An Introduction to LaTeX

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References

- *Learning LaTeX*
  Griffiths and Higham, SIAM 2016
  (second edition)
- *LaTeX : A Document Preparation System*
  Lamport, Addison-Wesley 1994
- *The LaTeX Companion*
  Mittelbach and Goossens, Addison-Wesley 2004
- A wealth of internet sources!

Basics

- typesetting package (not WYSIWYG)
- based on the TEX program by Don Knuth (Stanford, 1978)
- LATEX written by Leslie Lamport specifically for maths

  "a house built with wood and nails of TEX"

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"Although you can format an equation almost any way you want with LATEX , you have to work harder to do it wrong."

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  - `TeXworks` (for Windows operating systems) with MiKTeX;
  - `kile` (for Mac OS X and Linux operating systems);
  - `overleaf` (online at `https://www.overleaf.com/`).

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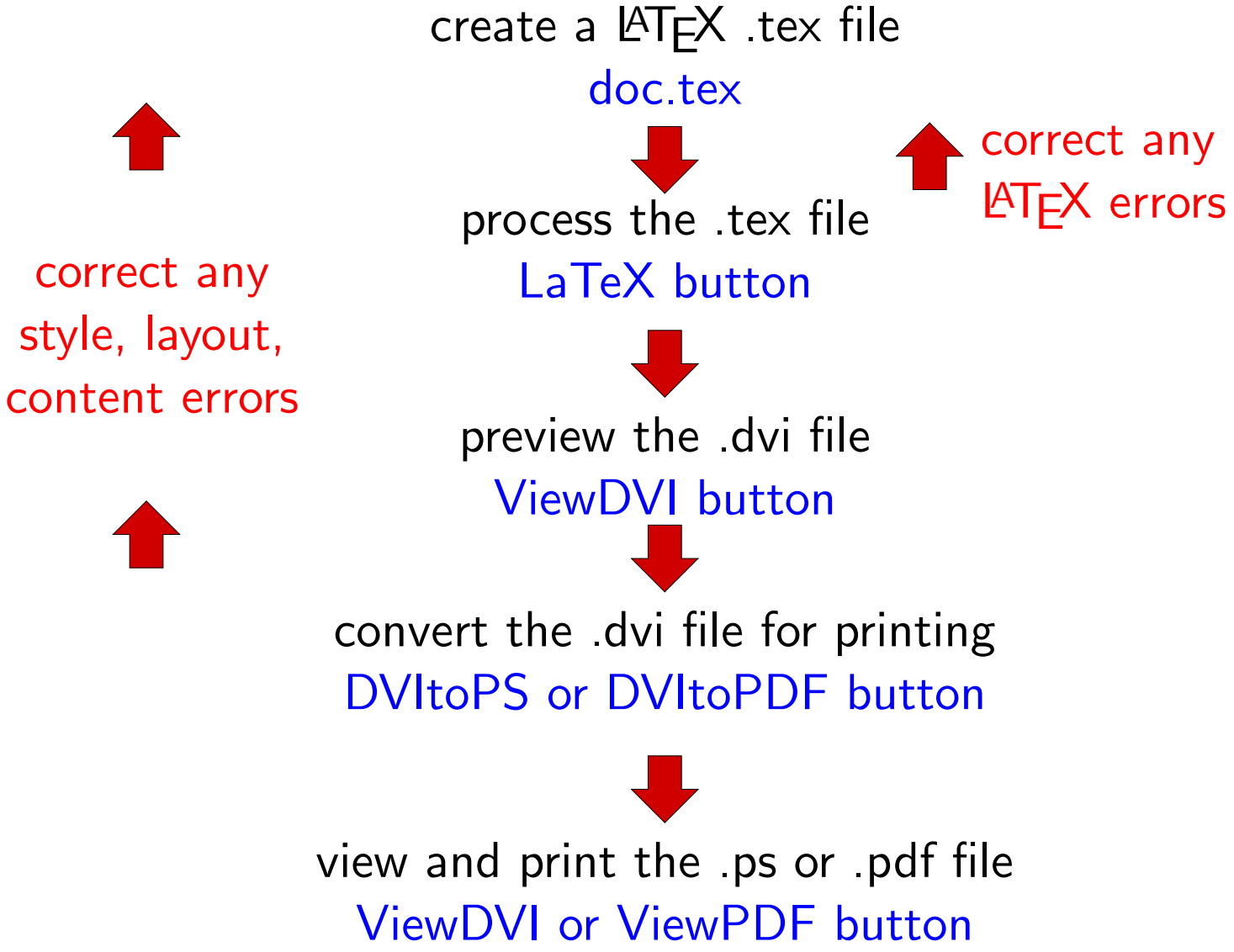
- All have many options which can be customised to your preferences once you have some experience.
- In this course we will use `TeXworks`.
- May need to configure PS or PDF viewing options for local architecture.

Overview


create a LaTeX .tex file
doc.tex
process the .tex file
LaTeX button
correct any
LaTeX errors
correct any
style, layout,
content errors
preview the .dvi file
ViewDVI button
convert the .dvi file for printing
DVItoPS or DVItoPDF button
view and print the .ps or .pdf file
ViewDVI or ViewPDF button

Notes

- If you are using internal references, you may get the message

  `LaTeX Warning: Label(s) may have changed. Rerun to get cross-references right.`

  You must then recompile the file by clicking the LaTeX button again.

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- Several different ways of producing a PDF file:
  - use the LaTeX button then DVItoPDF;
  - use the PDFLaTeX button to compile the file and produce a PDF file directly;
  - use the LaTeX button then DVItoPS followed by PStoPDF.

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- The previewing stage is very important: printing is expensive!

TeXworks Overview

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3. If there are no errors, a PDF file will appear containing your document.
4. If there is an error in your file, press the red cross button to cancel the process, correct the file and try again.

Exercises 1 and 2

In your .tex file

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- Special characters:

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  will be interpreted as LaTeX control characters.
- % acts as a 'comment' symbol: anything on the line after a % sign is ignored.
- Some commands have arguments:

  enclosed in { }: compulsory

  enclosed in [ ]: optional

Document structure

Each document has two parts:

- PREAMBLE

  This sets up the document class, type size, page settings etc.
  The first line must be

  ```
  \documentclass{STYLE}
  ```

  where STYLE is one of

  - article (includes sections and subsections)
  - report (includes chapters)
  - book (includes volumes)
  - letter
  - beamer (for slides)
  - a0poster (for posters)
  - ...

Preamble (cont.)

The preamble may also contain

- commands which define page size, margins etc, e.g.

```
\setlength{\textheight}{18.0cm}
\setlength{\topmargin}{1.2in}
\pagestyle{empty}
```

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- inclusion of any packages, e.g.
  ```
  \usepackage{amssymb}
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- user-defined new commands, e.g.
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  \usepackage{amssymb}
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- user-defined new commands, e.g.
  ```
  \newcommand{\fe}{finite element method}
  ```
- user-defined changes to default style, e.g.
  ```
  \renewcommand{\baselinestretch}{1.5}
  ```

Document structure (cont.)

- DOCUMENT BODY

  This contains the LaTeX commands to produce the document text.

```
\begin{document}
THE DOCUMENT TEXT GOES HERE.
\end{document}
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  - A document can be subdivided using

```
\chapter{...}
\section{...}
\subsection{...}
\subsubsection{...}
\Appendix
```

Document structure (cont.)

- Separate LaTeX input files can be included using

  `\input{`*filename*`}`

- A table of contents can be included using

  `\tableofcontents`

Sample document body:

```
\tableofcontents
\newpage
\input{chapter1}
\newpage
\input{chapter2}
```

SUMMARY

- A valid LaTeX document:

```
\documentclass{article}
\begin{document}
This is my first document.
\end{document}
```

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

This is all you need, but...

...hopefully your documents will be a little more sophisticated!

Exercise 3

Document style

- A title can be created with `\maketitle` which uses

  `\title{...}` `\author{...}` `\date{\today}`

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  `\textit{...}` `\textsc{...}` `\textsf{...}`
  `\textbf{...}` `\texttt{...}`

- Varying text size:

  `\tiny` `\scriptsize` `\footnotesize` `\normalsize`
  `\large` `\Large` `\LARGE` `\huge`
  `\Huge`

Some useful LaTeX concepts (1)

- environments

```
\begin{center}...\end{center}
\begin{itemize}...\end{itemize}
\begin{enumerate}...\end{enumerate}
\begin{description}...\end{description}
\begin{tabbing}...\end{tabbing}
\begin{tabular}...\end{tabular}
\begin{table}...\end{table}
\begin{figure}...\end{figure}
\begin{quote}...\end{quote}
\begin{verse}...\end{verse}
```

Exercise 4

Some useful LaTeX concepts (2)

- math mode

  All mathematics must be typeset in math mode. This can be done using dollar signs $...$, e.g.

```
Let $x$ be a real number.
```

Let x be a real number.

Some useful LaTeX concepts (2)

- math mode

  All mathematics must be typeset in math mode. This can be done using dollar signs $...$, e.g.

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Let $x$ be a real number.
```

  Let x be a real number.

- environments in math mode

```
\begin{displaymath}...\end{displaymath}
\begin{equation}...\end{equation}
\begin{array}...\end{array}
\begin{eqnarray}...\end{eqnarray}
\begin{eqnarray*}...\end{eqnarray*}
```

Examples of maths commands (1)

- maths fonts:

$$\mathcal{A} \quad \mathrm{A} \quad \mathit{A} \quad \mathrm{A} \quad \mathbf{A} \quad \mathtt{A}$$

```
\mathcal{A}, \mathrm{A}, \mathit{A},
\mathsf{A}, \mathbf{A}, \mathtt{A}
```

Examples of maths commands (1)

- maths fonts:

$\mathcal{A}$ \mathcal{A}, A \mathrm{A}, A A, A \mathit{A}, $\mathbf{A}$ \mathbf{A}, $\mathtt{A}$ \mathtt{A}

- Greek letters: α, β, γ, Γ, σ, Σ

\alpha,\beta,\gamma,\Gamma,\sigma,\Sigma

Examples of maths commands (1)

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- symbols: $\neq$, $\Leftrightarrow$, $\in$, $\sim$, ∇, ∂

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- symbols: $\neq$, $\Leftrightarrow$, $\in$, $\sim$, ∇, ∂

\ne,\Leftrightarrow,\in,\sim,\nabla,\partial

- variable-sized symbols: $\int$, $\oint$, $\sum$, $[$, $]$

\int, \oint, \sum, \left[, \right]

Examples of maths commands (2)

- subscripts and superscripts:

$$x_1, \quad y_{ij}, \quad z^{n+1}, \quad \lim_{x \rightarrow -1}, \quad \int_1^\infty$$

```
x_1,  y_{ij},  z^{n+1},
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```

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```
x_1, y_{ij}, z^{n+1},
\lim_{x\rightarrow -1}, \int_1^\infty
```

- fractions:

$$x = \frac{3 + \sin t}{t^2}, \qquad y = \frac{\partial x}{\partial t}$$

```
x=\frac{3+\sin{t}}{t^2}
y=\frac{\partial x}{\partial t}
```

Arranging formulae

- arrays: $A = \begin{bmatrix} 1 & 1 & 1 \\ x & y & z \\ x^2 & y^2 & z^2 \end{bmatrix}$

```
A=\left[\begin{array}{ccc}
1 & 1 & 1\\x & y & z\\x^2 & y^2 & z^2
\end{array} \right]
```

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A=\left[\begin{array}{ccc}
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\end{array} \right]
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- equation arrays:

$$\begin{aligned} x &= 17 + p^2 - 3p^5 \\ y &= \alpha - \theta \end{aligned} \tag{1}$$

```
\begin{eqnarray}
x&=&17+p^2-3p^5\\
y&=&\alpha - \theta\nonumber
\end{eqnarray}
```

A simple table

Team	Played	W	D	L	Goals	Points
Aberdeen	2	2	0	0	+10	6
Celtic	2	0	1	1	-5	1
Rangers	2	0	1	1	-5	1

```
\begin{center}
\begin{tabular}{||l||c|c|c|c|c|c|}
\hline
Team & Played & W & D & L & Goals & Points\\
\hline\hline
Aberdeen & 2 & 2 & 0 & 0 & +10 & 6\\\hline
Celtic & 2 & 0 & 1 & 1& -5 & 1 \\\hline
Rangers & 2 & 0 & 1 & 1& -5 & 1 \\\hline
\end{tabular}
\end{center}
```

Exercise 5

Cross-referencing

LaTeX can automatically number equations, references etc

- to label an equation: `\label{...}`

$$x = 1 \tag{2}$$

```
\begin{equation}
\label{eq1}
x=1
\end{equation}
```

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\end{equation}
```

- to refer to a label: `\ref{...}`

Using equation (2), we see that...

```
Using equation (\ref{eq1}), we see that...
```

Citing reference texts

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\begin{thebibliography}{99}
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- fancier methods available, e.g. bibtex

Including pictures

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- EXAMPLE
  - in preamble:
    ```
    \usepackage{graphicx}
    ```
  - in text:
    ```
    \begin{figure}[ht]
    \begin{center}
    \scalebox{0.3}{\includegraphics{fig.png}}
    \end{center}
    \caption{An example of including a picture.
    \label{fig1}}
    \end{figure}
    ```
- use scalebox to change the size of the picture

Packages and style files

- .sty, .cls files available from many sources:
  - colleagues and fellow students
  - publishers, e.g. siamltex, elsart
  - American Mathematical Society, e.g. amsfonts, amsmath, amssymb

    $\mathbb{R}$, $\mathbb{Z}$, $\mathbb{C}$

    `$\mathbb{R}$, $\mathbb{Z}$, $\mathbb{C}$`
  - UKTEX archive `http://www.tex.ac.uk`
  - Google search!
- include packages with the `\usepackage{packagename}` command

Slides and presentations

- beamer document class

```
\documentclass{beamer}
\begin{frame}...\end{frame}
```

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```

- slide style, colour etc. can be specified using the `\theme` and `\colortheme` commands.
- use standard themes or create your own
- a0poster document class for posters
- more information about these packages online

Support Material

Available from

`https://alisonramage.github.io/latex_course/`

• LaTeX notes	`LaTeXnotes.tex`
• sample file	`wpdoc.tex`
• sample figure	`fig1.png`
• slides from this talk	`LaTeXslides.tex`

Exercises 6 and 7