Chapter 1

Introduction to LaTeX

1.1 Plan of the Day

9:30–11:00	Introduction to LaTeX
11:00–12:30	Mathematics in LaTeX
13:00–14:30	Graphics and tables
14:30–16:00	Bibliography management
16:00–16:30	LaTeX style files: `muthesis`, `IEEEtran`

1.2 Why LaTeX?

- Extensive support of mathematical notation
- Article templates for IEEE, SIAM, ...
- Professional (beautiful) look of documents
- Predefined document classes
- High amount of custom functionality provided with packages
- User-defined notation
- Word hyphenation
- Content separation from layout
- Interactive cross-referencing (hyperref)
- Flexible and powerful bibliography management (BibTeX)

1.3 What is LaTeX?

- Text markup and programming language (HTML analogy)
- Compilation approach opposite to WYSIWYG
- Content ↔ Layout
- Elements are positioned with commands and environments
- Authors: Donald Knuth [2], Leslie Lamport [3]
- Pronunciation: "X" as in *loch* or *Bach*
- Meaning: TeX abbr. for "techne", Greek for "art", "craft", root of word "technical"

1.4 How Does LaTeX Work?

- Three steps: Edit → Compile → View
- Source file `*.tex` is created by user in a text editor
- Source file is compiled with LaTeX or PDFLaTeX
- Resulting file in DVI, PS or PDF format is viewed with a file viewer

1.5 LaTeX Command and LaTeX Environment

1.5.1 Command

```
\command[options]{arguments}
```

```
\documentclass[12pt,a4paper]{article}
```

- Commands begin with the backslash symbol "\"
- Command names are case-sensitive

1.5.2 Environment

```
\begin{environment}
...
\end{environment}
```

```
\begin{document}
...
\end{document}
```

1.6 Minimal Document

```
\documentclass{article}

\begin{document}
  The truth is out there...
\end{document}
```

1.7 Typical Document Structure

```
\documentclass{...}      % preamble

\usepackage{...}         % package inclusion

\begin{document}         % top matter

\title{...}
\author{...}
\date{...}

\maketitle

\section{...}            % main body
\subsection{...}

\appendix                % appendices
\section{...}
\subsection{...}

\bibliographystyle{...}  % bibliography
\bibliography{...}

\end{document}
```

1.8 Main Document Classes

```
\documentclass{article}
```

`article`	scientific articles, generic publications
`IEEEtran`	articles in IEEE Transactions
`report`	reports, documents > articles
`book`	books, documents > reports ≫ articles (even/odd pages)
`beamer`	presentations, lecture notes, handouts
`sciposter`	scientific posters (columns, portrait, landscape)
`muthesis`	BSc, MSc, PhD theses, UoM
`letter`	letters (address, signature)

1.9 Document Class Options

```
\documentclass[10pt,a4paper,twocolumn,twoside,draft]{article}
```

`10pt`	font size
`a4paper`	A4 paper size
`twocolumn`	two column
`twoside`	double sided (page numbers, margins, headers)
`draft`	draft version (no images, err. hyphenation, justification)

1.10 Sectioning Commands

- `\part{...}` book only
- `\chapter{...}` book, report only
- `\section{...}`
- `\subsection{...}`
- `\subsubsection{...}`
- `\paragraph{...}`
- `\subparagraph{...}`
- No sectioning commands in the `letter` class
- Optional short title with `\section[...]{...}`
- Unnumbered section with `\section*{...}`

1.11 Cross-Referencing

- Cross-referencing any numbered element
  (equation, theorem, figure, listing, section, page)
- Label an element with `\label{S:intro}`
- Refer to an element with `\ref{S:intro}`
- Denote element types in labels explicitly with `C, S, T, F, E`
- Use unbreakable space "~" before the reference `~\ref{S:intro}`

1.12 Example of Cross-Referencing

```
\section{Introduction}
\label{S:intro}

\section{Summary}
\label{S:summary}

Section~\ref{S:intro} provides a concise introduction.
```

1.13 Type Faces

Syntax	Example	Result
`\textrm{...}, {\rm ...}`	`{\rm Roman}`	Roman
`\textbf{...}, {\bf ...}`	`{\bf Bold Face}`	**Bold Face**
`\textit{...}, {\it ...}`	`{\it Italic}`	*Italic*
`\textsl{...}, {\sl ...}`	`{\sl Slanted}`	*Slanted*
`\textsf{...}, {\sf ...}`	`{\sf Sans Serif}`	Sans Serif
`\texttt{...}, {\tt ...}`	`{\tt True Type}`	`True Type`
`\textsc{...}, {\sc ...}`	`{\sc Small Caps}`	SMALL CAPS

- Curly brackets "{" and "}" limit the scope of a command
- Use the `\emph{}` command to emphasize:

  `All mass is \emph{interaction.}` → All mass is *interaction.*

1.14 Verbatim

- Short (inline) verbatim with `\verb|...|`

```
Special characters in \LaTeX{} include \verb|# $ % ^ & _ { } ~ \|.
```

Special characters in LaTeX include `# $ % ^ & _ { } ~ \`.

```
In MATLAB matrices may be initialised
with functions \verb|zeros()|, \verb|ones()| or \verb|rand()|.
```

In MATLAB matrices may be initialised with functions `zeros()`, `ones()` or `rand()`.

- Long verbatim with the `verbatim` environment

```
\begin{verbatim}
  Z = zeros(1,5)

  Z = 0 0 0 0 0
\end{verbatim}
```

```
Z = zeros(1,5)

Z = 0 0 0 0 0
```

1.15 Text Sizes

`{\tiny ...}`	`{\tiny Black White}`	Black White
`{\scriptsize ...}`	`{\scriptsize Black White}`	Black White
`{\footnotesize ...}`	`{\footnotesize Black White}`	Black White
`{\small ...}`	`{\small Black White}`	Black White
`{\normalsize ...}`	`{\normalsize Black White}`	Black White
`{\large ...}`	`{\large Black White}`	Black White
`{\Large ...}`	`{\Large Black White}`	Black White
`{\LARGE ...}`	`{\LARGE Black White}`	Black White
`{\huge ...}`	`{\huge Black White}`	Black White
`{\Huge ...}`	`{\Huge Black White}`	Black White

1.16 List Structures

1.16.1 Itemize

```
Number representations:

\begin{itemize}
  \item Decimal
  \item Binary
  \item Roman numerals
  \item Fractions
  \item Scientific notation
  \item Knuth's up-arrow
  \item Conway's chained arrow
\end{itemize}
```

Number representations:

- Decimal
- Binary
- Roman numerals
- Fractions
- Scientific notation
- Knuth's up-arrow
- Conway's chained arrow

1.16.2 Enumerate

```
Polygonal numbers:

\begin{enumerate}
  \item Triangular numbers
  \item Square numbers
  \item Pentagonal numbers
  \item Hexagonal numbers
  \item Heptagonal numbers
  \item Octagonal numbers
  \item Nanogonal numbers
  \item Decagonal numbers
  \item Dodecagonal numbers
\end{enumerate}
```

Polygonal numbers:

1. Triangular numbers
2. Square numbers
3. Pentagonal numbers
4. Hexagonal numbers
5. Heptagonal numbers
6. Octagonal numbers
7. Nanogonal numbers
8. Decagonal numbers
9. Dodecagonal numbers

1.16.3 Description

```
Algebraic numbers:

\begin{description}
  \item [Algebraic] number
  \item [Transcendental] number
  \item [Quadratic surd]
  \item [Constructible] number
  \item [Algebraic integer]
\end{description}
```

Algebraic numbers:

Algebraic number

Transcendental number

Quadratic surd

Constructible number

Algebraic integer

1.16.4 Nested Lists

- Only applicable to `itemize` and `enumerate` environments

```
\begin{itemize}

  \item Real numbers
    \begin{itemize}
      \item Rational numbers
      \item Irrational numbers
    \end{itemize}

  \item Complex numbers

\end{itemize}
```

- Real numbers
  - Rational numbers
  - Irrational numbers
- Complex numbers

1.17 Text Alignment Environments

```
\begin{flushleft}
  Viva Miami!
\end{flushleft}

\begin{center}
  Viva Miami!
\end{center}

\begin{flushright}
  Viva Miami!
\end{flushright}
```

Viva Miami!

Viva Miami!

Viva Miami!

1.18 Quotation Marks, Quotation Environments and Footnotes

- English quotation marks: ``mimetic equations'' → “mimetic equations”
- Quotations with the `quote` and `quotation` environments (short, long):

```
\begin{quotation}
  To those who do not know mathematics it is difficult to get across
  a real feeling as to the beauty, the deepest beauty, of nature...
  If you want to learn about nature, to appreciate nature, it is necessary
  to understand the language that she speaks in.%
  \footnote{Richard Feynman, The Character of Physical Law~(1965), Ch.~2}
\end{quotation}
```

> To those who do not know mathematics it is difficult to get across a real feeling as to the beauty, the deepest beauty, of nature... If you want to learn about nature, to appreciate nature, it is necessary to understand the language that she speaks in.[1]

[1] Richard Feynman, The Character of Physical Law (1965), Ch. 2

1.19 Exercises

1. Create a minimal LaTeX document that contains a phrase “Hello, World!”.
2. Start a new LaTeX document of class `article`. Supply a title of your research project with the `\title{}` command.
3. Add your name and the name of your supervisor(s) with the `\author{}` command, e.g. `\author{John Black, Jeremy Grey, Justin White}`.
4. Use the `\maketitle` command to produce a document title.
5. Include a short abstract with the `abstract` environment.
6. Add two sections to the article: one that gives a short motivation for your research (use the `itemize` environment) and another that highlights the main aims of your research (use the `enumerate` environment).
7. Supply labels for each section and refer to one of the sections in the main text.
8. Experiment with different font styles and text sizes.
9. Make use of the `verbatim` environment.
10. Add a phrase in quotation marks.
11. Enable the `url` package with the `\usepackage{url}` command in the document preamble. Include a URL into the main text with the `\url{}` command.
12. Add an appendix section to your document with the `\appendix` and `\section{}` commands.
13. Supply the table of contents for your document with the `\tableofcontents` command.

Bibliography

[1] (2012, Apr. 16) LaTeX Wikibook. [Online]. Available: http://www.wikibooks.org

[2] D. E. Knuth, *The TeXbook*. Addison-Wesley Professional, Jan. 11, 1984.

[3] L. Lamport, *LaTeX Document Preparation System, Users Guide & Reference Manual*, Oct. 1985.