LaTeX for Psychological Researchers

Lecture 2: Basics of the LaTeX language

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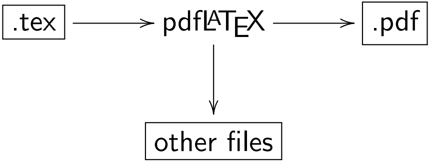
The LaTeX process



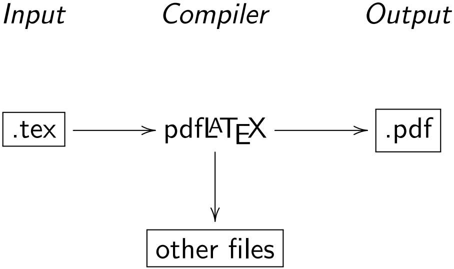
.tex

pdfLaTeX

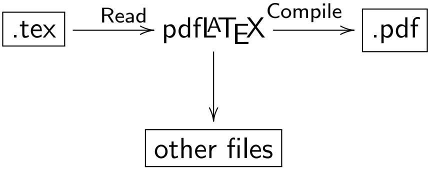
.pdf

other files

The LaTeX process



The LaTeX process



.tex

Read

pdfLaTeX

Compile

.pdf

other files

The LaTeX process

LaTeX refers to the *programming language* used to write the input file and the *program* used to interpret this file and compile the output file. It does **not** refer to an editor in which you write the input file.

For clarity, in this course LaTeX refers only to the language, the compiler is referred to as “the compiler” generally or pdfLaTeX specifically.

Hello World Example

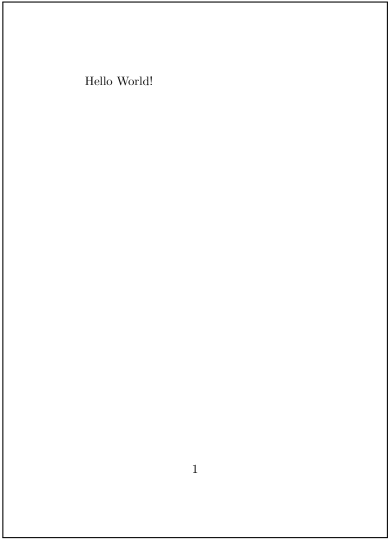
.tex file:

```latex
\documentclass{article}
\begin{document}

Hello World!

\end{document}
```

.pdf file:



Hello World!

1

LaTeX commands

A LaTeX document is mainly defined through **commands**. These generally take one of two formats:

- A backslash \ and then a name consisting of letters only. Command names are terminated by a space, a number or any other "non-letter"
- A backslash \ and exactly one non-letter

For example:

```
\int \alpha \beta \$ \& \[ \]
```

LaTeX commands

Some commands need an argument, which has to be given between curly braces { } after the command name (with some exceptions). Some commands support optional parameters, which are added after the command name in square brackets [ ]. The general syntax is:

```
\commandname[option1,option2,...]{argument1}{argument2}...
```

LaTeX Arguments

```
\commandname[option1, option2, ...]{argument1}{argument2}...
```

- Many commands require a single argument, and some commands require even multiple arguments
- Generally an argument is interpreted in one of three ways:
  - The text a command is applied to
    - `\textit{text to make italic}`
  - The mode or specification of a command
    - `\documentclass{classname}`
  - A name or title to be used for something
    - `\usepackage{packagename}`

LaTeX Options

\commandname[option 1, option 2, ...]{argument1}{argument 2}...

- Some commands can have several options
- Often optional
- Each option is a verbatim term of one of several mutually exclusive options
  - `\documentclass[a4paper,11pt]{article}`
  - `\usepackage[dutch]{babel}`
  - `\sqrt[3]{x}`

Environments

- Two special commands are `\begin{environment}` and `\end{environment}`
- These initiate and exit an environment
- The type of environment is applied to everything between the begin and end commands
- These must be properly nested
- As we will see, the entire LaTeX document is one big environment

Environments

LaTeX code:

```latex
\begin{itemize}
\item Two special commands are \verb|\begin{environment}| and \verb|\end{environment}|
\item These initiate and exit an environment
\item The type of environment is applied to everything between the begin and end commands
\item These must be properly nested
\item As we will see, the entire \LaTeX\ document is one big environment
\end{itemize}
```

Output:

- Two special commands are `\begin{environment}` and `\end{environment}`
- These initiate and exit an environment
- The type of environment is applied to everything between the begin and end commands
- These must be properly nested
- As we will see, the entire LaTeX document is one big environment

Environments

LaTeX code:

```
Apply Knuth's advice to \LaTeX:
\begin{quote}
The best way to learn how to use \LaTeX\ is to use it . Thus it's high time for you to sit down at a computer terminal and interact with the \LaTeX\ system, trying things out to see what happens.
\end{quote}
```

Output:

Apply Knuth's advice to LaTeX:

> *The best way to learn how to use LaTeX is to use it. Thus it's high time for you to sit down at a computer terminal and interact with the LaTeX system, trying things out to see what happens.*

Document Structure

Every LaTeX document has the following form:

```
\documentclass{ CLASS }

    PREAMBLE

\begin{document}

    BODY

\end{document}
```

Document Structure

- The first line is always the `\documentclass` command, specifying the *class of the document*
  - This specifies what *sort* of document you intend to write
- After the document-class comes the *preamble*
  - Load needed packages
  - Define things that affect the whole document
  - Define variables, custom commands or other things needed in the document
- After the preamble comes the *body*
  - Starts with `\begin{document}` and ends with `\end{document}`
  - This is the main document
  - Contains all text, figures, tables, etcetera
- Finally, anything added after `\end{document}` is not compiled. This room can be used for comments

Document Structure

For now, use this structure:

```
\documentclass{article}

\includepackages{amsmath, amssymb, graphicx}

\begin{document}

    BODY

\end{document}
```

The Body of a LaTeX Document

LaTeX code:

```
this is an example of the \emph{body} of a \LaTeX\ document.

Here we can write all sorts of funny things (e.g.\ Stories, fairy tales, general Microsoft Word bashing). But also equations:

\[
F(k) = \int_{-\infty}^{\infty} e^{-2 \pi i k x} \, \mathrm{d}x
\]
```

Output:

this is an example of the *body* of a LaTeX document.
Here we can write all sorts of funny things (e.g. Stories, fairy tales, general Microsoft Word bashing). But also equations:

$$F(k) = \int_{-\infty}^{\infty} e^{-2\pi ikx} \, \mathrm{d}x$$

The Body of a LaTeX Document

LaTeX code:

```
In a \LaTeX\ body there are 3 different modes in which you can write:

\begin{itemize}
  \item Text
  \item Math
  \item Verbatim
\end{itemize}

Where text mode is the default and the other two are obtained in environments. We will first focus on Text mode.
```

Output:

In a LaTeX body there are 3 different modes in which you can write:

- Text
- Math
- Verbatim

Where text mode is the default and the other two are obtained in environments. We will first focus on Text mode.

Letters and Spacing

LaTeX code:

```
All  letters  that we type are  the
↳ same in the output.

White space is     interpreted    as
↳      a single             space
↳between
words.  A newline  is
ignored  but

two newlines  are  interpreted  as
↳a change in  paragraphs.

After  a  period  the  spacing  is
↳ slightly   larger .  This might
↳not be what you want (e.g.
↳ right  here).  Force a normal
↳space with a backslash  (e.g.\
↳as here).
```

Output:

All letters that we type are the same in the output.

White space is interpreted as a single space between words. A newline is ignored but

two newlines are interpreted as a change in paragraphs.

After a period the spacing is slightly larger. This might not be what you want (e.g. right here). Force a normal space with a backslash (e.g. as here).

Line breaking

LaTeX code:

```
A new line can be forced with \textbackslash\textbackslash\which breaks the \\ paragraph and \textbackslash\textbackslash* \\* to not break the paragraph.

 Alternatively  \newline \verb|\newline| can be used.

A new page can be made with \verb|\newpage| or \verb|\clearpage|.
```

Output:

```
A new line can be forced with \\ which
breaks the
paragraph and \\*
to not break the paragraph.
Alternatively
\newline can be used.
A new page can be made with
\newpage or \clearpage.
```

Accents

LaTeX code:

```
Because the input is ASCII many special characters can not be written directly. Such a letter will not be compiled.

Accents can be added with escaped characters. For example, \verb|\'{o}| returns \'{o}.
```

Output:

Because the input is ASCII many special characters can not be written directly. Such a letter will not be compiled.
Accents can be added with escaped characters. For example, `\'{o}` returns ó.

Hyphenation

LaTeX code:

```
\LaTeX\ automatically hyphenates verylongwords

\verb|\mbox{}| can be used to force \mbox{verylongwords} to not be hyphenated.

\verb|\mbox{}| can be used to force verylongwords to not be hyphenated.

\verb|\-| can be used to make sure very\-longwords hyphenate at a certain point

\verb|\-| can be used to make sure verylong\-words hyphenate at a certain point.
```

Output:

```
LaTeX automatically hyphenates very-
longwords
\mbox{} can be used to force
verylongwords to not be hyphenated.
\mbox{} can be used to force verylong-
words to not be hyphenated.
\- can be used to make sure very-
longwords hyphenate at a certain point
\- can be used to make sure verylong-
words hyphenate at a certain point.
```

Emphasis

LaTeX code:

```
We can \emph{emphasize}
↳important parts of the text with
↳\verb|\emph{}|.

This works nested, in this way
↳\emph{we can \emph{
↳emphasize} while we are
↳emphasizing}.

In \LaTeX\ this is the preferred
↳ method for emphasizing over
↳manually setting text \textit{
↳ italic } or \textbf{bold}.
```

Output:

We can *emphasize* important parts of the text with `\emph{}`.
This works nested, in this way *we can emphasize while we are emphasizing*.
In LaTeX this is the preferred method for emphasizing over manually setting text *italic* or **bold**.

Quote marks

LaTeX code:

```latex
\LaTeX\ treats left and right quotes as different entities.

The left quote mark is the backtick (usually under tilde) (`)

The right quote is the normal tick mark (')

A double quote mark is obtained though two ticks at both sides. For ``example'' like so.
```

Output:

LaTeX treats left and right quotes as different entities.
The left quote mark is the backtick (usually under tilde) (‘)
The right quote is the normal tick mark (’)
A double quote mark is obtained though two ticks at both sides. For “example” like so.

Dashes and Footnotes

LATEX code:

```
An n−dash can be included with
↳two dashes−−like this−−and an
↳ m−dash can be included with
↳three dashes−−−like this−−−.

A footnote can be added with the
↳ \verb|\footnote| command\
↳footnote{Although this does not
↳ work in presentations.}.
```

Output:

An n-dash can be included with two dashes–like this–and an m-dash can be included with three dashes—like this—

.

A footnote can be added with the `\footnote` command.

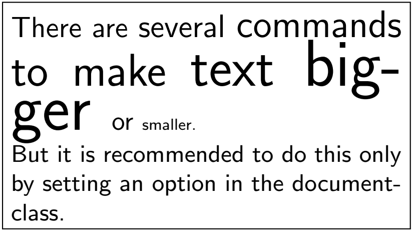
Font size

LaTeX code:

```
\normalsize{There are} \large{several} \Large{commands} \LARGE{to make} \huge{text} \Huge{bigger} \small{or} \tiny{smaller}.

\footnotesize{But it is recommended to do this only by setting an option in the documentclass.}
```

Output:



There are several commands to make text bigger or smaller.

But it is recommended to do this only by setting an option in the documentclass.

Special Characters

LaTeX code:

```latex
Several characters are used as
↳special commands in \LaTeX\
↳and can not be entered normally.
↳ % For example, anything
↳following a % is a comment and
↳ is not compiled.

Generally, you can get most
↳characters by ``escaping''
↳them (i.e.\ adding a backslash
↳ before it): \$ \% \&.
```

Output:

Several characters are used as special commands in LaTeX and can not be entered normally.
Generally, you can get most characters by “escaping” them (i.e. adding a backslash before it): $ % &.

Environments

- The `\begin` and `\end` commands can be used to create an environment
- This is used for many different things
- An environment breaks the paragraph, but in some cases we can also use inline environments

Environments

LaTeX code:

```
We can \emph{itemize} with the \verb|itemize| environment:
\begin{itemize}
\item This creates a bulleted list
\item The symbols depend on your documentclass
\item Can also be nested
\begin{itemize}
\item By adding an environment in an environment
\item Note that these must be properly nested (FILO)
\end{itemize}
\item After such a nested itemization we can continue with the first one
\end{itemize}
```

Output:

We can *itemize* with the `itemize` environment:

- This creates a bulleted list
- The symbols depend on your documentclass
- Can also be nested
    - By adding an environment in an environment
    - Note that these must be properly nested (FILO)
- After such a nested itemization we can continue with the first one

Environments

LaTeX code:

```latex
We can also itemize with numbers with the \verb|enumerate| environment:
\begin{enumerate}
\item This creates an enumerated list
\item Can also be nested
\begin{enumerate}
\item Like this
\end{enumerate}
\item After nesting we can continue with the original numbering
\end{enumerate}
```

Output:

We can also itemize with numbers with the `enumerate` environment:

1. This creates an enumerated list
2. Can also be nested

    2.1 Like this

3. After nesting we can continue with the original numbering

Environments

LaTeX code:

```latex
With the \verb| description |
↳environment we can itemize
↳with  descriptions .  So to
↳summarize
\begin{description}
\item[Itemize]  Creates  bulleted
↳ list
\item[enumerate] Creates
↳enumerated  list
\item[ description ]  Creates  a
↳ list  with  titles  such as  this
↳one
\end{description}
```

Output:

```
With the description environment
we can itemize with descriptions.  So
to summarize

        Itemize  Creates bulleted list

      enumerate  Creates enumerated
                 list

    description  Creates a list with
                 titles such as this one
```

Verbatim

LaTeX code:

```
To be able to include code as it is the \verb|verbatim| environment can be used:
\begin{verbatim}
$ Whatever % we write here
it does not break @
\end{verbatim}

Can also be used inline with the \verb|\verb| command, but this requires $\mid$ symbols instead of curly brackets.
```

Output:

To be able to include code as it is the `verbatim` environment can be used:

```
$ Whatever % we write here
it does not break @
```

Can also be used inline with the `\verb` command, but this requires $\mid$ symbols instead of curly brackets.

Verbatim

LaTeX code:

```
\begin{center}
The \verb|center| environment
↳can be used to center text and
↳ even figures and tables.
\end{center}
```

Output:

The `center` environment can be used to center text and even figures and tables.

- LaTeX is often used for its strong capabilities of writing mathematical text
- This is done in “math mode”, which can be enabled in several ways
- In the next few slides is a brief overview of the basics. For more information on this topic see one of many resources online

Math mode

LaTeX code:

```
We can use the \$ or  sign  to enable  and  disable  math mode in text. Within math mode spaces are ignored and  letters re  written  as  variables :  $1 apple  + 2 apples  = 3 apples$

To obtain  roman  letters  in  math  mode we can use the \verb|\text| and \verb|\mathrm| commands: $1\text{ apple} + 2\text{ apples} = 3\text{ apples}$.

 Alternatively  \textbackslash( and \textbackslash) can be used
```

Output:

We can use the $ or sign to enable and disable math mode in text. Within math mode spaces are ignored and letters re written as variables: $1 apple + 2 apples = 3 apples$

To obtain roman letters in math mode we can use the `\text` and `\mathrm` commands: $1\text{ apple} + 2\text{ apples} = 3\text{ apples}$.

Alternatively \(and \) can be used

Math mode

LaTeX code:

```latex
To write equations, the commands \verb|\[| and \verb|\begin{equation*}| can be used. For an enumerated equation you can use \verb|\begin{equation}|:
\[
1+1=2
\]
\begin{equation*}
1+1=2
\end{equation*}
\begin{equation}
1+1=2
\end{equation}
```

Output:

To write equations, the commands `\[` and `\begin{equation*}` can be used. For an enumerated equation you can use `\begin{equation}`:

$$1+1=2$$

$$1+1=2$$

$$1+1=2 \tag{1}$$

Math mode

LaTeX code:

```latex
To align several equations you can use the \verb|align*| or \verb|align| environments. These use the \& sign to align and the \textbackslash\textbackslash sign to go to a new line:
\begin{align*}
x^2 + 100 &= 200 \\
x^2 &= 100 \\
x &= \sqrt{100} \\
&= 10
\end{align*}
```

Output:

To align several equations you can use the `align*` or `align` environments. These use the & sign to align and the \\sign to go to a new line:

$$\begin{aligned} x^2 + 100 &= 200 \\ x^2 &= 100 \\ x &= \sqrt{100} \\ &= 10 \end{aligned}$$

Math mode

LaTeX code:

```latex
Many mathematical operators work (and are properly spaced) as expected:
\[
f(x) = 5x + 2
\]
For superscripts you can use \verb|^| and for subscripts \verb|_|:
\[
f(x_1,x_2) = x_1^2 + 5x_2 - 1
\]
To group characters together you can use \{ and \}:
\[
f(x) = e^{2x+1}
\]
```

Output:

Many mathematical operators work (and are properly spaced) as expected:

$$f(x) = 5x + 2$$

For superscripts you can use ^ and for subscripts _:

$$f(x_1, x_2) = x_1^2 + 5x_2 - 1$$

To group characters together you can use { and }:

$$f(x) = e^{2x+1}$$

Math mode

LaTeX code:

```latex
All mathematical operators can be used. These require you to know the commands. Some editors have these commands in the menu.
\[
\int_{-\infty}^{\infty} \prod_{j=1}^m \left( \sum_{i=1}^n \frac{x\sqrt{_i}}{\ln y_j} \right) \, \mathrm{d}x
\]
```

Output:

All mathematical operators can be used. These require you to know the commands. Some editors have these commands in the menu.

$$\int_{-\infty}^{\infty} \prod_{j=1}^m \left(\sum_{i=1}^n \frac{x\sqrt{_i}}{\ln y_j} \right) \, \mathrm{d}x$$

Math mode

LaTeX code:

```
Many Greek letters can be obtained with \verb|\letter| for lower case letters or \verb|\Letter| for upper case letters:
\[
\gamma, \Gamma, \theta, \Theta, \lambda, \Lambda
\]
Note that some Greek letters, such as omicron and capital beta, do not differ from roman letters and are not included.
```

Output:

Many Greek letters can be obtained with `\letter` for lower case letters or `\Letter` for upper case letters:

$$\gamma, \Gamma, \theta, \Theta, \lambda, \Lambda$$

Note that some Greek letters, such as omicron and capital beta, do not differ from roman letters and are not included.

Math mode

LaTeX code:

```latex
To obtain bold symbols the \verb|\boldsymbol| command can be used:
\[
\boldsymbol{A}\boldsymbol{x} = \boldsymbol{b}
\]
```

Output:

To obtain bold symbols the `\boldsymbol` command can be used:

$$\boldsymbol{A}\boldsymbol{x} = \boldsymbol{b}$$

Math mode

LaTeX code:

```latex
Matrices can be made by, among others, the \verb|bmatrix| environment, which works somewhat similar to the \verb|tabular| environment:
\[
\boldsymbol{A} =
\begin{bmatrix}
1 & 2 \\
3 & 4 \\
\end{bmatrix}
\]
```

Output:

Matrices can be made by, among others, the `bmatrix` environment, which works somewhat similar to the `tabular` environment:

$$\boldsymbol{A} = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

Very useful equation editor:

`http://www.codecogs.com/latex/eqneditor.php`

Contact Details

Course website:

- http://sachaepskamp.com/latex2015

E-mail:

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