

# SHORT INTRODUCTION TO L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub>

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# 1. INTRODUCTION

- What is  $\text{\LaTeX} 2_{\epsilon}$  ?
  - It is a typesetting program that is very good in *mathematics* and has other good features.
- Why  $\text{\LaTeX} 2_{\epsilon}$  ?
  - MUCH better than Word in mathematics.
  - Automatic chapter, section, equation, figure, table numbering
  - Simple cross-reference to pages, equations, figures, tables, chapters, bibliography.
  - By using BibTeX a general bibliographical database can be used. It is usable for all documents.

- Easy reconfiguration, e.g. submitted paper  $\rightarrow$  final paper, thesis  $\rightarrow$  paper, thesis, paper  $\rightarrow$  slides.
- If font size of text is changed it changes also for math.
- $\text{\LaTeX} 2_{\epsilon}$  style files available for many publications and conferences.
- Free version available to DOS, SUN, LINUX, WIN.
- $\text{\LaTeX} 2_{\epsilon}$  uses text files  $\Rightarrow$  saves space.
- Any text-editor that saves pure txt can be used. (X)Emacs, nedit, LyX, even MS Word if saved properly.

- Why not?
  - Though to be difficult, starting threshold high.
  - Not WYSIWYG.
  - Problems with figures. Free versions accept only *.eps* figures.  
(MATLAB, xfig)

## 2. STRUCTURE OF THE DOCUMENT

```
\documentclass[optional parameters]{LaTeX class-file  
(.cls)}   %%%MUST
```

```
%%%PREFACE
```

```
\usepackage{packages}   (call additional definitions  
                          and commands (.sty))
```

```
\title{TITLE}           (title 'page')
```

```
\author{author}
```

```
\date{11.11.1111}
```

```
other required/desired definitions
```

```
\includeonly{fileX} (process only file fileX, if all
                    files wanted comment this line with %)
%%DOCUMENT
\begin{document}

\maketitle          (makes title, includes
                    title,author,date)
\tableofcontents   (obvious)
\include{file1}    (text files; parts of the document)
...
\include{fileN}
```

```
%%reference list
\bibliographystyle{reference style (.bst)}
\bibliography{bibliography files (.bib)} (bibliographical
                                             databases)

\end{document} %%%MUST
%% %%END of DOCUMENT
```

- *optional parameters*
  - basic font size: 10pt, 11pt, 12pt
  - paper size: a4paper, ...
  - other: oneside, twoside, onecolumn, twocolumn, draft
- *class file*
  - .cls (L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub>-class)
  - defines layout
  - article(.cls), report(.cls), book(.cls), proc(.cls)
  - also: dithesis (for our department), phthesis (univ. acta)
  - others: IEEEtran, several conferences

- *packages*
  - .sty files
  - layout changes from .cls file, commands,...
  - *latexsym*: more symbols
  - `\usepackage[dvips]{graphicx}` needed with .eps figures. Figs into document by command `\includegraphics[width=8cm]{file.eps}`.
  - *showkeys*: shows labels and references.
  - *fancyhdr*: better header and footer than in basic L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> classes
  - *natbib*: author-year reference style

- *amsmath*: AMS L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> style. Still improved mathematics typesetting.
- *babel*: multilanguage typesetting; finnish, english (initial value), deutch, swedish. Hyphenation with those languages..  
`\usepackage[finnish,english]{babel}`
- *fontenc*: ä, ö. `\usepackage[T1]{fontenc}`. Otherwise, `\”a,...`
- *hyperref* for URL, links within dokuments, etc. in pdf form.
- Your own .sty files
- *Other definitions*
  - *pagestyle*: plain, heading, myheadings, empty `\pagestyle{empty}`
  - header and footer
  - laout changing; margins, ...
- `\begin{document}` starts document

- `\include{file}`
  - reads `.tex` files where text is
  - Short documents can be in one file but long ones should be divided into parts, e.g., chapter by chapter basis
- *reference style*
  - *plain*: alphabetical order, [1]
  - *unsrt*: order of appearance, [1]
  - *alpha*: alphabetical order, [Smi89]
  - with *natbib* also [Smith et al, 1989] or (...)

- *.bib-files*

- bibliographical databases are in .bib files
- called from document by `\cite{key}`-command.
- *key* is the name of reference
- examples

```
file: kirjal.bib
```

```
@Article{ABEL90, (ABEL90 is the key (name))
  author =      {Abel, J. S.},
  title =      "A Divide and Conquer Approach to
                Least-Squares Estimation",
  journal =    aes,
  year =      {1990},
  volume =    {26},
  number =    {2},
  month =     {March}, %or: mar
  pages =     {423-27}
}
```

```
@Book{ADRY74,  
  author =      "Adry, P.R. and Dempster, M.A.H.",  
  title =      "Introduction to Optimization Methods  
                Including {ML}",  
  publisher =   {Chapman and Hall Ltd},  
  year =       {1974}  
}
```

- 'aes' is the short name. M.J has been done catalog of those.
- In document reference is called by  
`\cite[eq. 1]{ABEL90}` which produces (e.g.) [3, eq. 1].
- Optional argument [ ] is not necessary
- many references `\cite{ABEL90,ANDRY74}`

- Titles are typically printed with small letters. If caps are desired put “... the {ML}-estimates ..”
- Separation of authors by *and*  
{Smith, M. L. and Cooper, K.}
- There exist bib-file makers like Wbibdb.
- `\end{document}` end of the document. DO NOT FORGET!

### 3. WRITING ORDINARY TEXT

- write normally
- empty row is equal to paragraph change, enter at the end causes nothing
- several empty rows = one empty row
- title levels: part, chapter (not in article.cls), section, subsection, subsubsection, paragraph
- different numeration depth: set by `\secnumdepth`
- counter numbering style: `\renewcommand{\thesection}{\arabic{chapter}}`.  
`\roman{section}}` for 1.III type
- font style and size. `\textsl{slanted}` = *slanted*, `\textit{italics}` = *italics*, `{\Large Large}` = Large, `{\tiny tiny}` = tiny
- Command things are inside { }

- `\` is important. It starts commands in  $\text{\LaTeX} 2_{\epsilon}$ .

## 4. WRITING OF MATHEMATICS

- text- and display styles
- equations surrounded by text with  $\$ \dots \$$   
e.g. `plaa $x(t)=7$ plaa`  $\Rightarrow$  `plaa  $x(t) = 7$  plaa`
- display style: separate equations by environments *displaymath*, *equation*, *eqnarray*, *eqnarray\** (in basic L<sup>A</sup>T<sub>E</sub>X )

```
\[                               % displaymath, no numbering
x(t)=\pi\int_1^6f(t)\ dt
\]
```

- Result:

$$x(t) = \pi \int_1^6 f(t) dt$$

---

```
\begin{equation} % numbering
y(t) = H_{a(u)} \otimes T(t) \sum_{k=1}^{\infty} x_k(t)
\end{equation}
```

- Result:

$$y(t) = H_{a(u)} \otimes T(t) \sum_{k=1}^{\infty} x_k(t) \quad (1)$$

---

---

```
\begin{eqnarray*} & & \% \text{ equation array,} \\ & & \% \text{ no numbering} \\ \cos 2\pi t & \& \& \frac{\pi}{2} \\ \lim_{k \rightarrow \infty} & \& \& \sqrt{2} \\ \end{eqnarray*}
```

- Result:

$$\cos 2\pi t = \frac{\pi}{2}$$
$$\lim_{k \rightarrow \infty} = \sqrt{2}$$

---

---

```

\begin{eqnarray}      % numbering
x(t)      &=& \alpha_i(t)+\beta^2(t) \\
y(t)      &=& \Big[\big[[x]\big]\Big] \nonumber \\
& & % no number to this line
z(t)      &=& x(t)+jy(t)
\end{eqnarray}

```

- Result:

$$x(t) = \alpha_i(t) + \beta^2(t) \quad (2)$$

$$y(t) = \left[ \left[ \left[ x \right] \right] \right]$$

$$z(t) = x(t) + jy(t) \quad (3)$$


---

- *array* -environment can be used to create matrices

```
\begin{equation}
H=\left[\begin{array}{ccc}
1 & \cdots & N \\
\vdots & \ddots & \vdots \\
p & \dots & N+p
\end{array}\right]
\end{equation}
```

- Result:

$$H = \begin{bmatrix} 1 & \cdots & N \\ \vdots & \ddots & \vdots \\ p & \cdots & N + p \end{bmatrix} \quad (4)$$

- Mathematics is written as it is read
- symbols can be found from manuals
- e.g.. `rightarrow` =  $\rightarrow$ , `Gamma` =  $\Gamma$ , `leq` =  $\leq$
- In `amsmath`-package there are more advanced properties (recommended), e.g. commands for matrices
- Crossreferencing to equations by `label{eqname}` `ref{eqname}` commands pair as

```
\begin{equation}
\label{eq:eq}
x(t)=y(t)
\end{equation}
In equation \ref{eq:eq} ...
```

- Result:

$$x(t) = y(t) \tag{5}$$

In equation 5 ...

- Equations can be moved arbitrary and  $\text{\LaTeX} 2_{\epsilon}$  numbers and crossreferences them correctly

- Commands can be shortened and saved to own .sty file

```
\newcommand{\be}{\begin{equation}}  
\newcommand{\ee}{\end{equation}}  
\renewcommand{\vec}[1]{\mathbf{#1}}  
\newcommand{\her}[1]{\mathrm{#1}}  
\newcommand{\gvec}[1]{\mbox{\boldmath $#1$}}
```

- Make special meanings rather general, e.g., vector command above. It now makes vectors boldface by  $\vec{\mathbf{b}}$  (result is  $\vec{\mathbf{b}}$ ). Just by changing the definition of the command the outlook of the vector can be changed. This means that do not use *mathbf* or anything like that for every vector but use *vec* command.
- Theorems etc. can be created by *newtheorem* environment
- *euler* package provides math fonts that differs more from regular text fonts than that of initially used by L<sup>A</sup>T<sub>E</sub>X .

## 5. ELSE

- figures into *figure* environment
- tables into *table* environment
- these are floating environments which means that  $\text{\LaTeX}$  but them were they best fit in  $\text{\LaTeX}$  mind. This might not be correct from your side.
- placement can be recommended by optional arguments *tbph* (top, bottom, page, here) like `\begin{figure}[htbp]` so that here is first place where  $\text{\LaTeX}$  tries to place figure.
- *float* package provides H (put it right here)
- *endfloat* provides put floats to end of document

- tables are made in *tabular* environment

```
\begin{tabular}{cc}\hline
A & B \\
& kg \\ \hline\hline
banana & 10 \\ \hline
\end{tabular}
```

- This gives

A	B
	kg
banana	10

- *label*, *ref* pair can be used to crossreference titles (chapter,section), tables, figures etc.. *label* is after *caption* or *chapter* command  
e.g. `chapter{Johdanto} \label{chapter1}`, ... in `Chapter \ref{chapter1}`  
...

## 6. PROCESSING

- It is good habit to write small part of text, process, correct errors until it is free from errors, write piece of new text, etc..
- *PROCESSING* in UNIX
  - *latex yourfile* (not .tex:i)
  - correct errors until *latex yourfile* goes to end
  - *bibtex yourfile* (makes references to literature)
  - *latex yourfile* (makes bib-reference, equation, page etc numbering)
  - *latex yourfile* (final version)
- Summary: 3 latexing and 1 bibtexing makes final result
- Result is *yourfile.dvi* (dvi-file)
- It can be seen by *xdvi* program: *xdvi yourfile*

- Transformation into ps-file by *dvips yourfile*
- *dvips -Pamz -Pcmz* give better fonts for pdf (not with T1 encoding).
- Result is *yourfile.ps*
- Printing by *lpr -Ptlhp1 -s yourfile.ps*

- set these variables in .cshrc

```
setenv TEXINPUTS :./:/home/harza/tex/styles
                                     (your own .sty and .cls files)
setenv BIBINPUTS :./:/home/harza/tex/biblio
                                     (your own .bib files)
setenv BSTINPUTS :./:/home/harza/tex/styles
                                     (your own .bst files)
```

- set .dvipsrc as

```
m 1000000
j
D 600
M ljfour
R 300 600
t a4
o
```

- while latexing it might appear *error* followed by ?-mark By giving  $x$  after ?-mark latexing stops
- In xemacs you have spelling checker for english (in edit-spell)
- You can write L<sup>A</sup>T<sub>E</sub>X also by LyX (free), PC-TeX (not free), Scientific Workplace (not cheap).
- MikTeX is free windows version, WinEdt non-free editor with L<sup>A</sup>T<sub>E</sub>X-buttons (we have some licenses of it).

- Example file:

```
\documentclass[twocolumn]{ec2k}

\usepackage{latexsym}
\usepackage{amsmath} % includes(amsbsy,amstext,amsfonts)
\usepackage{amssymb}
\usepackage{amscd,amsshort}
\usepackage[dvips]{graphicx,color} % Abbildungen
\DeclareMathOperator{\fft}{FFT}

%\setcounter{page}{1}
\pagestyle{empty}

\begin{document}
```

```
\title{Phase Interference Extractor Interference  
Canceller in DS/SS Code Synchronization}
```

```
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phone: +358-40-5727803, fax: +358-8-5532845  
\thanks{This work is supported by Finnish Defense Force,  
Nokia and Electrobit.}}
```

```
\maketitle  
\thispagestyle{empty}  
\begin{abstract}  
Interference mitigation ...  
\end{abstract}
```

```
\section{Introduction}
```

```
The direct sequence spread spectrum (DS/SS) technique ...  
like the notch filter \cite{MILSTEIN88}, and some  
considerable demanding, ...
```

```
\section{Interference Cancellation}
```

```
... \ref{fi:synchronizer}.
```

```
\begin{figure}
```

```
\begin{center}
```

```
\input{synchronizer}
```

```
\caption{The structure of the proposed synchronizer.}
```

```
\label{fi:synchronizer}
```

```
\end{center}
```

```
\end{figure}
```

```
\subsection{The Notch Filter}
...
\begin{equation}
\label{eq:mfoutput}
r(\tau)=\sum_{k=1}^K\abs{\inprod{y,s(\tau)}}^2
\end{equation}
... \eqref{eq:mfoutput}

\bibliographystyle{IEEEbib}
\bibliography{strings,kirjal}
```

```
\begin{figure}
\begin{center}
\includegraphics[width=9cm]{mf_in_tsnbj.eps}
\caption{Probability of acquisition}\label{fi:mf}
\end{center}
\end{figure}
\end{document}
```

## 7. XFIG-PROGRAM

- .eps and .tex and mixture figures can be produced by XFIG
- unix program, but like usual drawing programs
- xfig -me file.fig
- -me makes metric scale grid
- file.fig meas that xfig saves file for that name which then can be used to convert to .tex or .eps
- -specialtext flag can be used to force xfig .tex figures to have  $\text{\LaTeX 2}_{\epsilon}$  math-mode.

## 8. WHERE TO GET HELP

- Manuals. One is copied here in Lab
- Web: [www.latex-project.org](http://www.latex-project.org), [www.tug.org](http://www.tug.org)
- to obtain .sty files and their manuals (CTAN):  
<ftp://ftp.dante.de/tex-archive/macros/latex> or <http://www.tex.ac.uk/tex-archive>
- in contrib direectory there exist several .sty files produced by ordinary people
- manulas are often provided by copying corresponding .dtx file and latexing it as *latex file.dtx*