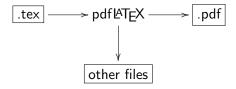
LATEX for Psychological Researchers

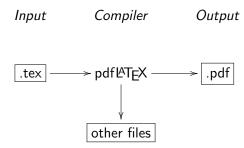
Lecture 2: Basics of the LATEX language

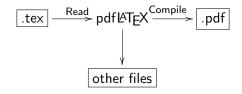
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LATEX refers to the *programming language* used to write the input file and the *program* used to interpret this file and compile the output file. It does **not** refer to an editor in which you write the input file.

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:

.pdf file:

Hello World!

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

```
 \label{local_command_command} $$ \operatorname{command_name}[ \operatorname{option} 1, \operatorname{option} 2, \dots ] $ \{ \operatorname{argument} 1 \} $ \{ \operatorname{argument} 2 \} \dots $ \} $ \} $$ $$
```

- 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

```
\verb|\commandname| [option 1, option 2, \ldots] { argument 1 } { argument 2 } \ldots
```

- 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}

- ▶ 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

LATEX code:

\begin{itemize} \item Two special commands are $\lceil | \text{verb} | \text{begin} \{ \text{environment} \} \rceil$ and \verb|\end{environment}| 3 \item These initiate and exit an ↓ environment 4 \item The type of environment is applied to everything between by the begin and end commands 5 \item These must be properly [□]nested 6 \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

LATEX code:

Output:

Apply Knuth's advice to \LaTeX:
\begin{quote}

The best way to learn how to use \\ \LaTeX\\ is to use it. Thus it \\ down at a computer terminal \\ and interact with the \LaTeX\\ \ system, trying things out to \\ see what happens.

Apply Knuth's advice to \LaTeX:

Apply Knuth's advice to LATEX:

The best way to learn how to use LETEX is to use it. Thus it's high time for you to sit down at a computer terminal and interact with the LETEX 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

Today, use this structure:

```
\documentclass{article}
\includepackages{amsmath, amssymb, graphicx}
\begin{document}
BODY
\end{document}
```

The Body of a LATEX Document

LATEX code:

Output:

```
this is an example of the \
                                 Jemph{body} of a \LaTeX\
                                 <sup>↓</sup>document.
                            Here we can write all sorts of
                                 ↓funny things (e.g.\ Stories,
                                 fairy tales, general Microsoft
                                 → Word bashing). But also

↓equations:

_{6}|F(k) = \int_{-\infty}^{\infty} F(k) 
                              \downarrow ^{-}\{-2 \neq i \mid k \neq k \} \setminus mathrm{
                              -d}x
```

this is an example of the body of a $\ensuremath{\text{\fontfont MTEX}}$ document.

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

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

The Body of a LATEX Document

LATEX code:

Output:

In a \LaTeX\ body there are 3
\(\different \) modes in which you
\(\different \) can write:
\\\ \text{begin} \{ \text{item Math} \)

\item Verbatim \end{itemize}

5

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

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

⇒as here).

LATEX code:

All letters that we type are the White space is interpreted as a single space **between** 4 words. A newline is 5 ignored but two newlines are interpreted as ↓a change in paragraphs. 8 After a period the spacing is → slightly larger . This might ↓not be what you want (e.g. ight here). Force a normal ⇒space with a backslash (e.g.\

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.

A new page can be made with \
\textstyre=\verb|\newpage| or \verb|\
\textstyre=\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:

Output:

2

Accents can be added with Gescaped characters. For Gescaped, \verb|\'{o}| returns Gescaped characters. 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 √not be hyphenated. $\mathbf{verb} \setminus \mathbf{mbox} \{\} |$ can be used to bforce verylongwords to not be hyphenated. $|\mathbf{verb}| - |$ can be used to make ↓sure very\—longwords hyphenate 4 at a certain point 8

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 verylongwords to not be hyphenated.

\- can be used to make sure verylongwords hyphenate at a certain point \- can be used to make sure verylongwords hyphenate at a certain point.

Emphasis

LATEX code:

Output:

 $\label{eq:weighted} \begin{array}{l} \text{We can } \backslash \text{emph} \{\text{emphasize}\} \\ \downarrow \backslash \text{important parts of the text with} \\ \downarrow \backslash \text{verb} \backslash \text{emph} \{\} |. \end{array}$

2

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

4

In \LaTeX\ this is the preferred by method for emphasizing over by manually setting text \textit { by italic } or \textbf{bold}. 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\\ treats left and right
\(\daggregarrow\) quotes as different entities.

The left quote mark is the
\(\daggregarrow\) backtick (usually under tilde)
\(\daggregarrow\) (')

The right quote is the normal

A double quote mark is obtained \$\frac{1}{2}\$though two ticks at both sides
\$\frac{1}{2}\$. For "example" like so.

↓ tick mark (')

6

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:

Output:

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

2

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

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:

Output:

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

\text{footnotesize} \But it is
\partial \{section \text{tiny} \text{or} \\ section \\
```

There are several commands to make text big-ger or smaller.

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

Special Characters

LATEX code:

Output:

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

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

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): \$ % &.

- ► 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

LATEX code:

1 We can \emph{itemize} with the **\verb**|itemize| environment: 2 \begin{itemize} \item This creates a bulleted list با 4 \item The symbols depend on your documentclass 5 \item Can also be nested 6 \ **begin**{itemize} \item By adding an environment bin an environment \item Note that these must be properly nested (FILO) 9 \end{itemize} 10 \item After such a nested itemization we can continue with the first one 11 \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

LATEX code:

1 We can also itemize with umbers 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

LATEX code:

- 1 With the \verb | description | benvironment we can itemize with descriptions. So to summarize
- 2 \ **begin** { description }
- \item[Itemize] Creates bulleted ↓ list
- \item[enumerate] Creates benumerated list
- 5 \item[description] Creates a b list with titles such as this -one
- 6 **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

Verhatim

6

LATEX code:

To be able to include code as it is the \verb|verbatim| benvironment can be used: 2 \begin{verbatim}

3 \$ Whatever % we write here

it does not break @

end{verbatim}

Can also be used inline with the → \verb|\verb| command, but 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 | symbols instead of curly brackets.

Verbatim

LATEX code:

Output:

\begin{center}

2 The \verb|center| environment

↓can be used to center text and

↓ even figures and tables.

3 \end{center}

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

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 homode we can use the \verb|\hototatext| and \verb|\mathrm|
hototatext| apples hototatext apples hototatext apples hototatext hototat

Alternatively \textbackslash(\partial and \textbackslash) can be \partial 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: 1apple + 2apples = 3apples

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

Alternatively \setminus (and \setminus) can be used

LATEX code:

```
Output:
```

```
1 To write equations, the
  begin{equation∗} | can be used.
  For an enumerated equation you
  ٠}|:
3 1+1=2
5 \begin{equation*}
6 1+1=2
 \end{equation*}
8 \begin{equation}
9 1+1=2
10 \end{equation}
```

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

$$1+1=2$$
 $1+1=2$
 $1+1=2$ (1)

LATEX code:

```
1 To align several equations you
  \verb| align | environments.
  ↓These use the \& sign to align

    □ and the \textbackslash\

  \textbackslash sign to go to a
  bnew line:
2 \begin{align*}
|x^2 + 100| = 200 \
4 x^2 &= 100 \\
_{5} x &= \sqrt{100} \\
_{6} &= 10
7 \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:

$$x^{2} + 100 = 200$$

$$x^{2} = 100$$

$$x = \sqrt{100}$$

$$= 10$$

LATEX code:

```
1 Many mathematical operators
   work (and are properly spaced)
  ∫as expected:
|f(x)| = 5x + 2
5 For superscripts you can use \
   verb|^| and for subscripts \
  ⊳verb |_|:
7 | f(x_1,x_2) = x_1^2 + 5x_2 - 1
9 To group characters together you
   └ can use \{ and \}:
  1/
10
11 f(x) = e^{2x+1}
12 \
```

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 $\}$:

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

LATEX code:

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

2 \[
3 \int_{-\infty}^{\infty} \prod_{j} \\
\$ \b=1\^m \left(\sum_{i=1}^n \\
\$ \frac{x\\sqrt_{i}}{\ln y_{j}} \right \\
\$ \, \mathrm{d}x
\$ 4 \]

Output:

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

$$\int_{-\infty}^{\infty} \prod_{j=1}^{m} \left(\sum_{i=1}^{n} \frac{x\sqrt{i}}{\ln y_{j}} \right) dx$$

LATEX code:

1 Many Greek letters can be

↓obtained with \verb|\ letter |

↓ for lower case letters or \

↓verb|\Letter| for upper case

↓ letters:

2 \[

\gamma, \Gamma, \theta, \\
\bar{Theta}, \lambda, \Lambda

| \]

5 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.

LATEX code:

Output:

```
To obtain bold symbols the \begin{tabular}{ll} \begin{tabular}{l
```

LATEX code:

```
Matrices can be made by, among

    others, the \verb|bmatrix|

  benvironment, which works

    Somewhat similar to the \verb|

  └ tabular | environment:
 \box{boldsymbol}{A} =
4 \begin{bmatrix}
5 1 & 2 \\
6 3 & 4 \\
7 \end{bmatrix}
8 \]
```

Output:

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

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

Very useful equation editor:
http://www.codecogs.com/latex/eqneditor.php

Contact Details

Course website:

▶ http://sachaepskamp.com/latex2014

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