# An introduction to LaTeX
## Mathematical modelling I

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- LATEX is a typesetting program, not a word processing program.
- LATEX is free.
- LATEX is good to use when you want to write scientific documents.
- LATEX is a programming language.

# Software

The software you need is free and avaible on internet.

**Distributors**

- Miktex - Windows      http://www.miktex.org/
- Tex Live - Linux        http://www.tug.org/texlive/
- Mactex - Mac OSX    http://tug.org/mactex/

**Text editors**

- Texniccenter - Windows      http://www.texniccenter.org/
- Gnu Emacs                          http://www.gnu.org/software/emacs/
- Kile - Linux                           http://www.kile.sourceforge.net/
- Texshop - Mac OSX           http://www.uoregon.edu/~koch/texshop/

**Moreover**

- Adobe reader
- Ghostscript

# Getting started

The file where you are writing your document in should be named *.tex.
The document should have the following structure:

```
\documentclass[a4paper]{article}

%Load packages

\usepackage[T1]{fontenc}
\usepackage[swedish,english]{babel}
\usepackage[latin1]{inputenc}

\begin{document}
A short example of how to structure your document.
\end{document}

Text after \end{document} will be ignored.
```

# Getting started

You can load different packages with the command \usepackage{}

All commands starts with the symbol \

The command \\ gives a new line. (But it is recommended to insert a blank line to mark where a new part begins)

To insert a space after a command, type \ directly after the command. For example \LaTeX\ generates:

LaTeX with a space, compare with \LaTeX, which gives LaTeXwithout space.

# Getting started

Some signs are reserved by LaTeX. All of them are presented in the table below

| Sign | Command in LaTeX |
|------|------------------|
| \    | \textbackslash   |
| {    | \{               |
| }    | \}               |
| %    | \%               |
| ~    | \textasciitilde  |
| $    | \$               |
| _    | \_               |
| ^    | \textasciicircum |
| &    | \&               |
| #    | \#               |

# Some basics

Here is an example of how to create a front page with title, date and author:

```
\title{Name of the report}
\author{Student1 \and Student2}
\date{\today}
\maketitle
```

The result is presented on next page.

You can also add subtitle with the command \subtitle{} and more authors with the command \and.

# Some basics

Name of the report

Student1          Student2

August 9, 2010

A table of contents are genereted with the command \tableofcontents.

You can devide your paper into different sections and subsections with the commands \section{} and \subsection{}. If you want further subsections, just type \subsubsection{}.

**If you want to make your text bold, use the command** `\textbf{}`

*If you want to make your text italic, use the command* `\textit{}`

# Some basics

A centered text is created with the commands \begin{*center*} and \end{*center*}.

A left aligned text is created with the commands \begin{*flushleft*} and \end{*flushleft*}.

A right aligned text is created with the commands \begin{*flushright*} and \end{*flushright*}.

For example the code

```
\begin{center}
        Centered text
\end{center}
```

gives the result

<div align="center">Centered text</div>

# Some basics

A page break can be inserted with one of the following commands:

\newpage
\clearpage
\cleardoublepage

A foot note is made with the command \footnote{*text*}

# Some basics

A numbered list is inserted with the command \begin {enumerate}.
Every new item in the list is created with the command \item.

1. Some text.
2. Some more text.
3. Even more text.

To create a list without numbers, use the command \begin{itemize}.

The above example where made with the following code:

```
\begin{enumerate}
        \item Some text.
        \item Some more text.
        \item Even more text.
\end{enumerate}
```

# Mathematics

To bo able to write mathematics you need to load the following package

\usepackage{amsmath,amssymb,amsthm,upref}

When you write mathematics. You have two choices:

- Directly in the text, between dollar signs, examples:
  - \$f(x)\$ gives the result $f(x)$
  - \$e^t + 3\$ gives the result $e^t + 3$
  - \$ \sin(x) \$ gives the result $\sin(x)$
- Independently in a environment.
  - *equation* - gives a number on the equation
  - *align* - several rows, with the possibility to adjust
  - *gather* - several rows, centered

It now follows some examples of the different environments. The code

```
\begin{equation}
        \int_{0}^{\infty}{\frac{\sin x}{x}}dx=\frac{\pi}{2}.
\end{equation}
```

Generates the following:

$$\int_0^\infty \frac{\sin x}{x}\,dx = \frac{\pi}{2}. \qquad (1)$$

If you want to create equations without a number, type \[ and \] instead of \begin{equation} and \end{equation}.

# Mathematics

The environment *align* can be used to adjust several lines. Note how the signs & and \\ is used in the following code. The signs & will lie on a vertical line. The sign \\ indicates a new row.

```
\begin{align}
      f^2 + g^4 & = 4 \\
      2f^2 + 5g^4 & = 6\\
      7f^2 + 3g^4 & = 8
\end{align}
```

This generates the following:

$$f^2 + g^4 = 4 \tag{2}$$
$$2f^2 + 5g^4 = 6 \tag{3}$$
$$7f^2 + 3g^4 = 8 \tag{4}$$

To write several equations without numbers, just use the symbol * in the name of the enviroment. For example \begin{align*} generates the same code as above, but without numbering.

# Mathematics

If you use the environment *gather* then will every row be centered.

```
\begin{gather}
    x^2 = 4 \\
    \sin^2 (x) + \cos^2(x) = 1
\end{gather}
```

The above code generates the following:

$$x^2 = 4 \tag{5}$$

$$\sin^2(x) + \cos^2(x) = 1 \tag{6}$$

# Mathematics

Rational expressions are typed with the command
\frac{*numerator*}{*denominator*}.
The code

```
\[
    \frac{1+\cos2x}{2} = \cos^2x.
\]
```

gives

$$\frac{1 + \cos 2x}{2} = \cos^2 x.$$

# Mathematics

To get parenthesis in the correct size, use \left and \right. Compare

$$(\frac{\sqrt{x}}{2}) \text{ with } \left(\frac{\sqrt{x}}{2}\right).$$

This example was made with the following code:

```
\[
        (\frac{\sqrt{x}}{2}) \text{ with } \left(\frac{\sqrt{x}}{2}\
            right).
\]
```

# Mathematics

Cases are typed with the command \begin{cases}. The code

```
\[
    f(x)=
    \begin{cases}
        x & \text{ if } x>2 \\
        x−4 & \text{ if } x \leq 2.
    \end{cases}
\]
```

Gives this result:

$$f(x) = \begin{cases} x & \text{if } x > 2 \\ x - 4 & \text{if } x \leq 2. \end{cases}$$

When you write mathematics note that the sentences has to be complete. Formulas and symbols have to be a part of a sentence.

# Tables

This is an example of how to insert a table:

```
\begin{tabular}{columns}
        text
\end{tabular}
```

Where columns can be one or several of the following:

- l - align left
- c - centered
- r - align right
- | - vertical line

# Tables

If you want to insert a horizontal line, type \hline.

The commands \\ and & is used to mark when a new row and column begins.

# Tables

The code

```
\begin{tabular}{|c|cr|}
                \hline
                AB & CD & DE \\
                \hline
                12 & 34 & 56 \\
                45 & 24 & 61 \\
                \hline
\end{tabular}
```

Generates this table:

| AB | CD | DE |
|----|----|----|
| 12 | 34 | 56 |
| 45 | 24 | 61 |

# Pictures

To be able to insert pictures, you have to load one of the following packages, depending on the compiler:

`\usepackage[dvips]{graphicx}`
`\usepackage[pdftex]{graphicx}`

The recommended image format is

LaTeX - .eps, .mps.
pdfLaTeX - .jpg, .mps, .pdf, png.

You can use the schools computers to convert pictures to desired format.

Pictures are inserted with the command

`\includegraphics[`*parameters*`]{`*filename*`}`

The picture should be in the same folder as your document.

# Pictures

With [*parameters*] can we manipulate the picture. Some of the commands are

`height` - Change the height of the picture
`width` - Change the height of the picture
`scale` - Scale the picture with a given factor

For example, if we want to insert the picture, *testpicture.eps*, with the height and width 4.8cm and 3.7cm respective. We write

\includegraphics[height=4.8cm,width=3.7cm]{testpicture.eps}

# Pictures

It is recommended to insert pictures and tables in a floating environment. That means that the object is inserted either in the top or bottom of the page.

There are two different standard environment, `figure` and `table`. The code

```
\begin{floatingobject}[where]
        picture or table
\end{floatingobject}
```

inserts a picture or table, depending on your choice. The command `where` should be replaced with one of the following

h - Here, the object is placed where you insert it
t - Top, the object is placed on the top of the page
b - Bottom, the object is placed on the bottom of the page
p - Page, the object is placed on a new page.

# Pictures

Picture- and table text is inserted with the command

\caption{*text*}

To center the object, use \centering.
We are now ready for an example. To insert a graph in the format .jpg,
type the following code

```
\begin{figure}[b]
        \centering
        \includegraphics[width=6cm]{graph.jpg}
        \caption{The graph $f(x)=x^2$.}
\end{figure}
```
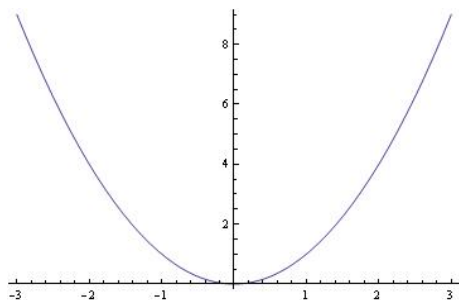
# Pictures



Figure: The graph $f(x) = x^2$.

# References

A bibliography are typed with the environment

\**begin**{thebibliography}{9}
        \bibitem[text]{tag}
\**end**{thebibliography}

To refer to a reference, use the command \cite{tag}.

# References

The code generates the bibliography on next page

```
\begin{thebibliography}{9}
        \bibitem{brockwell}
        Brockwell, Peter \& Davis, Richard (2002), \emph{
            Introduction to Time Series and Forecasting}, Second
            edition, New York: Springer−Verlag.
        \bibitem{resnick}
        Resnick, S.I. (1987), \emph{Extreme Values, Regular Variation
            , and Point Processes}, New York: Springer−Verlag.
\end{thebibliography}
```

# References

Brockwell, Peter & Davis, Richard (2002), *Introduction to Time Series and Forecasting*, Second edition, New York: Springer-Verlag.

Resnick, S.I. (1987), *Extreme Values, Regular Variation, and Point Processes*, New York: Springer-Verlag.

# Cross-reference

To be able to refer to an object, the object first needs an label. This is done with the command \label{*tag*}.

To refer to an object write

\ref{*tag*} - refer to an object, for example picture or table.
\pageref{*tag*} - refer to a page.
\eqref{*tag*} - refer to an equation.

Example of how to refer to an equation:

---
\\**begin**{equation}
    a^2+b^2=c^2
    \\label{eq: pyth}
\\**end**{equation}
We **all** know the meaning **of** equaion~\\eqref{eq: pyth}.

---

The above code gives the result:

$$a^2 + b^2 = c^2 \tag{7}$$

We all know the meaning of equation (7).

# Error-handling

Sometimes when you compile, you will note that the code does not work. Then you have to search for errors.

Some common errors are

- Misspelling
- Forgot a right parenthesis.
- Using wrong commands in wrong environment. For example \frac{}{} when you write text.
- Forgot to close an environment.

# Help

Don't be afraid to use internet to find out more about LaTeX.

There are a lot of litterature available in the library and on internet.

**The Not So Short Introduction to LaTeX $2_\varepsilon$**
http://www.ctan.org/tex-archive/info/lshort/english/lshort.pdf
Contains almost all information you need to know about LaTeX.