Informatics 1 – Basics of LaTeX

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Using Kristóf Kovács's slides

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TEX

- **TEX**: typesetting system, free software
- **Created by**: 1977 – 1978: Donald E. Knuth, the author of The Art of Computer Programming. In 1989 it was declared feature complete: this is TEX3, since then, only bug fixes were published, the current version number is 3.1415926
- **Accessories**: macro language, font descriptor METAFONT language (ver. 2.718281), Computer Modern typefaces.
- **Etymology**: From the greek *Techne* (τεχνη) plus text.
- **Mark**: TEX, in text TeX.
- **Macro packages**: LATEX(Leslie Lamport – standard in publishing a "formula rich" article), ConTEXt (Hans Hagen), LuaTEX, XƎTEX,...

LaTeX

- **LaTeX 2.09**: first public version, 1985, Leslie Lamport (after his retirement the LaTeX3 group was established)
- **LaTeX 2_ε**: 1994 (beta version of LaTeX3).
- **LaTeX pronunciation**: la-tech
- **Mark**: LaTeX, LaTeX 2_ε, in text `LaTeX`, `LaTeX2e`.

Advantages of LaTeX

In more details check out: http://www.nitens.org/taraborelli/latex

- print quality output;
- easy to learn, can be generated by a program; any text editor will do;
- the language describes the document's **logical structure** (minimal visual editing), but the visual structure can be influenced as well;
- bibliography-, table of contents, list of figures. . . ;
- mathematical formulas in the highest possible quality;
- lots of useful packages;
- open source;
- runs on every operating system;
- supports a lot of languages, multi-language documents are supported as well.

Disadvantages of LaTeX (TeX)

- in certain tasks can be more inconvenient than usual WYSIWYG* systems;
- controlling the looks of a document requires some serious study of the inner workings of LaTeX and TeX
- trying to understand the error messages can be confusing;

* **WYSIWYG**: What You See Is What You *Get* (e.g. WORD)
WYSIWYM: What You See Is What You *Mean* (e.g. LyX, Scientific Word)
WYSIAYG: What You See Is *All* You Get (e.g. WORD???)

Learning TeX

- Distributions
    - WINDOWS: MiKTeX (http://miktex.org)
    - LINUX: TeXLive (http://www.tug.org/texlive/)
    - MACINTOSH: MacTeX – TeXLive alapú (http://www.tug.org/mactex)
- Where to look
    - CTAN (Comprehensive TeX Archive Network): http://www.ctan.org/
    - TUG honlapja: http://www.tug.org
- Where to learn
    - Knuth: The TeXbook. Addison-Wesley, 1986. (downloadable)
    - https://en.wikibooks.org/wiki/LaTeX

Author, typographer, typesetter, editor

- Classic phases of writing:
  - the author completes the writing,
  - proofreading,
  - typographer creates the plan of the visual look,
  - typesetting,
  - printing,
  - editor coordinates all of these.
- **Problem**: The usual document editor softwares provide easy means for the author to create a camera ready (print ready) book, or article. But the author most likely did not learn how to typeset or how to create the visual look of the book.
- **Solution**: Drawing a clear line between creating the contents of the book and the visual look of the book. LaTeX does just that, we can specify which words should be emphasized, or who the author is, etc. but the actual look of these is left to the editor.

TEX/LATEX editors

Editor	Style	Oper.Sys.	Free
EMACS/AUCTEX	source	LM W	yes
Kile http://kile.sourceforge.net/	source	L	yes
LyX www.lyx.org	WYSIWYM	LM W	yes
Scientific Word www.mackichan.com/	WYSIWYM	W	NO
TeXnicCenter www.texniccenter.org/	source	W	yes
Texmaker www.xm1math.net/texmaker/	source	LM W	yes
TeXworks www.tug.org/texworks/	source	LM W	yes
WinEdt www.winedt.com/	source	W	NO
WinShell www.winshell.org/	source	W	yes

TEX/LATEX highlighting is available to most text editors (gedit, kate,. . .).

DVI (.dvi divice independent) – PDF made it obsolete

- General, looks the same on all systems.
- Does not contain the included files themselves, they need to be next to the .dvi file.
- Fast compile times.
- Viewers: YAP (Windows), kdvi, evince, xdvi (Linux).
- We won't accept the homework in this format.

PDF (.pdf Portable Document Format)

- The upgrade of PostScript (Adobe)
- Contains everything needed to display the whole document, print ready.
- Can contain local links to pages, or hypertext links, animations, videos, etc.
- Popular.
- We can embed *jpeg*, *png*, *pdf* pictures.
- This is the preferred format for the homework.
- Viewers: Acrobat Reader, Adobe Reader/acroread (Windows, Linux, Mac), evince, kpdf, xpdf (Linux)

Compiling, viewing

```
$ pdflatex testlatex.tex
This is pdfTeXk, Version 3.141592-1.40.3 (Web2C 7.5.6)
...
Babel <v3.8h> and hyphenation patterns for english, usengli
dumylang, nohyphenation, hungarian, ukenglish, loaded.
...
Output written on testlatex.pdf (1 page, 5644 bytes).
Transcript written on testlatex.log.
$ evince testlatex.pdf &
```

Error message

```
! Undefined control sequence.
l.35 \Na
         something!
?
```

Error in line a 35. possible answers:
q ENTER: continue.
x ENTER: abort.
? ENTER: what can we do?

```
Hello World!
\bye
```

Hello World!

Another example (with a TEX macro):

```
Simple maths: $a+b$, $\sqrt{1+\sqrt{1+x}}$.
$$ \sum_{n=1}^\infty {1\over n^2} = {\pi^2\over 6}. $$

\def\ifthen #1 => #2.{If #1, then #2.}
\ifthen it rains => we stay at home.

\bye
```

Simple maths: $a + b$, $\sqrt{1 + \sqrt{1 + x}}$.

$$ \sum_{n=1}^\infty \frac{1}{n^2} = \frac{\pi^2}{6}. $$

If it rains, then we stay at home.

The structure of a LaTeX document

```
\documentclass{article} % article, book,...
                        % preamble
\begin{document}
  Hello world!          % the body, contents of the document
\end{document}
```

It is possible to do this but looks ugly!

```
\documentclass{article}\begin{document}Hello world!\end{document}
```

```
        \documentclass{article}        \begin{document}
   Hello        world!   \end{document}
```

Using spaces: however many spaces and tabs and at most one new line character is equivalent to one space (in the visual document). At least two new line characters creates a new paragraph, the spaces and tabs at the beginning of lines are ignored.

The structure of a LaTeX document – additional details

```latex
\documentclass[11pt]{article} % documentum class with options
                              %%%%%% PREAMBLE
\usepackage[T1]{fontenc}      % internal font encoding
\usepackage[utf8]{inputenc}   % input encoding
\usepackage[magyar]{babel}    % for different laguages (magyar: hungarian)
\usepackage{amsmath,graphicx} % mathematical and graphical packages

\title{First paper}          % title
\author{Kovács József}        % Author
\date{2009. 10. 19.}          % Date

\begin{document}             %%%%%% DOCUMENT BODY
\maketitle                    % create the title
\tableofcontents              % create the table of contents
                              %
\section{Introduction}        % title of the section
                              %
This is my first text.        % text content
                              %
\end{document}               %%%%%% END
```

```latex
\documentclass{book}

\title{Nonsense Novels}
\author{Stephen Leacock}
\date{1911}

\begin{document}
\maketitle

\chapter*{Gertrude the Governess}

It was a wild and stormy night on the West Coast of Scotland. This,
however, is immaterial to the present story, as the scene is not laid
in the West of Scotland. For the matter of that the weather was just
as bad on the East Coast of Ireland.

But the scene of this narrative is laid in the South of England and ...

\end{document}
```

```latex
\documentclass{book}

\usepackage[T1]{fontenc}
\usepackage[utf8]{inputenc}
\usepackage[magyar]{babel}

\title{A rejtély titka}
\author{Stephen Leacock\\Fordította: Karinthy Frigyes}
\date{1911}

\begin{document}
\maketitle

\chapter*{Gertrúd, a nevelőnő}

Vad, viharos éjszaka dühöngött Skócia nyugati partjai fölött. Ezen
történetünk szempontjából ugyan ennek különösebb jelentősége nincsen,
miután történetünk nem Skócia nyugati partjain játszódik, hanem
Írország keleti partjain. De azért ott is elég rossz idő volt.

\end{document}
```

Document classes

	article, amsart
	book
	report
presentation	beamer
	letter

The 10 characters with special meaning

- Most ASCII characters represent themselves in the code, for example these:

    . , : ; ! ? ' ` " @ - + = * / ( ) [

- **10 characters with special meaning:**

    \ { } % $ & # _ ^ ~

- Displaying them, **escaping**:

    \{ \} \% \$ \& \# _

- The other three:

    | \ | \textbackslash | $\backslash$ |
    | ^ | \textasciicircum | \^{} |
    | ~ | \textasciitilde | \~{} | $\sim$ |

- Example: He won 10\$-t because he payed 50% less in B&C.

Special characters: \, %, $

- **The \ symbol: command character**
    - **Alphabetic command** consists of \ and alphabetic characters
- **The % symbol: comments**
    - Whatever is after the % symbol in the same line is omitted from the actual compiled document.
- **The $ symbol: inline mathematical formulas**
    - `$a+b_n^3$`, `$\sqrt[3]{27}$`, `$2^{10}\ne10^3$`:
    - $a + b_n^3$, $\sqrt[3]{27}$, $2^{10} \neq 10^3$

Special characters: $\{$, $\}$ – blocks

- `$\frac12, \frac{1}{2}, \frac ab, \frac{a}{b}$`:
  $\frac{1}{2}, \frac{1}{2}, \frac{a}{b}, \frac{a}{b}$
- `$\frac123, \frac{12}3, \frac1{23}$`: $\frac{1}{2}3, \frac{12}{3}, \frac{1}{23}$
- `1\textsuperscript {st}`: 1st, `1\textsuperscript st`: $1^{s}t$
- `\fracab` results in an error!
- *Optional* block in square brackets e.g. `$\sqrt{23}$`: $\sqrt{23}$, `$\sqrt[3]{23}$`: $\sqrt[3]{23}$
- Blocks can be created by *environments* as well: `\begin{`*name*`}` *text* `\end{`*name*`}`
- Blocks **can not cross each other**, this is wrong: `{...\begin{small}...}...\end{small}`

Special characters

- **&** denoting the next column in tables,
- **#** in macro definition #1, #2 are the first and second arguments
- **~** unbreakable space: at the beginning of sentences after „A" or names, e.g. `A~dog...`, `Egerváry~J.`

Titles, sections

Type of section	Command	level	
neve	neve	article	book report
part	\part	0	-1
chapter	\chapter		0
section	\section	1	1
subsection	\subsection	2	2
subsubsection	\subsubsection	3	3
paragraph	\paragraph	4	4
subparagraph	\subparagraph	5	5

- change the level where the sections are still numbered:
  \setcounter{secnumdepth}{2}
- change the level where sections are included in the table of
  contents: \setcounter{tocdepth}{2}

Labels

- Labeling something we want to reference later: `\label`.
- convention: chapters (cha), sections (sec), subsections (sub), equations (eq), tables (tab), figures (fig), pictures (pic),…
- example

  `\chapter{Introduction to running}\label{cha:intro}`
  `\section{First steps}\label{sec:first}`
- `\label{eq:Cauchy}`, `\label{tab:income}`, `\label{pic:buli}`, `\label{fig:sin(x)/x}`,
- referencing the labeled number: `\ref`, `\pageref`
- ```
  We explained all these things
  in the chapter \ref{cha:intro}
  on the page \pageref{cha:intro}.
  ```
  We explained all these things in the chapter 1 on the page 23.

Notes, footnotes

- Footnote[1] is referenced here.

  `Footnote\footnote{footnote} is referenced here.`

- Margin note (in books – not here):

  `Margin note\marginpar{margin note} is placed on the mar`

---

[1]footnote

Table of contents

- Table of contents: `\tableofcontents`, list of figures: `\listoffigures`, list of tables: `\listoftables`
- Influencing the depth of the table of contents: `\setcounter{tocdepth}{4}`

Bibliography

Bibliography in a presentation:

📄 Donald E. Knuth, *The TEXbook*, Addison-Wesley, Reading, 1984.

📄 Leslie Lamport, *LATEX A Document Preparation System*, 2nd ed. Addison-Wesley, 1994.

The same in an article starts with the generated [1], [2] labels:

```
\begin{thebibliography}{9}
\bibitem{textbook} Donald E. Knuth, \textit{The \TeX book},
  Addison-Wesley, Reading, 1984.
\bibitem{latexbook} Leslie Lamport, \textit{\LaTeX\ A Document
  Preparation System}, 2nd ed. Addison-Wesley, 1994.
\end{thebibliography}
```

BIBTEX

```
\documentclass{article}
\begin{document}
   The book \cite{book}, and the \cite{art}.
   \bibliography{mybib}
   \bibliographystyle{plain}
\end{document}
```

BibTeX 2.

The contents of the `mybib.bib` file:

```
@article{art,
   author  = {Almond, W. E. and Biggs, A. D.},
   title   = {Title of article},
   year    = {1983},
   journal = {Journal of Something},
   volume  = {10},
   number  = {2},
   pages   = {347--359}
}

@book{book,
  author    = "Joe Smith and Tom Johns",
  title     = "Title of the book",
  publisher = "Nice books",
  year      =  2010,
}
```

Embedding pictures

- The package required: \usepackage{graphicx}
- To embed a picture \includegraphics{file.jpg} (PDF, PNG, JPG formats). This embeds the picture like a "character". Like here:
- Pictures should usually be handled as a floating object, for this we can use the figure environment. The optional parameters control the placement: h (here), t (top), b (bottom), p (page – separate page), ! (force it to use this placement).

```
\begin{figure}[!h]
  \centering  %%% to center the figure vertically
  \includegraphics{picture.jpg}
  \caption{Description}
  \label{pic:first}
\end{figure}
```

- Inside the figure environment we need a (\caption) to have a caption, and if we want to reference it: (\label).

You can create basic pictures with the \begin{picture}
environment of LATEX or the more complex TikZ package, or
external programs. An example of TikZ:

```
\begin{tikzpicture}[scale=.8]
  \draw[gray, very thin] (-2.2,-2.2) grid (2.2,2.2);
  \draw (0,0) circle (1) node[below left] {$O$};
  \draw[fill=green!40] (-1,1) ellipse (1 and .5);
  \draw[very thick,->] (0,0) -- (1,1)
    node[above,fill=white] {$\mathbf a$};
  \draw[fill=blue] (-1.5,-2) rectangle (-1,-.5);
  \draw[thick] (1,0) -- +(-30:1)
    arc(-30:-90:1) -- cycle;
\end{tikzpicture}
```
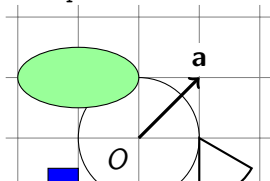
Classic table

Shopping		Cost
What	Where	Forints
Apple	Market	200
Tomatoes	Fruit market	300
Chair	Furniture shop	13 000

Classic table (source)

```
\begin{tabular}{|l|l|r|}
\hline
  \multicolumn{2}{|c|}{Shopping} & \multicolumn{1}{|r|}{Cost
\cline{1-2}\cline{3-3}
  What & Where & Forints \\
\hline
  Apple      & Market   & 200 \\
  Tomatoes   & Fruit market   & 300 \\
  Chair      & Furniture shop& 13\,000 \\
\hline
\end{tabular}
```

Nice looking table

	Shopping	Cost
What	Where	Forints
Apple	Market	200
Tomatoes	Fruit market	300
Chair	Furniture shop	13 000

Nice looking table (source)

```
\begin{tabular}{@{}llr@{}}
\toprule
  \multicolumn{2}{c}{Shopping} & \multicolumn{1}{c}{Cost} \
\cmidrule(r){1-2}\cmidrule(l){3-3}
  What & Where & \multicolumn{1}{c}{Forints} \\
\midrule
  Apple    & Market        & 200 \\
  Tomatoes & Fruit market & 300 \\
  Chair    & Furniture shop& 13\,000 \\
\bottomrule
\end{tabular}
```

Multirow cells

Text here	First line second line third line fourth line	Text here now	end of first line second line third line fourth line

Multirow cells (source)

```
\begin{tabular}{|l|l|l|l|}
  \hline
  \multirow{4}{12mm}{Text here} & First line &
  \multirow{4}{12mm}{Text here now} & end of first line \\
  & second line & & second line \\
  & third line & & third line \\
  & fourth line & & fourth line \\\hline
\end{tabular}
```

Multirow cells in a nice table

Text here	First line second line third line fourth line	Text here now	end of first line second line third line fourth line

Multirow cells in a nice table (source)

```
\begin{tabular}{@{}lccr@{}}
  \toprule
  \multirow{4}{14mm}{Text here} & First line &
  \multirow{4}{14mm}{Text here now} & end of first line \\
  & second line & & second line \\
  & third line & & third line \\
  & fourth line & & fourth line \\\bottomrule
\end{tabular}
```

Embedding a table

```
\begin{table}[!h]
\caption{title of the table}\label{tab:1}
  \begin{center}
    \begin{tabular}{@{}llr@{}}
     \toprule
       \multicolumn{2}{c}{Shopping} & \multicolumn{1}{c}{Cost} \
     \cmidrule(r){1-2}\cmidrule(l){3-3}
       What & Where & \multicolumn{1}{c}{Forints} \\
     \midrule
       Apple    & Market       & 200 \\
       Tomatoes & Fruit market & 300 \\
       Chair    & Furniture shop& 13\,000 \\
     \bottomrule
    \end{tabular}
  \end{center}
\end{table}
```

Questions

- What does the `pdftex` and the `pdflatex` shell command do? (What is the input and the output?)
- What are the rules of using whitespaces (space, tab, newline) in the source?
- What is the first command of a LaTeXdocument (usually), what is the preamble?
- What are some important document classes?
- What are the 10 special characters and what is their meaning?
- How do we write unbreakable spaces in LaTeX-ben, a comment, how do we reference the third argument of a macro definition?

Questions 2

- What is the meaning of the \usepackage[utf8]{inputenc} command?
- What is the meaning of the \usepackage[T1]{fontenc} command?
- What is the meaning of the \setcounter{secnumdepth}{2}, and the \setcounter{tocdepth}{2} command?
- How do we label a subsection so we can reference its number later?
- How do we write a footnote?

Questions 3

- What does \tableofcontents, \listoffigures and \listoftables do?
- What does the \begin{thebibliography}{9} command do, what is that 9?
- What are floating objects? Which environment defines a floating object?
- How do we embed a picture in LaTeX? Which file formats are usable?
- How do we resize a picture? Show an example!

- Create the following table in LaTeX:

	Head	Number
Row1	text	12
Row2	text	1234

	Head	Number
Row1	text	12
Row2	text	1234

- Show the LaTeX code that gives the following:
  1. $\sin' x = \cos x$,
  2. $\cos' x = -\sin x$.

- Show the LaTeX code that gives the following:
  - $\sin' x = \cos x$,
  - $\cos' x = -\sin x$.