

Unicode declarations for L^AT_EX documents.

Mark Armstrong

May 25, 2020

Contents

1	About this file	1
1.1	Usage	2
1.2	Required L ^A T _E X packages	2
1.3	Contributing to this document	3
1.4	The Emacs Lisp script	4
2	Blackboard, Calligraphic, and Bold-font	4
2.1	Blackboard	4
2.1.1	Lowercase Latin	4
2.1.2	Uppercase latin	7
2.1.3	TODO Arabic numerals	8
2.1.4	Greek	10
2.2	Calligraphic	10
2.2.1	Lowercase Latin	10
2.2.2	Uppercase Latin	14
2.3	Bold-font	15
2.3.1	Lowercase Latin	15
2.3.2	Uppercase Latin	15

1 About this file

In order to write L^AT_EX documents using unicode in the source code, we must often tell L^AT_EX what we want the unicode characters to be rendered as.

There are at least two ways to inform L^AT_EX of unicode character translations;

- `\DeclareUnicodeCharacter`; this command does not work with XeLaTeX or LuaLaTeX, which I use.

- `\newunicodechar`; this command is provided by the `newunicodechar` package, which may not be pre-installed for all \LaTeX users.

This collection uses the second.

1.1 Usage

This file generates (via Org Babel tangling) the file `unicode.sty`.

To use it, either place it in the same directory as your `.tex` file, and require it via `\usepackage{unicode}`.

Alternatively, place it in your `texmf` directory to allow global usage on your system. That directory is commonly located at the following locations on various OS's.

- Linux
 - `~/texmf/tex/latex/local/`
- Mac OS X
 - `/Users/<user name>/Library/texmf/tex/latex/local/`
- Windows 10 (and miktex)
 - `C:\Users\<user name>\Appdata\Local\MikTeX\<number>\tex\latex\local\`
- Windows Vista/7
 - `C:\Users\<user name>\texmf\tex\latex\local\`
- Windows XP
 - `C:\Documents and Settings\<user name>\texmf\tex\latex\local\`

By default, we assume the standard `pdf \LaTeX` typesetting engine is used, if you are using XeLaTeX or LuaLaTeX, then simply declare:

```
\pdf $\text{\LaTeX}$ false
```

1.2 Required \LaTeX packages

Of course we require the `newunicodechar` package to use that command.

```

\usepackage{newunicodechar}

\usepackage{ifxetex, ifluatex} % Also used in agda.sty: xifthen

% https://tex.stackexchange.com/questions/47576/combining-ifxetex-and-ifluatex-with-the
\newif\ifpdflatex
\ifxetex
  \pdflatexfalse
\else
  \ifluatex
    \pdflatexfalse
  \else
    \pdflatextrue
  \fi
\fi

%\newif\ifpdflatex
%\pdflatextrue
%% To use other typesetting engines, declare the following:
%% \pdflatexfalse

```

The unicode-math package “provides a complete implementation of unicode maths for XeLaTeX and LuaLaTeX”.

```

\ifpdflatex
  \usepackage{pifont}
  \usepackage{stmaryrd}
  \usepackage{amsmath, amssymb, amsthm, latexsym, amscd, enumerate, bbm, etex, nicefrac}
\else
  \usepackage{unicode-math}
\fi

```

1.3 Contributing to this document

This document is written in Emacs using Org mode. While the exported PDF version, etc., show a collection of L^AT_EX source blocks, these are in fact generated by an Emacs Lisp script below.

That means that contributions to this document should modify the Emacs Lisp script, not `unicode.sty` or the L^AT_EX source blocks themselves.

1.4 The Emacs Lisp script

In this document, several lists of unicode character, L^AT_EX translation pairs are declared, and then “wrapped” into `latex` source blocks, using this function to map the pairs into `newunicodechar` declarations.

```
generate-newunicodechars
```

2 Blackboard, Calligraphic, and Bold-font

These lists are most likely complete, unless I have missed some characters aside from Latin letters, Greek letters and Arabic numerals which should be included.

For Agda users, the unicode symbols may be entered using the following sequences:

Blackboard	<code>\bx</code>
Calligraphic	<code>\MCx</code>
Bold-font	<code>\MIx</code>

2.1 Blackboard

2.1.1 Lowercase Latin

```
\ifpdflatex
  \newunicodechar{a}{\ensuremath{\mathbbm{a}}}
\else
  \newunicodechar{a}{\ensuremath{\mathbb{a}}}
\fi
\ifpdflatex
  \newunicodechar{b}{\ensuremath{\mathbbm{b}}}
\else
  \newunicodechar{b}{\ensuremath{\mathbb{b}}}
\fi
\ifpdflatex
  \newunicodechar{c}{\ensuremath{\mathbbm{c}}}
\else
  \newunicodechar{c}{\ensuremath{\mathbb{c}}}
\fi
\ifpdflatex
  \newunicodechar{d}{\ensuremath{\mathbbm{d}}}
\else
```

```

\newunicodechar{d}{\ensuremath{\mathbb{d}}}
\fi
\ifpdflatex
\newunicodechar{e}{\ensuremath{\mathbb{e}}}}
\else
\newunicodechar{e}{\ensuremath{\mathbb{e}}}}
\fi
\ifpdflatex
\newunicodechar{f}{\ensuremath{\mathbb{f}}}}
\else
\newunicodechar{f}{\ensuremath{\mathbb{f}}}}
\fi
\ifpdflatex
\newunicodechar{g}{\ensuremath{\mathbb{g}}}}
\else
\newunicodechar{g}{\ensuremath{\mathbb{g}}}}
\fi
\ifpdflatex
\newunicodechar{h}{\ensuremath{\mathbb{h}}}}
\else
\newunicodechar{h}{\ensuremath{\mathbb{h}}}}
\fi
\ifpdflatex
\newunicodechar{i}{\ensuremath{\mathbb{i}}}}
\else
\newunicodechar{i}{\ensuremath{\mathbb{i}}}}
\fi
\ifpdflatex
\newunicodechar{j}{\ensuremath{\mathbb{j}}}}
\else
\newunicodechar{j}{\ensuremath{\mathbb{j}}}}
\fi
\ifpdflatex
\newunicodechar{k}{\ensuremath{\mathbb{k}}}}
\else
\newunicodechar{k}{\ensuremath{\mathbb{k}}}}
\fi
\ifpdflatex
\newunicodechar{l}{\ensuremath{\mathbb{l}}}}
\else

```

```

\newunicodechar{ll}{\ensuremath{\mathbb{ll}}}
\fi
\ifpdflatex
\newunicodechar{m}{\ensuremath{\mathbb{m}}}
\else
\newunicodechar{m}{\ensuremath{\mathbb{m}}}
\fi
\ifpdflatex
\newunicodechar{n}{\ensuremath{\mathbb{n}}}
\else
\newunicodechar{n}{\ensuremath{\mathbb{n}}}
\fi
\ifpdflatex
\newunicodechar{o}{\ensuremath{\mathbb{o}}}
\else
\newunicodechar{o}{\ensuremath{\mathbb{o}}}
\fi
\ifpdflatex
\newunicodechar{p}{\ensuremath{\mathbb{p}}}
\else
\newunicodechar{p}{\ensuremath{\mathbb{p}}}
\fi
\ifpdflatex
\newunicodechar{q}{\ensuremath{\mathbb{q}}}
\else
\newunicodechar{q}{\ensuremath{\mathbb{q}}}
\fi
\ifpdflatex
\newunicodechar{r}{\ensuremath{\mathbb{r}}}
\else
\newunicodechar{r}{\ensuremath{\mathbb{r}}}
\fi
\ifpdflatex
\newunicodechar{s}{\ensuremath{\mathbb{s}}}
\else
\newunicodechar{s}{\ensuremath{\mathbb{s}}}
\fi
\ifpdflatex
\newunicodechar{t}{\ensuremath{\mathbb{t}}}
\else

```

```

\newunicodechar{t}{\ensuremath{\mathbb{t}}}
\fi
\ifpdflatex
\newunicodechar{u}{\ensuremath{\mathbbm{u}}}
\else
\newunicodechar{u}{\ensuremath{\mathbb{u}}}
\fi
\ifpdflatex
\newunicodechar{v}{\ensuremath{\mathbbm{v}}}
\else
\newunicodechar{v}{\ensuremath{\mathbb{v}}}
\fi
\ifpdflatex
\newunicodechar{w}{\ensuremath{\mathbbm{w}}}
\else
\newunicodechar{w}{\ensuremath{\mathbb{w}}}
\fi
\ifpdflatex
\newunicodechar{x}{\ensuremath{\mathbbm{x}}}
\else
\newunicodechar{x}{\ensuremath{\mathbb{x}}}
\fi
\ifpdflatex
\newunicodechar{y}{\ensuremath{\mathbbm{y}}}
\else
\newunicodechar{y}{\ensuremath{\mathbb{y}}}
\fi
\ifpdflatex
\newunicodechar{z}{\ensuremath{\mathbbm{z}}}
\else
\newunicodechar{z}{\ensuremath{\mathbb{z}}}
\fi

```

2.1.2 Uppercase latin

```

\newunicodechar{A}{\ensuremath{\mathbb{A}}}
\newunicodechar{B}{\ensuremath{\mathbb{B}}}
\newunicodechar{C}{\ensuremath{\mathbb{C}}}
\newunicodechar{D}{\ensuremath{\mathbb{D}}}
\newunicodechar{E}{\ensuremath{\mathbb{E}}}

```

```

\newunicodechar{F}{\ensuremath{\mathbb{F}}}
\newunicodechar{G}{\ensuremath{\mathbb{G}}}
\newunicodechar{H}{\ensuremath{\mathbb{H}}}
\newunicodechar{I}{\ensuremath{\mathbb{I}}}
\newunicodechar{J}{\ensuremath{\mathbb{J}}}
\newunicodechar{K}{\ensuremath{\mathbb{K}}}
\newunicodechar{L}{\ensuremath{\mathbb{L}}}
\newunicodechar{M}{\ensuremath{\mathbb{M}}}
\newunicodechar{N}{\ensuremath{\mathbb{N}}}
\newunicodechar{O}{\ensuremath{\mathbb{O}}}
\newunicodechar{P}{\ensuremath{\mathbb{P}}}
\newunicodechar{Q}{\ensuremath{\mathbb{Q}}}
\newunicodechar{R}{\ensuremath{\mathbb{R}}}
\newunicodechar{S}{\ensuremath{\mathbb{S}}}
\newunicodechar{T}{\ensuremath{\mathbb{T}}}
\newunicodechar{U}{\ensuremath{\mathbb{U}}}
\newunicodechar{V}{\ensuremath{\mathbb{V}}}
\newunicodechar{W}{\ensuremath{\mathbb{W}}}
\newunicodechar{X}{\ensuremath{\mathbb{X}}}
\newunicodechar{Y}{\ensuremath{\mathbb{Y}}}
\newunicodechar{Z}{\ensuremath{\mathbb{Z}}}

```

2.1.3 TODO Arabic numerals

```

% For double stroke digits with pdflatex
\usepackage[bbgreek1]{mathbbol}
\DeclareSymbolFontAlphabet{\mathbbl}{bbold}

\ifpdflatex
  \newunicodechar{1}{\ensuremath{\mathbbl{1}}}
\else
  \newunicodechar{1}{\ensuremath{\mathbb{1}}}
\fi
\ifpdflatex
  \newunicodechar{2}{\ensuremath{\mathbbl{2}}}
\else
  \newunicodechar{2}{\ensuremath{\mathbb{2}}}
\fi
\ifpdflatex
  \newunicodechar{3}{\ensuremath{\mathbbl{3}}}

```



```

\else
  \newunicodechar{3}{\ensuremath{\mathbb{3}}}
\fi
\ifpdflatex
  \newunicodechar{4}{\ensuremath{\mathbb{1}{4}}}
\else
  \newunicodechar{4}{\ensuremath{\mathbb{4}}}
\fi
\ifpdflatex
  \newunicodechar{5}{\ensuremath{\mathbb{1}{5}}}
\else
  \newunicodechar{5}{\ensuremath{\mathbb{5}}}
\fi
\ifpdflatex
  \newunicodechar{6}{\ensuremath{\mathbb{1}{6}}}
\else
  \newunicodechar{6}{\ensuremath{\mathbb{6}}}
\fi
\ifpdflatex
  \newunicodechar{7}{\ensuremath{\mathbb{1}{7}}}
\else
  \newunicodechar{7}{\ensuremath{\mathbb{7}}}
\fi
\ifpdflatex
  \newunicodechar{8}{\ensuremath{\mathbb{1}{8}}}
\else
  \newunicodechar{8}{\ensuremath{\mathbb{8}}}
\fi
\ifpdflatex
  \newunicodechar{9}{\ensuremath{\mathbb{1}{9}}}
\else
  \newunicodechar{9}{\ensuremath{\mathbb{9}}}
\fi
\ifpdflatex
  \newunicodechar{0}{\ensuremath{\mathbb{1}{0}}}
\else
  \newunicodechar{0}{\ensuremath{\mathbb{0}}}
\fi

```

2.1.4 Greek

```
%-----  
% Greek  
%-----
```

There are unfortunately not many included in Unicode.

```
\ifpdflatex  
  \newunicodechar{TODO}{\ensuremath{TODO}}  
\else  
  \newunicodechar{TODO}{\ensuremath{\mathbb{\Gamma}}}}  
\fi  
\ifpdflatex  
  \newunicodechar{TODO}{\ensuremath{TODO}}  
\else  
  \newunicodechar{TODO}{\ensuremath{\mathbb{\gamma}}}}  
\fi  
\ifpdflatex  
  \newunicodechar{TODO}{\ensuremath{TODO}}  
\else  
  \newunicodechar{TODO}{\ensuremath{\mathbb{\Pi}}}}  
\fi  
\ifpdflatex  
  \newunicodechar{TODO}{\ensuremath{TODO}}  
\else  
  \newunicodechar{TODO}{\ensuremath{\mathbb{\pi}}}}  
\fi  
\ifpdflatex  
  \newunicodechar{TODO}{\ensuremath{TODO}}  
\else  
  \newunicodechar{TODO}{\ensuremath{\mathbb{\Sigma}}}}  
\fi
```

2.2 Calligraphic

2.2.1 Lowercase Latin

```
%-----  
% Uppercase latin  
%-----
```

```

\ifpdflatex
  \newunicodechar{a}{\ensuremath{a}}
\else
  \newunicodechar{a}{\ensuremath{\mathcal{a}}}
\fi
\ifpdflatex
  \newunicodechar{b}{\ensuremath{b}}
\else
  \newunicodechar{b}{\ensuremath{\mathcal{b}}}
\fi
\ifpdflatex
  \newunicodechar{c}{\ensuremath{c}}
\else
  \newunicodechar{c}{\ensuremath{\mathcal{c}}}
\fi
\ifpdflatex
  \newunicodechar{d}{\ensuremath{d}}
\else
  \newunicodechar{d}{\ensuremath{\mathcal{d}}}
\fi
\ifpdflatex
  \newunicodechar{e}{\ensuremath{e}}
\else
  \newunicodechar{e}{\ensuremath{\mathcal{e}}}
\fi
\ifpdflatex
  \newunicodechar{f}{\ensuremath{f}}
\else
  \newunicodechar{f}{\ensuremath{\mathcal{f}}}
\fi
\ifpdflatex
  \newunicodechar{g}{\ensuremath{g}}
\else
  \newunicodechar{g}{\ensuremath{\mathcal{g}}}
\fi
\ifpdflatex
  \newunicodechar{h}{\ensuremath{h}}
\else
  \newunicodechar{h}{\ensuremath{\mathcal{h}}}
\fi

```

```

\ifpdflatex
  \newunicodechar{i}{\ensuremath{i}}
\else
  \newunicodechar{i}{\ensuremath{\mathcal{i}}}
\fi
\ifpdflatex
  \newunicodechar{j}{\ensuremath{j}}
\else
  \newunicodechar{j}{\ensuremath{\mathcal{j}}}
\fi
\ifpdflatex
  \newunicodechar{j}{\ensuremath{j}}
\else
  \newunicodechar{j}{\ensuremath{\mathcal{k}}}
\fi
\ifpdflatex
  \newunicodechar{l}{\ensuremath{l}}
\else
  \newunicodechar{l}{\ensuremath{\mathcal{l}}}
\fi
\ifpdflatex
  \newunicodechar{m}{\ensuremath{m}}
\else
  \newunicodechar{m}{\ensuremath{\mathcal{m}}}
\fi
\ifpdflatex
  \newunicodechar{n}{\ensuremath{n}}
\else
  \newunicodechar{n}{\ensuremath{\mathcal{n}}}
\fi
\ifpdflatex
  \newunicodechar{o}{\ensuremath{o}}
\else
  \newunicodechar{o}{\ensuremath{\mathcal{o}}}
\fi
\ifpdflatex
  \newunicodechar{p}{\ensuremath{p}}
\else
  \newunicodechar{p}{\ensuremath{\mathcal{p}}}
\fi

```

```

\ifpdflatex
  \newunicodechar{q}{\ensuremath{q}}
\else
  \newunicodechar{q}{\ensuremath{\mathcal{q}}}
\fi
\ifpdflatex
  \newunicodechar{r}{\ensuremath{r}}
\else
  \newunicodechar{r}{\ensuremath{\mathcal{r}}}
\fi
\ifpdflatex
  \newunicodechar{s}{\ensuremath{s}}
\else
  \newunicodechar{s}{\ensuremath{\mathcal{s}}}
\fi
\ifpdflatex
  \newunicodechar{t}{\ensuremath{t}}
\else
  \newunicodechar{t}{\ensuremath{\mathcal{t}}}
\fi
\ifpdflatex
  \newunicodechar{u}{\ensuremath{u}}
\else
  \newunicodechar{u}{\ensuremath{\mathcal{u}}}
\fi
\ifpdflatex
  \newunicodechar{v}{\ensuremath{v}}
\else
  \newunicodechar{v}{\ensuremath{\mathcal{v}}}
\fi
\ifpdflatex
  \newunicodechar{w}{\ensuremath{w}}
\else
  \newunicodechar{w}{\ensuremath{\mathcal{w}}}
\fi
\ifpdflatex
  \newunicodechar{x}{\ensuremath{x}}
\else
  \newunicodechar{x}{\ensuremath{\mathcal{x}}}
\fi

```

```

\ifpdflatex
  \newunicodechar{y}{\ensuremath{y}}
\else
  \newunicodechar{y}{\ensuremath{\mathcal{y}}}
\fi
\ifpdflatex
  \newunicodechar{z}{\ensuremath{z}}
\else
  \newunicodechar{z}{\ensuremath{\mathcal{z}}}
\fi

```

2.2.2 Uppercase Latin

```

%-----
% Uppercase latin
%-----

\newunicodechar{A}{\ensuremath{\mathcal{A}}}
\newunicodechar{B}{\ensuremath{\mathcal{B}}}
\newunicodechar{C}{\ensuremath{\mathcal{C}}}
\newunicodechar{D}{\ensuremath{\mathcal{D}}}
\newunicodechar{E}{\ensuremath{\mathcal{E}}}
\newunicodechar{F}{\ensuremath{\mathcal{F}}}
\newunicodechar{G}{\ensuremath{\mathcal{G}}}
\newunicodechar{H}{\ensuremath{\mathcal{H}}}
\newunicodechar{I}{\ensuremath{\mathcal{I}}}
\newunicodechar{J}{\ensuremath{\mathcal{J}}}
\newunicodechar{K}{\ensuremath{\mathcal{K}}}
\newunicodechar{L}{\ensuremath{\mathcal{L}}}
\newunicodechar{M}{\ensuremath{\mathcal{M}}}
\newunicodechar{N}{\ensuremath{\mathcal{N}}}
\newunicodechar{O}{\ensuremath{\mathcal{O}}}
\newunicodechar{P}{\ensuremath{\mathcal{P}}}
\newunicodechar{Q}{\ensuremath{\mathcal{Q}}}
\newunicodechar{R}{\ensuremath{\mathcal{R}}}
\newunicodechar{S}{\ensuremath{\mathcal{S}}}
\newunicodechar{T}{\ensuremath{\mathcal{T}}}
\newunicodechar{U}{\ensuremath{\mathcal{U}}}
\newunicodechar{V}{\ensuremath{\mathcal{V}}}
\newunicodechar{W}{\ensuremath{\mathcal{W}}}

```

```

\newunicodechar{\mathcal{X}}{\ensuremath{\mathcal{X}}}
\newunicodechar{\mathcal{Y}}{\ensuremath{\mathcal{Y}}}
\newunicodechar{\mathcal{Z}}{\ensuremath{\mathcal{Z}}}

```

2.3 Bold-font

2.3.1 Lowercase Latin

```

\newunicodechar{\mathbf{a}}{\ensuremath{\mathbf{a}}}
\newunicodechar{\mathbf{b}}{\ensuremath{\mathbf{b}}}
\newunicodechar{\mathbf{c}}{\ensuremath{\mathbf{c}}}
\newunicodechar{\mathbf{d}}{\ensuremath{\mathbf{d}}}
\newunicodechar{\mathbf{e}}{\ensuremath{\mathbf{e}}}
\newunicodechar{\mathbf{f}}{\ensuremath{\mathbf{f}}}
\newunicodechar{\mathbf{g}}{\ensuremath{\mathbf{g}}}
\newunicodechar{\mathbf{h}}{\ensuremath{\mathbf{h}}}
\newunicodechar{\mathbf{i}}{\ensuremath{\mathbf{i}}}
\newunicodechar{\mathbf{j}}{\ensuremath{\mathbf{j}}}
\newunicodechar{\mathbf{k}}{\ensuremath{\mathbf{k}}}
\newunicodechar{\mathbf{l}}{\ensuremath{\mathbf{l}}}
\newunicodechar{\mathbf{m}}{\ensuremath{\mathbf{m}}}
\newunicodechar{\mathbf{n}}{\ensuremath{\mathbf{n}}}
\newunicodechar{\mathbf{o}}{\ensuremath{\mathbf{o}}}
\newunicodechar{\mathbf{p}}{\ensuremath{\mathbf{p}}}
\newunicodechar{\mathbf{q}}{\ensuremath{\mathbf{q}}}
\newunicodechar{\mathbf{r}}{\ensuremath{\mathbf{r}}}
\newunicodechar{\mathbf{s}}{\ensuremath{\mathbf{s}}}
\newunicodechar{\mathbf{t}}{\ensuremath{\mathbf{t}}}
\newunicodechar{\mathbf{u}}{\ensuremath{\mathbf{u}}}
\newunicodechar{\mathbf{v}}{\ensuremath{\mathbf{v}}}
\newunicodechar{\mathbf{w}}{\ensuremath{\mathbf{w}}}
\newunicodechar{\mathbf{x}}{\ensuremath{\mathbf{x}}}
\newunicodechar{\mathbf{y}}{\ensuremath{\mathbf{y}}}
\newunicodechar{\mathbf{z}}{\ensuremath{\mathbf{z}}}

```

2.3.2 Uppercase Latin

```

\newunicodechar{\mathbf{A}}{\ensuremath{\mathbf{A}}}
\newunicodechar{\mathbf{B}}{\ensuremath{\mathbf{B}}}
\newunicodechar{\mathbf{C}}{\ensuremath{\mathbf{C}}}
\newunicodechar{\mathbf{D}}{\ensuremath{\mathbf{D}}}

```

```

\newunicodechar{E}{\ensuremath{\mathbf{E}}}
\newunicodechar{F}{\ensuremath{\mathbf{F}}}
\newunicodechar{G}{\ensuremath{\mathbf{G}}}
\newunicodechar{H}{\ensuremath{\mathbf{H}}}
\newunicodechar{I}{\ensuremath{\mathbf{I}}}
\newunicodechar{J}{\ensuremath{\mathbf{J}}}
\newunicodechar{K}{\ensuremath{\mathbf{K}}}
\newunicodechar{L}{\ensuremath{\mathbf{L}}}
\newunicodechar{M}{\ensuremath{\mathbf{M}}}
\newunicodechar{N}{\ensuremath{\mathbf{N}}}
\newunicodechar{O}{\ensuremath{\mathbf{O}}}
\newunicodechar{P}{\ensuremath{\mathbf{P}}}
\newunicodechar{Q}{\ensuremath{\mathbf{Q}}}
\newunicodechar{R}{\ensuremath{\mathbf{R}}}
\newunicodechar{S}{\ensuremath{\mathbf{S}}}
\newunicodechar{T}{\ensuremath{\mathbf{T}}}
\newunicodechar{U}{\ensuremath{\mathbf{U}}}
\newunicodechar{V}{\ensuremath{\mathbf{V}}}
\newunicodechar{W}{\ensuremath{\mathbf{W}}}
\newunicodechar{X}{\ensuremath{\mathbf{X}}}
\newunicodechar{Y}{\ensuremath{\mathbf{Y}}}
\newunicodechar{Z}{\ensuremath{\mathbf{Z}}}

```