markdownRendererOlEndTightPrototype{\stopitemize}%
\definedescription
  [MarkdownConTeXtDlItemPrototype]
  [location=hanging,
   margin=standard,
   headstyle=bold]%
\definestartstop
```

```
  [MarkdownConTeXtDlPrototype]
  [before=\blank,
   after=\blank]%
\definestartstop
  [MarkdownConTeXtDlTightPrototype]
  [before=\blank\startpacked,
   after=\stoppacked\blank]%
\def\markdownRendererDlBeginPrototype{%
  \startMarkdownConTeXtDlPrototype}%
\def\markdownRendererDlBeginTightPrototype{%
  \startMarkdownConTeXtDlTightPrototype}%
\def\markdownRendererDlItemPrototype#1{%
  \startMarkdownConTeXtDlItemPrototype{#1}}%
\def\markdownRendererDlItemEndPrototype{%
  \stopMarkdownConTeXtDlItemPrototype}%
\def\markdownRendererDlEndPrototype{%
  \stopMarkdownConTeXtDlPrototype}%
\def\markdownRendererDlEndTightPrototype{%
  \stopMarkdownConTeXtDlTightPrototype}%
\def\markdownRendererEmphasisPrototype#1{{\em#1}}%
\def\markdownRendererStrongEmphasisPrototype#1{{\bf#1}}%
\def\markdownRendererBlockQuoteBeginPrototype{\startquotation}%
\def\markdownRendererBlockQuoteEndPrototype{\stopquotation}%
\def\markdownRendererInputVerbatimPrototype#1{\typefile{#1}}%
\def\markdownRendererInputFencedCodePrototype#1#2{%
  \ifx\relax#2\relax
    \typefile{#1}%
  \else
```

The code fence infostring is used as a name from the ConTEXt `\definetyping` macro. This allows the user to set up code highlighting mapping as follows:

```
\definetyping [latex]
\setuptyping  [latex] [option=TEX]

\starttext
  \startmarkdown
~~~ latex
\documentclass{article}
\begin{document}
  Hello world!
\end{document}
~~~
  \stopmarkdown
\stoptext
```

```
    \typefile[#2][]{#1}%
  \fi}%
\def\markdownRendererHeadingOnePrototype#1{\chapter{#1}}%
\def\markdownRendererHeadingTwoPrototype#1{\section{#1}}%
\def\markdownRendererHeadingThreePrototype#1{\subsection{#1}}%
\def\markdownRendererHeadingFourPrototype#1{\subsubsection{#1}}%
\def\markdownRendererHeadingFivePrototype#1{\subsubsubsection{#1}}%
\def\markdownRendererHeadingSixPrototype#1{\subsubsubsubsection{#1}}%
\def\markdownRendererHorizontalRulePrototype{%
  \blackrule[height=1pt, width=\hsize]}%
\def\markdownRendererFootnotePrototype#1{\footnote{#1}}%
\def\markdownRendererTickedBoxPrototype{$\boxtimes$}
\def\markdownRendererHalfTickedBoxPrototype{$\boxdot$}
\def\markdownRendererUntickedBoxPrototype{$\square$}
\def\markdownRendererStrikeThroughPrototype#1{\overstrikes{#1}}
\def\markdownRendererSuperscriptPrototype#1{\high{#1}}
\def\markdownRendererSubscriptPrototype#1{\low{#1}}
```

3.4.2.1 Tables

There is a basic implementation of tables.

```
\newcount\markdownConTeXtRowCounter
\newcount\markdownConTeXtRowTotal
\newcount\markdownConTeXtColumnCounter
\newcount\markdownConTeXtColumnTotal
\newtoks\markdownConTeXtTable
\newtoks\markdownConTeXtTableFloat
\def\markdownRendererTablePrototype#1#2#3{%
  \markdownConTeXtTable={}%
  \ifx\empty#1\empty
    \markdownConTeXtTableFloat={%
      \the\markdownConTeXtTable}%
  \else
    \markdownConTeXtTableFloat={%
      \placetable{#1}{\the\markdownConTeXtTable}}%
  \fi
  \begingroup
  \setupTABLE[r][each][topframe=off, bottomframe=off, leftframe=off, rightframe=off]
  \setupTABLE[c][each][topframe=off, bottomframe=off, leftframe=off, rightframe=off]
  \setupTABLE[r][1][topframe=on, bottomframe=on]
  \setupTABLE[r][#1][bottomframe=on]
  \markdownConTeXtRowCounter=0%
  \markdownConTeXtRowTotal=#2%
  \markdownConTeXtColumnTotal=#3%
  \markdownConTeXtRenderTableRow}
\def\markdownConTeXtRenderTableRow#1{%
  \markdownConTeXtColumnCounter=0%
  \ifnum\markdownConTeXtRowCounter=0\relax
```

```
    \markdownConTeXtReadAlignments#1%
    \markdownConTeXtTable={\bTABLE}%
  \else
    \markdownConTeXtTable=\expandafter{%
      \the\markdownConTeXtTable\bTR}%
    \markdownConTeXtRenderTableCell#1%
    \markdownConTeXtTable=\expandafter{%
      \the\markdownConTeXtTable\eTR}%
  \fi
  \advance\markdownConTeXtRowCounter by 1\relax
  \ifnum\markdownConTeXtRowCounter>\markdownConTeXtRowTotal\relax
    \markdownConTeXtTable=\expandafter{%
      \the\markdownConTeXtTable\eTABLE}%
    \the\markdownConTeXtTableFloat
    \endgroup
    \expandafter\gobbleoneargument
  \fi\markdownConTeXtRenderTableRow}
\def\markdownConTeXtReadAlignments#1{%
  \advance\markdownConTeXtColumnCounter by 1\relax
  \if#1d%
    \setupTABLE[c][\the\markdownConTeXtColumnCounter][align=right]
  \fi\if#1l%
    \setupTABLE[c][\the\markdownConTeXtColumnCounter][align=right]
  \fi\if#1c%
    \setupTABLE[c][\the\markdownConTeXtColumnCounter][align=middle]
  \fi\if#1r%
    \setupTABLE[c][\the\markdownConTeXtColumnCounter][align=left]
  \fi
  \ifnum\markdownConTeXtColumnCounter<\markdownConTeXtColumnTotal\relax\else
    \expandafter\gobbleoneargument
  \fi\markdownConTeXtReadAlignments}
\def\markdownConTeXtRenderTableCell#1{%
  \advance\markdownConTeXtColumnCounter by 1\relax
  \markdownConTeXtTable=\expandafter{%
    \the\markdownConTeXtTable\bTD#1\eTD}%
  \ifnum\markdownConTeXtColumnCounter<\markdownConTeXtColumnTotal\relax\else
    \expandafter\gobbleoneargument
  \fi\markdownConTeXtRenderTableCell}
\stopmodule\protect
```

References

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[3] Anton Sotkov. *File transclusion syntax for Markdown*. Jan. 19, 2017. URL: https://github.com/iainc/Markdown-Content-Blocks (visited on 01/08/2018).

[4] Donald Ervin Knuth. *The TEXbook*. 3rd ed. Vol. A. Computers & Typesetting. Reading, MA: Addison-Wesley, 1986. ix, 479. ISBN: 0-201-13447-0.

[5] Frank Mittelbach. *The `doc` and `shortvrb` Packages*. Apr. 15, 2017. URL: https://mirrors.ctan.org/macros/latex/base/doc.pdf (visited on 02/19/2018).

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[11] Donald Ervin Knuth. *TEX: The Program*. Vol. B. Computers & Typesetting. Reading, MA: Addison-Wesley, 1986. xvi, 594. ISBN: 0-201-13437-7.

[12] Victor Eijkhout. *TEX by Topic. A TEXnician's Reference*. Wokingham, England: Addison-Wesley, Feb. 1, 1992. 307 pp. ISBN: 0-201-56882-0.

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