VON001F: Thesis Skills

4.3 Document preparation tool: $\LaTeX$ overview

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Chapter Objectives

- Get an overview on LaTeX.

- Learn about strengths and weaknesses of LaTeX.

- Enable decision whether LaTeX suits you for thesis writing or not.

LaTeX: Introduction

- "LaTeX is a high-quality typesetting system;

- it includes features designed for the production of technical and scientific documentation.

- LaTeX is the de facto standard for the communication and publication of scientific documents.

- LaTeX is available as free software."

[https://www.latex-project.org/ Retrieved 1.10.2019]

- Note: pronunciation not defined.
    - The L^A comes from Leslie Lamport.
    - The T$_E$X is Greek, so the X at the end is the Greek letter chi.
    - But, typically pronounced as: "LAH-tekh" or "LAY-tekh".

LaTeX: History

- **1976/1977**: Computer Science professor Donald Knuth was dissatisfied with the quality of the printing of his book series "The Art of Computer Programming" (his father ran a printing company):

  - The traditional metal typesetting had been replaced by photo typesetting.

- **1977/1978**: Knuth started to develop $\TeX$, a computer typesetting system.

- **1982**: TeX released as we know it today.

- **1983**: Computer Science researcher Leslie Lamport wrote TeX macros to ease the use of TeX: $\LaTeX$

LaTeX: Idea

- When writing a document, you should be concerned with its logical content, not its visual appearance.

- Similar to, e.g., the HTML markup language, mark your text, e.g. whether it is a headline, bullet point, etc.

- Let a tool, i.e. LaTeX/TeX, take care of the visual appearance.

LaTeX: Example

- We want to write an article (using A4 paper), titled "Cartesian closed categories and the price of eggs" authored by Jane Doe, dated October 2019, that has an introduction section with some text, followed by a research question sub-section with some text.

- LaTeX code:

```
\documentclass[a4paper]{article}

\title{Cartesian closed categories and the price of eggs}
\author{Jane Doe}
\date{October 2019}

\begin{document}
\maketitle % Generate title using above info

\section{Introduction}
The price of eggs is a miracle to many consumers,
so are Cartesian closed categories.

This has never been investigated before.

\subsection{Research Question}
Is the price of eggs related to Cartesian closed categories?

\end{document}
```

Example inspired by: https://www.latex-project.org/about/

LaTeX: Result

- Need to run the LaTeX code through a LaTeX compiler.
    - E.g. Run on command line pdflatex tool for generating PDF:
      `pdflatex main.tex`
- Output:

Cartesian closed categories and the price of eggs

Jane Doe

October 2019

1 Introduction

The price of eggs is a miracle to many consumers, so are Cartesian closed categories.

This has never been investigated before.

1.1 Research Question

Is the price of eggs related to Cartesian closed categories?

LaTeX: Pros

- High-quality output.
  - Pleases the reader.

- Less hyphenation
  - Easier to read.

- Less big space between words.
  - Easier to read.

Picture source:
http://www.rtznet.nl/zink/latex.php?lang=en

Microsoft Word 2008

Call me Ishmael. Some years ago – never mind how long precisely – having little or no money in my purse, and nothing particular to interest me on shore, I thought I would sail about a little and see the watery part of the world. It is a way I have of driving off the spleen, and regulating the circulation. Whenever I find myself growing grim about the mouth; whenever it is a damp, drizzly November in my soul; whenever I find myself involuntarily pausing before coffin warehouses, and bringing up the rear of every funeral I meet; and especially whenever my hypos get such an upper hand of me, that it requires a strong moral principle to prevent me from deliberately stepping into the street, and methodically knocking people's hats off – then, I account it high time to get to sea as soon as I can. This is my substitute for pistol and ball. With a philosophical flourish Cato throws himself upon his sword; I quietly take to the ship. There is nothing surprising in this. If they but knew it, almost all men in their degree, some time or other, cherish very nearly the same feelings towards the ocean with me.

Adobe InDesign CS4

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pdf-LaTeX 3.1415926

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LaTeX: Pros

- Fluency of writing mathematical expressions.
  - Use same code inside text and as separate formula:

```
Sum $\sum_{n=1}^{\infty} 2^{-n} = 1$ inside text
```
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```
$$\sum_{n=1}^{\infty} 2^{-n} = 1$$
```
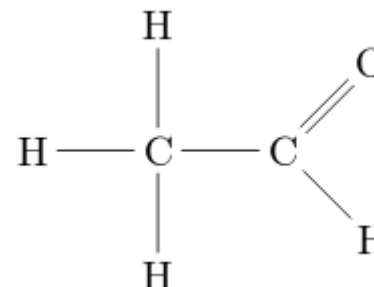$$\sum_{n=1}^{\infty} 2^{-n} = 1$$

```
Integral $\int_{a}^{b} x^2 dx$ inside text
```
Integral $\int_a^b x^2 dx$ inside text

```
$$\int_{a}^{b} x^2 dx$$
```
$$\int_a^b x^2 dx$$

- There is macro package for everything, e.g. Chemistry:

```
\usepackage{chemfig}

\chemfig{H-C(-[2]H)(-[6]H)-C(=[1]O)-[7]H}
```

Code examples and output from:
https://www.overleaf.com/learn/latex/Integrals,_sums_and_limits

LaTeX: Pros

- Ease of referencing literature.
  - LaTeX automatically adjust references to literatures, e.g. if new literature is added.
  - No matter whether you use [number] or (Author, year) style.

```
Two items are cited: \textit{The
\LaTeX\ Companion} book
\cite{latexcompanion}, the Einstein
journal paper, and the Donald Knuth's
website \cite{knuthwebsite}.
The \LaTeX\ related items are
\cite{latexcompanion, knuthwebsite}.
```

```
Three items are cited: \textit{The
\LaTeX\ Companion} book
\cite{latexcompanion}, the Einstein
journal paper \cite{einstein}, and the
Donald Knuth's
website \cite{knuthwebsite}.
The \LaTeX\ related items are
\cite{latexcompanion, knuthwebsite}.
```

Two items are cited: *The LaTeX Companion* book [1], the Einstein journal paper, and the Donald Knuth's website [2]. The LaTeX related items are [1, 2].

Three items are cited: *The LaTeX Companion* book [1], the Einstein journal paper [2], and the Donald Knuth's website [3]. The LaTeX related items are [1, 3].

References

[1] Michel Goossens, Frank Mittelbach, and Alexander Samarin. *The LaTeX Companion*. Addison-Wesley, Reading, Massachusetts, 1993.

[2] Donald Knuth. Knuth: Computers and typesetting.

Code examples and output from:
https://www.overleaf.com/learn/latex/Bibliography_management_with_bibtex

References

[1] Michel Goossens, Frank Mittelbach, and Alexander Samarin. *The LaTeX Companion*. Addison-Wesley, Reading, Massachusetts, 1993.

[2] Albert Einstein. Zur Elektrodynamik bewegter Körper. (German) [On the electrodynamics of moving bodies]. *Annalen der Physik*, 322(10):891–921, 1905.

[3] Donald Knuth. Knuth: Computers and typesetting.

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LaTeX: Pros

- Can automate tasks for you. E.g.
  - Abbreviations/acronyms:
    - Expand them automatically, when they are first used, use later only short form. (No need to keep track of first usage.)

```
\acrodef{CCC}{Cartesian Closed Category}
The price of eggs is a miracle to many consumers, so are \acp{CCC}.
Is the price of eggs related to \acp{CCC}?
```

The price of eggs is a miracle to many consumers, so are Cartesian Closed Categorys (CCCs). Is the price of eggs related to CCCs?

  - When you include source code listings:
    - Do automatic syntax highlighting.

```
\begin{lstlisting}[language=Python]
import numpy as np

def incmatrix(gen1,gen2):
    m = len(gen1)
```

```python
import numpy as np

def incmatrix(gen1, gen2):
    m = len(gen1)
```

Code example and output from:
https://www.overleaf.com/learn/latex/Code_listing

LaTeX: Pros

- LaTeX and TeX are free software.
  - Both free as in "free beer" and as in "free speech".
    - Many different editors supporting LaTeX,
    - There is a macro package for everything,
      - Tons of packages providing exactly the functionality you need.
    - You can extend LaTeX by writing your own macros.
    - You do not have to pay.

- Escape the Microsoft universe:
  - No more Word documents containing macros installing ransomware encrypting your hard disk.
  - No more software phoning home transmitting data to Microsoft.
  - No license fees.

LaTeX: Cons

- No "what you see is what you get" (WYSIWYG):
  You do not see the result immediately.
  - Instead: Focus on writing,
  - trust that the tool does the formatting.

- Running LaTeX compiler locally is fast, though.
- When using a LaTeX cloud offering
  (e.g. overleaf.com):
  - Transmitting the output to your browser is slow!

LaTeX: Cons

- **Some formatting is tedious**, e.g.
  - Tables are not fun.
    - Use a tool to generate LaTeX code for tables.

  - Sometimes, LaTeX needs hints to get optimal formatting.

Output from:
https://www.overleaf.com/learn/latex/%5Coverfullrule

```
Inside this vbox
we'll set the linewidth ■
to 30mm using \hsize=30mm. ■
We are typesetting
some text inside a
\vbox because it will ■
cause TEX to perform ■
linebreaking and build ■
the paragraph as a
stack of horizontal boxes. ■
For some lines TEX
might be unable to ■
find a good linebreak ■
which can result in
lines too wide to fit
```

  - E.g. you have to write "`2.\ October`" instead of "`2. October`", because LaTeX otherwise thinks that the "." ends a sentence. (LaTeX adds extra space at the end of a sentence – that you do not want to have at end of "2.").
  - If LaTeX cannot hyphenate a word, it rather gives up than producing non-optimal output.

```
\begin{tabular}{||c c c c||}
\hline
Col1 & Col2 & Col2 & Col3 \\ [0.5ex]
\hline\hline
1 & 6 & 87837 & 787 \\
\hline
2 & 7 & 78 & 5415 \\
\hline
3 & 545 & 778 & 7507 \\
\hline
4 & 545 & 18744 & 7560
\hline
5 & 88 & 788 & 6344 \\ [1ex]
\hline
\end{tabular}
```

Col1	Col2	Col2	Col3
1	6	87837	787
2	7	78	5415
3	545	778	7507
4	545	18744	7560
5	88	788	6344

Code example and output from:
https://www.overleaf.com/learn/latex/Tables

Note the extra space?!

```
2. October 2019

2.\ October 2019
```

2. October 2019
2. October 2019

LaTeX: Cons

- It is more like a programming language (in fact, it *is*):
  - You need to learn the LaTeX language.
    - Learning curve. But plenty of documentation online:
      - You will find the solution for your problem.
  - You may even get compiler errors need to debug your code, e.g. if you placed a closing bracket is missing.

Summary

- Use LaTeX if you
  - have more than one math formula,
  - want to use referencing to literature that simply works,
  - have no problems in doing programming-style markup of your text,
  - have no problem with a learning curve.
    - Hard to say where break even is, but my claim is that for an average M.Sc. thesis, it pays off to learn and use LaTeX.
  - do not want to run Microsoft code (or cannot, e.g, as Linux user).

- Do not use LaTeX if you
  - do not need high-quality formatting, but need quick results,
  - want to see immediately the output (WYSIWYG),
  - are afraid of programming-style markup.

Exercise and Outlook

- **Homework:**
  - This deck of slides contains at least one slide that is an example of bad academic practise: which one?

- **Outlook:**
  - Next: lecture on Microsoft Word.
  - Knowing the pros and cons should enable you decide what document preparation tool you want to use.
  - Later, two parallel classes:
    - Hands-on usage of LaTeX with HÍ thesis template for those who want to use LaTeX.
    - Hands-on usage of MS Word for those who want to use MS Word.