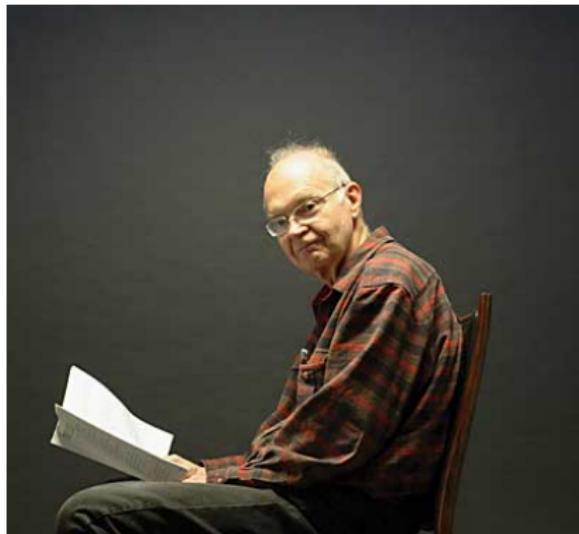


Using L^AT_EX for scientific writing

Dag Langmyhr (dag@ifi.uio.no)

What is **T_EX**?

The man behind it all



*Donald Knuth created **T_EX** in 1974–82, primarily to typeset his own books.*

What is \LaTeX ?

What is \LaTeX ?

\LaTeX is a document processing system based on Donald Knuth's \TeX .

- It is free and open.
- It runs on all computer systems known to man.
- It produces high quality documents.
- It is particularly good for mathematics.
- It uses a markup language (like XML and HTML) so your files are readable by humans.

Starting a \LaTeX document

How to start

You edit your \LaTeX documents using either

- a general text editor (like Emacs)
- a graphical editor (like Kile;
see Wikipedia: *Comparison of TeX editors*)

Starting a \LaTeX document

A good basis

http:

//dag.atifi.uio.no/public/download/mymaster.tex

is a good starting point. Save a copy of that file.

Starting a L^AT_EX document

```
\documentclass[UKenglish]{ifimaster}    %% ... or USenglish or norsk or nynorsk
\usepackage[utf8]{inputenc}                %% ... or latin1 or applemac
\usepackage[T1]{fontenc,url}
\urlstyle{sf}
\usepackage{babel, textcomp, csquotes, ifimasterforside, varioref, graphicx}
\usepackage[backend=biber, style=numeric-comp]{biblatex}

\title{The title of my thesis}           %% ... or whatever
\subtitle{Any short subtitle}            %% ... if any
\author{My Name}                       %% ... or whoever

\bibliography{mybib}                   %% ... or whatever

\begin{document}
\ififimaster{}%
\frontmatter{}%
\maketitle{}%

\chapter*{Abstract}                    %% ... or Sammendrag or Samandrag

\tableofcontents{}%
\listoffigures{}%
\listoftables{}%

\chapter*{Preface}                     %% ... or Forord
```

```
\mainmatter{}                                %% ... or Innledning or Innleiing
\part{Introduction}
\chapter{Background}                         %% ... or Bakgrunn

\part{The project}                          %% ... or ???
\chapter{Planning the project}               %% ... or ???

\part{Conclusion}                           %% ... or Konklusjon
\chapter{Results}                            %% ... or ???

\backmatter{}                                %% ...
\printbibliography
\end{document}
```

Note!

A % in L^AT_EX signals that the rest of the line is a comment.

How do I process a \LaTeX file?

Running \LaTeX

Give the commands

```
pdflatex mymaster.tex  
biber mymaster  
pdflatex mymaster.tex
```

and the result is mymaster.pdf.

A Gui tool will typically provide an icon for this.

On Ifi computers, I recommend

```
ltx mymaster.
```

The \LaTeX commands

A \LaTeX file starts like this:

```
\documentclass[UKenglish]{ifimaster}  
%% ... or USenglish or norsk or nynorsk
```

From this we can learn:

- \LaTeX markup consists of commands like `\documentclass`.
 - All commands start with a backslash (`\`).
 - Commands may have *options* in square brackets; these may be omitted.
 - Commands have zero or more *parameters* in curly braces; the braces should always be there.

The initial part

The initial command

```
\documentclass[UKenglish]{ifimaster}  
%% ... or USenglish or norsk or nynorsk
```

specifies that

- The option **UKenglish** specifies the language used; you should change this if necessary.
- The parameter **ifimaster** is a document class suitable for a master's thesis. Other common document classes are:

article	for short articles
report	for longer reports
book	for books
beamer	for presentations

The initial part

Then \LaTeX will load some packages:

```
\usepackage[utf8]{inputenc}          %% ... or latin1 or applemac
\usepackage[T1]{fontenc,url}
\urlstyle{sf}
\usepackage{babel, textcomp, csquotes, ifimasterforside, varioref, graphicx}
\usepackage[backend=biber, style=numeric-comp]{biblatex}
```

- **inputenc** specifies the text encoding used in the source file.
- **fontenc** specifies the font encoding to use.
- **url** makes URLs easier. (Using sans serif URLs is a good idea.)
- **babel** handles language adaption.
- **textcomp** adds useful symbols; see
<http://dag.at.ifi.uio.no/latex-links/textcomp-symbols.pdf>.
- **csquotes** handles quotation marks.
- **ifimasterforside** defines an official University of Oslo frontpage.
- **varioref** provides \vref command.
- **graphicx** opens possibilities for including images.
- **biblatex** is for bibliographies.

The initial part

Document elements (like the author's name) are specified without regard to how they should appear:

```
\title{The title of my thesis}      %% ... or whatever
\subtitle{Any short subtitle}       %% ... if any
\author{My Name}                  %% ... or whoever
```

The initial part

The bibliography file mybib.bib must be specified:

\bibliography{mybib} % ... or whatever

Hint

Start with an empty .bib file.

The document itself

Then we can start the document itself:

```
\begin{document}  
 \ififorside{}  
 \frontmatter{}  
 \maketitle{}
```

Note!

A **LATEX** document is always placed in a **LATEX environment** `\begin{document}... \end{document}`.

- **\ififorside** produces the official frontpage.
- **\frontmatter** specifies that we now start the initial part of the thesis.
- **\maketitle** creates the inner frontpage.

The document itself



UiO • Department of Informatics

University of Oslo

The title of my thesis

Any short subtitle

My Name

Master's Thesis Spring 2014



The document itself

Then comes a short abstract.

```
\chapter*{Abstract} %% ... or Sammendrag or Samandrag  
The text of the abstract;  
typically, 2-5 sentences.
```

The document itself

Now it is time for the table of contents and other tables
(if you have any):

```
\tableofcontents{}  
\listoffigures{}  
\listoftables{}}
```

And, finally, the initial part ends with a preface:

```
\chapter*{Preface} %% ... or Forord  
\mainmatter{}}
```

The document structure

How to structure your document

```
\part{...}
\chapter{...}          (not in articles)
\section{...}
\subsection{...}
\subsubsection{...}
\paragraph{...}
\subparagraph{...}
```

The characters you type

Writing ordinary text

Basically, you just write your text as you would on a typewriter.

One or more blank lines start a new paragraph.

The characters you type

Some characters need special treatment:

Character Write

\#

\$ \\$

% \%

{ \{

} \}

Character Write

& \&

_ _

\ \textbackslash{}{}

^ \textasciicircum{}{}

~ \textasciitilde{}{}

Hint

You can create your own commands for the long names:

```
\newcommand{\bsl}{\textbackslash{}}
```

Some words are more special than others

You can emphasize particular words:

Command	Result
\emph{...}	<i>Emphasised text (italics)</i>
\textbf{...}	Bold text
\textit{...}	<i>Italic text</i>
\textsc{...}	CAPS AND SMALL CAPS
\textsf{...}	Sans serif
\texttt{...}	Typewriter

These may be combined: ***Bold italic typewriter***.

Diagrams and other pictures

L^AT_EX has no integrated drawing facilities; instead, it can import illustrations created by other programs, as long as they produce JPEG, PDF or PNG format. For this, the `graphicx` package is required.

```
\usepackage{graphicx}
```

Illustrations

The file `Don.png` contains the picture of Donald Knuth.
It is imported using

```
\includegraphics[height=4cm] % The size.  
{Don.png} % The image file.
```

Other useful options include

angle=90.05 rotates the image 90.05°.

width=12.575cm will scale the image making it
12.575 cm wide.

Floating figures

To avoid page break problems, a figure should be allowed to “float” to a suitable position.

```
\begin{figure}
    \includegraphics[height=5.8cm]{Don}
    \caption{\TeX{}'s creator Donald Knuth}
\end{figure}
```

The illustration will be placed on the same page (if there is room) or the next.

Cross references

Cross references

Since we won't know exactly where a floating figure will land, we cannot write

... as we can see in this illustration:

Instead, we must attach a label to the figure (*inside* the `\caption-command`):

```
\caption{Donald Knuth}\label{knuth}
```

Now we can write

... as we can see in figure\ref{knuth}.

The result becomes something like

... as we can see in figure 5 on the next page.

You can also assign labels to \section, \subsection etc.

Remember

The \vref command requires a package:
\usepackage{varioref}.

How do you create tables?

```
\begin{tabular}{cl}
l& left justified\\
c& centered\\
r& right justified\\
\end{tabular}
```

- l left justified
- c centered
- r right justified

The size of columns and rows is automatically adjusted.

Tables

Tables can easily be framed:

```
\begin{tabular}{|r|l|}\hline Figures& \verb:\begin{figure}:\\\hline Tables& \verb:\begin{table}:\\\hline\end{tabular}
```

Figures	\begin{figure}
Tables	\begin{table}

(\verb:...: is used for to turn formatting off.)

To float, tables are placed in \begin{table}... \end{table}. They may be given a \label.

Programming formulas

Matematical formulas

It seems strange to «program» formulas, but it is easy and fast with some training. I created the following formula in 2 min 3 sec:

$$\pi(n) = \sum_{m=2}^n \left[\left(\sum_{k=1}^{m-1} \left\lfloor (m(k)/\lceil m/k \rceil) \right\rfloor \right)^{-1} \right]$$

- Writing \LaTeX commands is actually faster than “point and click”.
- “Cut and paste” is easy.
- It is simple to modify a formula.
- You can make commands for formulas or formula parts.

Programming formulas

There are *inline formulas* $\sum_{k=1}^{\infty} 2^{-k}$ which are intended to go among the ordinary text, and *display formulas*

$$\sum_{k=1}^{\infty} 2^{-k}$$

that appear on a line of their own. The commands are identical, but \LaTeX will format them differently.

Environments for formulas

Inline formulas in \LaTeX are written as $\$...$$, while display formulas use $\{[...] \}$. We also have $\begin{equation} ... \end{equation}$ which gives numbered display formulas.

$$\sum_{k=1}^{\infty} 2^{-k} \tag{1}$$

Programming formulas

Mathematical formulas follow special rules:

- Very few ordinary \LaTeX commands work in this context; instead, there are math commands.
- All spaces are ignored in formulas.

Mathematical symbols

Mathematical symbols

- Letters and digits are written as usual:

Write	Result
--------------	---------------

e	e
---	---

122	122
-----	-----

- We need commands for most Greek letters:

Write	Result
--------------	---------------

\alpha, \gamma, \omega	α, γ, ω
------------------------	--------------------------

A, \Gamma, \Omega	A, Γ, Ω
-------------------	---------------------

Mathematical symbols

- Mathematical symbols found on your keyboard can be used as they are:

Write $+, -, /, <, >, =, '$ **Result** $+,-,/,<,>,=,'$

- Other symbols need a command:

Write $\backslash times, \cdot, \leq$ \geq, \neq, \wedge \vee, \in, \approx \forall, \exists, \notin **Result** \times, \cdot, \leq \geq, \neq, \wedge \vee, \in, \approx \forall, \exists, \notin

Mathematical symbols

- You can apply a `\not` to most symbols:

Write`\not\approx`**Result** $\not\approx$

- There exist lots of arrows:

Write`\leftarrow, \leftrightarrow`**Result** $\leftarrow, \leftrightarrow$ `\not\rightarrow, \uparrow` $\not\rightarrow, \uparrow$ `\longleftarrow` \longleftrightarrow `\leftrightsquigarrow` \leftrightsquigarrow

Mathematical symbols

- You may add either a subscript using `_` or a superscript using `^`, or both:

Write

`n^{2}, \Theta^x`
`x_{1}, \pi_a, H_2O`
`x_{1}^{2}, \Psi_{\xi_1}^{t+1}`

Result

n^2, Θ^x
 x_1, π_a, H_2O
 $x_1^2, \Psi_{\xi_1}^{t+1}$

Mathematical symbols

- Fractions are written using \frac:

Write $\backslash\text{frac}\{1\}\{a\} + \backslash\text{frac}\{22-4b+1\}\{n\}$ **Result**

$$\frac{1}{a} + \frac{22-4b+1}{n}$$

- Square roots require a \sqrt:

Write $\backslash\text{sqrt}\{\backslash\text{frac}\{1\}\{2+\backslash\text{frac}\{1\}\{n\}\}\} <$ **Result** $\backslash\text{sqrt}[n]\{b+4c\}$

$$\sqrt{\frac{1}{2+\frac{1}{n}}} < \sqrt[n]{b+4c}$$

Mathematical symbols

- Integrals and sums are made using `\int` and `\sum`:

Write

```
\int_{0}^1 \partial t \approx \sum_{i=1}^n x_i
```

Result

$$\int_0^1 t \partial t \approx \sum_{i=1}^n x_i$$

Mathematical symbols

- There are various brackets:

Skriv

$$f(x) \rightarrow A[x]$$

$$\{x \mid x > 0\}$$

$$\left(\sum_{0 < k < n} \frac{2^k}{k!} \right)$$

$$\left(\int_{\alpha}^{\beta} \right)_{\alpha + \beta = n}$$
Resultat

$$f(x) \rightarrow A[x]$$

$$\{x \mid x > 0\}$$

$$\left(\sum_{0 < k < n} \frac{2^k}{k!} \right)$$

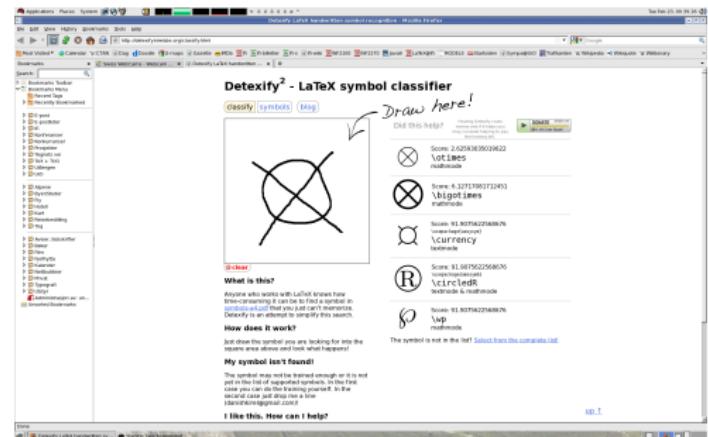
$$\left(\int_{\alpha}^{\beta} \right)_{\alpha + \beta = n}$$

Mathematical symbols

A plethora of symbols

\LaTeX knows
approximately
6000 symboler.

Then we need <http://detexify.kirelabs.org/classify.html>.



What is good about \LaTeX ?

\LaTeX 's strong points

- The user is free to concentrate on the contents.
- It usually produces a beautiful and well-structured result.
- The math notation has become a standard.
- It produces identical results on all systems.
- It will not change in the future.
- It is extensible.

What is good about \LaTeX ?

Quality

Typographical quality is inherent in $\text{T}_{\text{E}}\text{X}$ og \LaTeX (so the users do not have to worry about it), for instance

- Some letter pairs should be adjusted:

WAVERLY

WAVERLY

- Changing from *italics* to ordinary text, the spacing should also be adjusted:

... idea (borrowed from $\text{T}_{\text{E}}\text{X}$)

... idea (borrowed from $\text{T}_{\text{E}}\text{X}$)

What is good about \LaTeX ?

- There are several symbols for the square root:

$$1 + \sqrt{1 + \sqrt{1 + \sqrt{1 + \sqrt{1 + \sqrt{1 + \sqrt{1 + 1}}}}}}$$

Warning

Once you develop an interest in typography, you will never be able to read a book normally!

What is not quite so good?

LATEX's weaker points

- The error messages are difficult to understand.
- It is unsuited for non-structured documents.

How to get \LaTeX on your own computer

How to get \LaTeX

Linux (and other Unixs) Use **T_EX Live** from
<http://www.tug.org/texlive/>.

Mac Use **T_EXShop** from
<http://pages.uoregon.edu/koch/texshop/>.

Windows Use **MiK_TE_X** from <http://miktex.org/> or from
the Ifi start package.

If you need help

Assistance

- Your fellow students
- Some Ifi staff
- “ \LaTeX for nybegynnere” in <http://www.mn.uio.no/ifi/tjenester/it/hjelp/latex/latex-for-nybegynnere.pdf>
- The web page
<http://www.mn.uio.no/ifi/tjenester/it/hjelp/latex/>
- E-mail to dag@ifi.uio.no

A last advice

A last word of advice

To use \LaTeX successfully,

- process your \LaTeX file often.
- let your figures and tables float as they please.
- think **content** and **structure** rather than **appearance**.