LaTeX: Introduction

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Goals:

- After the course you should:
  - Be able to write simple documents in LaTeX
  - Have an basic understanding of the working principle of LaTeX
  - Knowledge of basic structure and functions
  - Basic error handeling

Contents:

- History of LaTeX
- Why and when to use Latex
- Programs
- A simple document
  - Classes
- How latex works
  - Functions
  - Packages
- Language
- Math
- Figures
- Tables

History of LaTeX:

- 1962 – TeX
  - Donald Knuth
  - Wrote "*The Art of Computer Programming*"
  - Got frustrated
  - Created TeX
- 1968 – AMS
  - Math got in
- 1980's – LaTeX
  - Leslie Lamport
  - Standard Macro Package



Donald Knuth **Source:** Wikipedia.org

What is LaTeX

- Typesetting system
- “Programming” the document
- Free





Word



LaTeX



InDesign



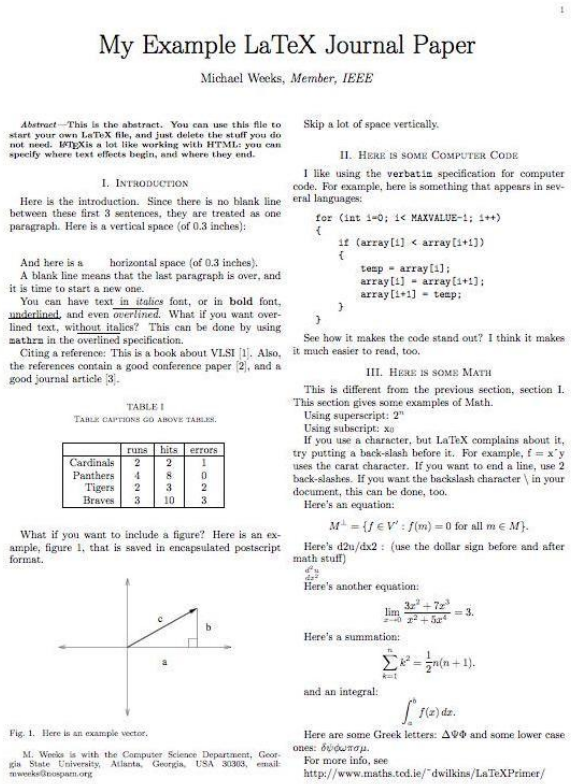
Photoshop



Simplicity **Control**

Why use LaTeX

- Output Quality
- Stability
- Freedom
- Standard



My Example LaTeX Journal Paper

Michael Weeks, *Member, IEEE*

Abstract—This is the abstract. You can use this file to start your own LaTeX file, and just delete the stuff you do not need. LaTeXis a lot like working with HTML: you can specify where text effects begin, and where they end.

I. Introduction

Here is the introduction. Since there is no blank line between these first 3 sentences, they are treated as one paragraph. Here is a vertical space (of 0.3 inches):

And here is a horizontal space (of 0.3 inches).

A blank line means that the last paragraph is over, and it is time to start a new one.

You can have text *in italics* font, or in **bold** font, underlined, and even *overlined*. What if you want overlined text, without italics? This can be done by using `mathrm` in the overlined specification.

Citing a reference: This is a book about VLSI [1]. Also, the references contain a good conference paper [2], and a good journal article [3].

TABLE I
Table captions go above tables.

	runs	hits	errors
Cardinals	2	2	1
Panthers	4	8	0
Tigers	2	3	2
Braves	3	10	3

What if you want to include a figure? Here is an example, figure 1, that is saved in encapsulated postscript format.

Fig. 1. Here is an example vector.

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Skip a lot of space vertically.

II. Here is some Computer Code

I like using the `verbatim` specification for computer code. For example, here is something that appears in several languages:

```
for (int i=0; i< MAXVALUE-1; i++)
{
    if (array[i] < array[i+1])
    {
        temp = array[i];
        array[i] = array[i+1];
        array[i+1] = temp;
    }
}
```

See how it makes the code stand out? I think it makes it much easier to read, too.

III. Here is some Math

This is different from the previous section, section I. This section gives some examples of Math.

Using superscript: 2^n

Using subscript: x_0

If you use a character, but LaTeX complains about it, try putting a back-slash before it. For example, $f = x^*y$ uses the carat character. If you want to end a line, use 2 back-slashes. If you want the backslash character \ in your document, this can be done, too.

Here's an equation:

$$M^{\perp} = \{f \in V' : f(m) = 0 \text{ for all } m \in M\}.$$

Here's d2u/dx2 : (use the dollar sign before and after math stuff)

$\frac{d^2u}{dx^2}$

Here's another equation:

$$\lim_{x \to 0} \frac{3x^3 + 7x^5}{x^2 + 5x^4} = 3.$$

Here's a summation:

$$\sum_{k=1}^{n} k^2 = \frac{1}{2}n(n+1).$$

and an integral:

$$\int_a^b f(x)\,dx.$$

Here are some Greek letters: $\Delta\Psi\Phi$ and some lower case ones: $\delta\psi\phi\omega\pi\sigma\mu$.

For more info, see http://www.maths.tcd.ie/~dwilkins/LaTeXPrimer/

When not to use LaTeX

- Short and simple documents
- When you don’t need fancy formatting
- When making picture books and cookbooks
- When you need to have a lot of customization



LaTeX Programs:

- Minimal:
  - Command line
  - Notepad ++
- WYSIWYG:
  - LyX
  - Scientific WorkPlace
  - LaTeXOnlineEditor.de (Online)
- “IDE”
  - Eclipse
  - TeXstudio
  - TeXworks
- Online:
  - Overleaf
  - ShareLatex

https://en.wikipedia.org/wiki/Comparison_of_TeX_editors

ShareLatex.com

- https://innsida.ntnu.no/wiki/-/wiki/English/ShareLaTeX
  - Campus License
- Synchronies with GitHub and Dropbox
- Easy to collaborate with others
- No need to install anything

Go to: empty.pippidis.no

Look at me writing in LaTeX

DO THE SAME YOURSELF

empty.pippidis.no/

(This page is intentionally left blank)

TASK 1

Simple table

- Add a table like this to the document:

Hest	Ku	Kylling
1	10	0
2	5	10

- Hint: Google it

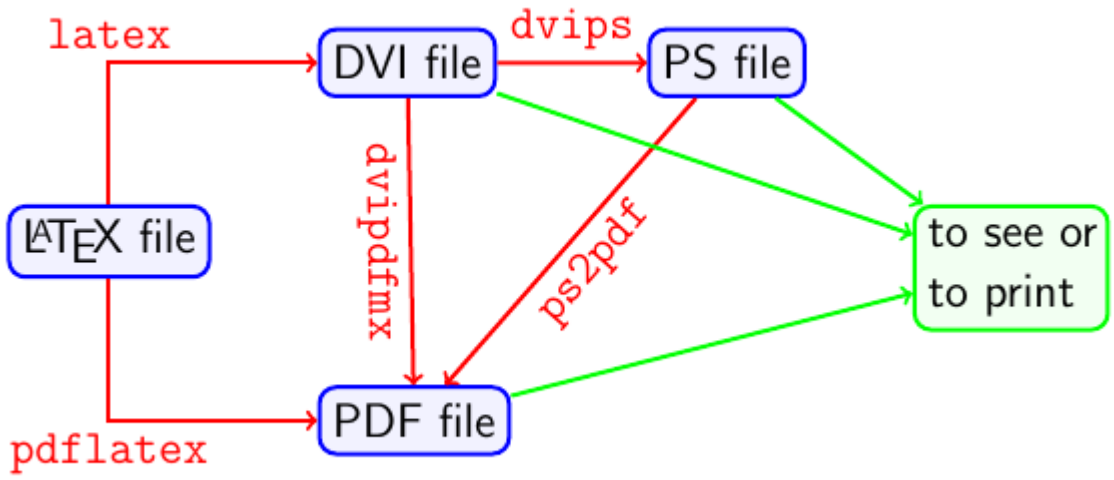
TASK 1

Solution

```
\begin{tabular}{ c c c }
   Hest  & Ku  & Kylling  \\
   1     & 10  & 0        \\
   2     & 5   & 10
\end{tabular}
```

Basic compilation of LaTeX:

- Compiler:
  - Takes the code and makes it into a PDF
  - Typesetting the document
- Most common:
  - pdflatex



Latex Compilation **Source:** ShareLatex.com

Basic commands:

- Begins with an \
- Then comes the command name
- Then comes []
  - With options inside
- Then comes {}
  - With input inside
  - NB: there can be multiple inputs in some functions

\command[options]{input}

Environments:

- Starts with **\begin{name}**
- Then comes the contents
- Ends with **\end{name}**

- Examples:
  - Abstract
  - Document
  - Figure
  - Centring
  - Listings
  - Todo
  - Rotating
  - Say

Minimal document:

```
\documentclass{article}

\begin{document}

\end{document}
```

Document Classes:

- What kind of document it is:
  - Article
  - Book
  - Report
  - Slides
  - Letter
  - +++
- Changes the structure of the document



\documentclass[options**]{**article**}**

Document structure:

- A document is divided into different parts
- Different types have different sections

Command	Level	Comment
`\part{''part''}`	-1	not in letters
`\chapter{''chapter''}`	0	only books and reports
`\section{''section''}`	1	not in letters
`\subsection{''subsection''}`	2	not in letters
`\subsubsection{''subsubsection''}`	3	not in letters
`\paragraph{''paragraph''}`	4	not in letters
`\subparagraph{''subparagraph''}`	5	not in letters

Source: en.wikibooks.org/wiki/LaTeX/Document_Structure

Packages:

- Provide extra functionality
  - There is a package for everything

\usepackage[options**]{**name**}**

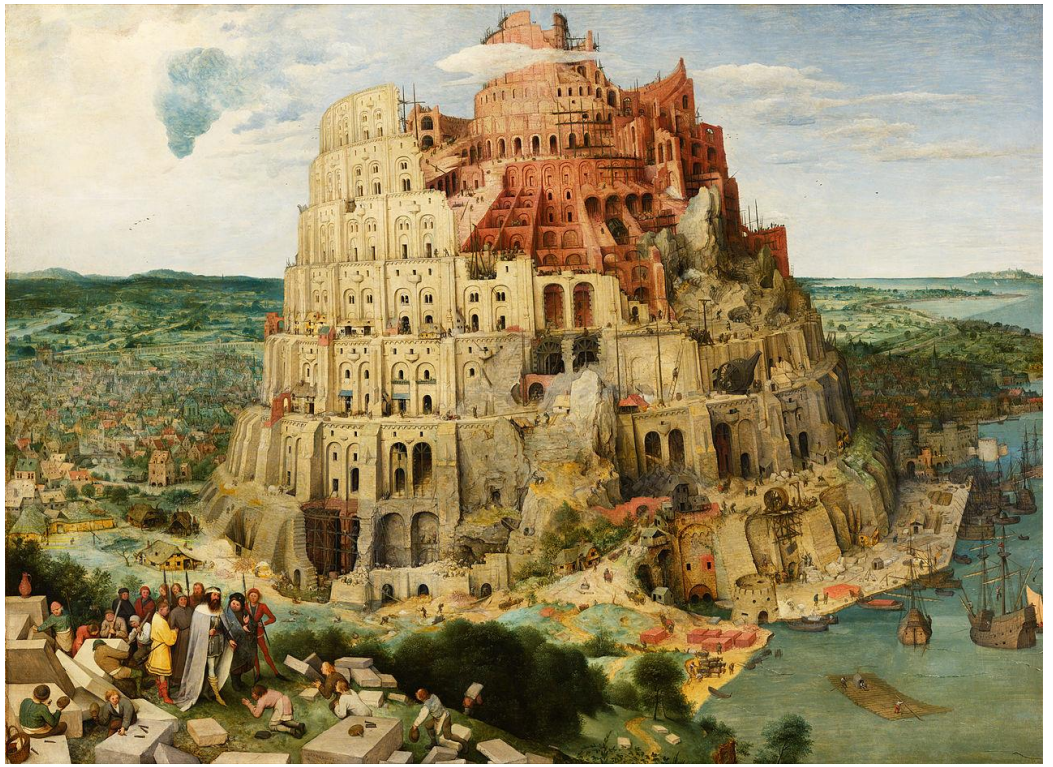
- Most packages has an manual
- Distributed by CTAN
  - Comprehensive TEX Archive Network



Languages: 1/2

- Using the package **babel**
  - **Norwegian:** norsk
  - **English:** english, USenglish, american, UKenglish, british, canadian, australian, newzealand

\usepackage[**norsk**]{**babel**}



https://no.sharelatex.com/learn/International_language_support

Languages: 2/2

- \usepackage[**utf8**]{**inputenc**}
  - To have special characters as input
- \usepackage[**T1**]{**fontenc**}
  - To have special characters as output

ÆØÅ

https://no.sharelatex.com/learn/International_language_support

TASK 2

Structure and classes

- Set up a document with the following:
  - Book
  - Two chapters
  - Some sections and subsections
  - Norwegian as the language

- Hint: use lipsum to generate text

TASK 2

Solution

```
\documentclass[a4paper,12pt,twoside]{book}
\usepackage[utf8]{inputenc}
\usepackage{lipsum}
\usepackage[norsk]{babel}

\begin{document}

\chapter{Something to do with ducks}
\lipsum[1-5]

\chapter{A chapter}
\lipsum[10]

\section{a Section}
\lipsum[11-20]

\subsection{a Subsection}
\lipsum[10]

\end{document}
```

Math:

- Use the **amsmath package**
  - **AMS** = American Mathematical Society

- Inline: **$** [Equation] **$**
- As equation:

```
\begin{equation}
    [Equation]
\end{equation}
```

- Unnumbered: `\begin*{equation}`

$$H_p^{Rx} = -\frac{I_0 A}{4\pi r^3}$$

$$R_1(\sigma_{a,2}) = \frac{\sigma_{a,2} - \sigma_1}{\sigma_2 - \sigma_1} \tag{1.2a}$$

$$R_2(\sigma_{a,3}) = \frac{\sigma_{a,3} - \sigma_1[1 - R_1] - \sigma_2 R_1}{\sigma_3 - \sigma_2} \tag{1.2b}$$

$$R_3(\sigma_{a,3}) = \frac{\sigma_{a,3} - \sigma_1[1 - R_1] - \sigma_2[R_1 - R_2] - \sigma_3 R_2}{\sigma_4 - \sigma_3} \tag{1.2c}$$

$$\vdots \qquad\qquad \vdots$$

$$R_{n-1}(\sigma_{a,n}) = \frac{\sigma_{a,n} - \sigma_1[1 - R_1] - (\sum_{i=2}^{n-2} \sigma_i[R_{i-1} - R_i]) - \sigma_{n-1} R_{n-2}}{\sigma_n - \sigma_{n-1}} \tag{1.2d}$$

Symbols:

- Lots and lots and lots of symbols
- Many need packages
  - Latexsym
  - Amsfonts
  - Amssymb
  - Wasysym
- Use a list of symbols

$\leq$	\leq	$\geq$	\geq	$\neq$	\neq
$\times$	\times	$\div$	\div	$\pm$	\pm
$\circ$	\^{}\{\circ\}	$\circ$	\circ	$\prime$	\prime
∞	\infty	$\neg$	\neg	$\wedge$	\wedge
$\supset$	\supset	$\forall$	\forall	$\in$	\in
$\subset$	\subset	$\exists$	\exists	$\notin$	\notin
$\cup$	\cup	$\cap$	\cap	$\mid$	\mid
$\dot{a}$	\dot a	$\hat{a}$	\hat a	$\bar{a}$	\bar a
α	\alpha	β	\beta	γ	\gamma
ϵ	\epsilon	ζ	\zeta	η	\eta
θ	\theta	ι	\iota	κ	\kappa
λ	\lambda	μ	\mu	ν	\nu
π	\pi	ρ	\rho	σ	\sigma
υ	\upsilon	ϕ	\phi	χ	\chi
ω	\omega	Γ	\Gamma	Δ	\Delta
Λ	\Lambda	Ξ	\Xi	Π	\Pi
Υ	\Upsilon	Φ	\Phi	Ψ	\Psi

www.rpi.edu/dept/arc/training/latex/LaTeX_symbols.pdf

Sub- and Superscripts:

SUBSCRIPT

- A_{sub}

$$A_{sub}$$

SUPERSCRIPT

- A^{super}

$$A^{super}$$

TASK 3

Math

- Enter the following equation in the document:

$$\iiint_V \left(\frac{\mu(t,u,v)}{4\pi}\right) dt\, du\, dv = 4\pi\alpha$$

- Hints:
  - Need amsmath package
  - Equation environment
  - Google it

TASK 3

Solution

```
\begin{equation}

   \iiint_V \frac{\mu(t,u,v)}{4\pi} dt \, du\, dv = 4\pi \alpha

\end{equation}
```

$$\iiint_V (\frac{\mu(t,u,v)}{4\pi}) dt\, du\, dv \ = 4\pi\alpha$$

Floats:

- Things that “float” in the document:
  - Tables
  - Figures
  - Custom floats
- Placement algorithm
- Text-to-Float ratio
  - If its to low – bad stuff happen



https://en.wikibooks.org/wiki/LaTeX/Floats,_Figures_and_Captions

Figures: 1/2

- Uses the **figure** environment
  - **[htbp]** = Where to place it
    - h = here
    - t = top
    - b = bottom
    - p = figure page
    - H = HERE
- \includegraphics
  - **[options]** = scaling ++
    - Eg. width=0.6\textwidth
  - **{sau.jpg}** = What picture to include
    - NB: notice formats

```
\begin{figure}[htbp]
    \includegraphics[options]{sau.jpg}
    \caption[]{}
    \label{fig:sau1}
\end{figure}
```

Figures: 2/2

- \caption**[]{}** = caption
  - **[]** = List of figures text
  - **{}** = Figure caption
- \label{fig:sau1}
  - The internal referencing part
  - Use \ref{fig:sau1} to reference

```
\begin{figure}[htbp]
    \includegraphics[options]{sau.jpg}
    \caption[]{}
    \label{fig:sau1}
\end{figure}
```

Tables: 1/2

- Uses the **table** environment
  - Usually in a float
- **{ c | c c }** = columns
  - c = centred
  - r = right
  - l = left
  - | = vertical line
- **&** = next column

```
\begin{table}[htpb]
    \begin{tabular}{ c | c c }
        Hest  & Ku    & Kylling   \\
        \hline
        1     & 10    & 0         \\
        2     & 5     & 10
    \end{tabular}
    \caption[]{}
\end{table}
```

Tables: 2/2

- **//** = end line
- **\hline** = Horizontal line
- Other parts to notice
  - Rotating = rotate the table
  - Multiline = multiline cells

```
\begin{table}[htpb]
    \begin{tabular}{ c | c c }
        Hest  & Ku     & Kylling    \\
        \hline
        1     & 10     & 0          \\
        2     & 5      & 10
    \end{tabular}
    \caption[]{}
\end{table}
```

TASK 4

Floats

- 1) Change the table to a float
  - Also add a caption
- 2) Add a figure
  - With a caption
  - Of a duck
- **Hint:** The graphicx package is needed

TASK 4

Solution

```
\begin{table}[htpb]
    \begin{tabular}{ c  c c }
        Hest    & Ku        & Kylling    \\
        1       & 10        & 0          \\
        2       & 5     & 10
    \end{tabular}
    \caption[a text in list]{ducks}
\end{table}
```

```
\begin{figure}[htbp]
    \includegraphics[options]{duck.jpg}
    \caption[text]{A figure of a duck}
    \label{fig:sau1}
\end{figure}
```

Error Handling:

- **Errors is a fact of life**
  - You cant avoid all of them
- **Compile often**
  - Especially when working with error prone stuff
- **Google it**
  - Someone always have had the same problem before
- **Acceptance**
  - Sometime you just need to accept some errors



https://www.sharelatex.com/learn/Errors
https://en.wikibooks.org/wiki/LaTeX/Errors_and_Warnings

File management

- One folder per project

- Give good filenames
  - Main.tex
  - Refferences.bib
  - Introduction.tex

- Take backup

Citation: 1/2

- Different versions:
  - Bibtex
  - Natbib
  - Biblatex
- Uses a .bib file
  - @ = entry
  - Different kinds of entry
- **\cite{**label**}**

\bibliographystyle{**[Citation style]**}

\bibliography{**[Name of reference file]**}

Citation: 2/2

- Consists of:
  - Type of entry
  - Label
  - Title
  - Name of author
  - Year
  - ect

```
@article{label1990,
    author = {Peter Adams},
    title = {The title of the work},
    journal = {The name of the journal},
    year = 1993,
    number = 2,
    pages = {201-213},
    month = 7,
    note = {An optional note},
    volume = 4
}
```

TASK 5

Citation

- Add the book «Snake Robots» as a citation

Pål Liljebäck
Applied Cybernetics
SINTEF ICT
Trondheim, Norway
and
Department of Engineering Cybernetics
Norwegian University of Science & Technology
Trondheim, Norway

Kristin Y. Pettersen
Department of Engineering Cybernetics
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Norwegian University of Science & Technology
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Jan Tommy Gravdahl
Department of Engineering Cybernetics
Norwegian University of Science & Technology
Trondheim, Norway

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TASK 5

Solution

```
@book{liljeback2012snake,
  title={Snake robots: modelling, mechatronics,
and control},
  author={Liljeb{\"a}ck, Pal and Pettersen,
Kristin Ytterstad and Stavdahl, Oyvind and
Gravdahl, Jan Tommy},
  year={2012},
  publisher={Springer Science \& Business Media}
}
```

Links:

- Slides and all information on:

pippidis.no

➔ LaTeX folder