Week 1: Foundations of Computing, LaTeX
MSc/MRes CMEE 2014-15

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WHAT'S LATEX?

- In your research, you will produce papers, reports and – very importantly – your thesis

- These documents can be written using a WYSIWYG (What You See Is What You Get) editor (e.g., Word).

- However, an alternative especially suited for scientific publications is LATEX.

- In LATEX, the document is simply a text file (`.tex`)

- Text formatting is using markups (like HTML)

- The file is then "compiled" (like source code of a programming language) into a file – typically `.pdf`.

WHY LATEX?

- The input is a small, portable text file
- LATEX compilers are freely available for all OS'
- Exactly the same result on any computer (not true for Word)
- LATEX produces beautiful, professional looking docs (e.g., these slides!)
- Mathematical formulas (esp complex ones) are easy to write
- LATEX is very stable – current version basically same since 1994! (9 major versions of MS Word since 1994 – with compatibility issues)
- LATEX is free!
- Many journals provide LATEX templates, making formatting quicker
- Bibliographies are a breeze and work with Mendeley and Zotero
- Plenty of online support available – your question has probably already been answered
- You can integrate LATEX into a workflow to auto-generate lengthy and complex documents (like your thesis).
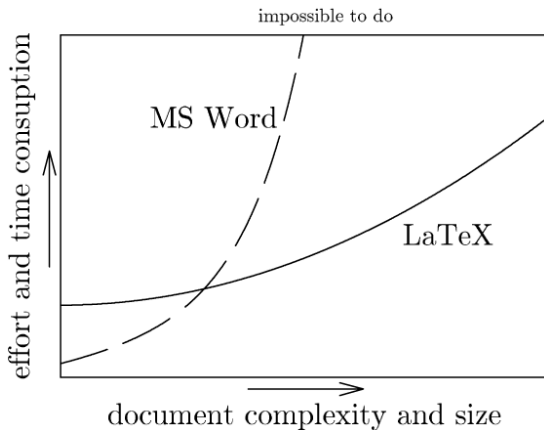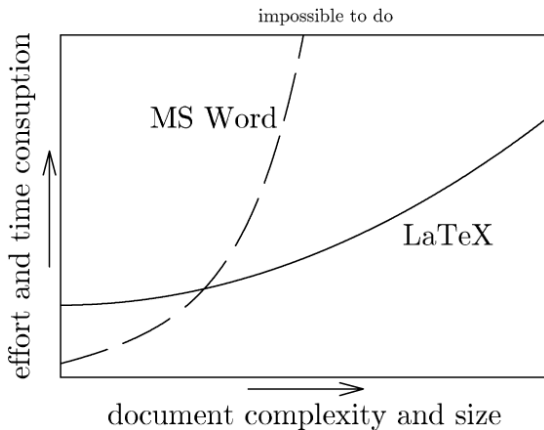
LIMITATIONS OF LATEX?

- It has a steeper learning curve.

- Can be difficult to manage revisions with multiple authors – especially if they don't use LATEX! (I have a dark secret)

- Typesetting tables can be a bit complex.

- Images and floats don't jump like Word, but if you don't use the right package, they can be difficult to place where you want!

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INSTALLING LATEX

```
sudo apt-get install texlive-full texlive-fonts-recommended latex-beamer texpower texlive-pictures
texlive-latex-extra texpower-examples imagemagick
```

We will use a text editor in this lecture, but you can use one of a
number of WYSIWYG frontends (e.g., `Lyx`, `TeXmacs`), as well as
GUI's (I like `Kile`)

- Open geany and type the following in a file
  `Week1/Code/Latex/FirstExample.tex`:

```
1  \documentclass[12pt]{article}
   \title{A Simple Document}
3  \author{Your Name}
   \date{}
5  \begin{document}
     \maketitle
7
   \begin{abstract}
9    Man, this paper was the shit!
   \end{abstract}
11
   \section{Introduction}
13   But I didn't understand anything
15 \section{Materials \& Methods}
   One of the most famous equations is:
17 \begin{equation}
     E = mc^2
19 \end{equation}
   This equation was first proposed by Einstein in 1905
21 \cite{einstein1905does}.
23 \bibliographystyle{plain}
   \bibliography{FirstBiblio}
25 \end{document}
```

FIRST LATEX EXAMPLE II

- Now, let's get a citation for Einstein's paper.
- In Google Scholar, go to "settings" (upper right corner) and choose BibTeX as bibliography manager.
- Now type "does the energy of a body einstein 1905"
- The paper should be the one on the top.
- Click " Import into BibTeX" should show the following text, that you will save in the file `FirstBiblio.bib` (in the same directory as `FirstExample.tex`)

```
1  @article{einstein1905does,
     title={Does the inertia of a body depend upon its energy-content?},
3    author={Einstein, A.},
     journal={Annalen der Physik},
5    volume={18},
     pages={639--641},
7    year={1905}
   }
```

- Now create a `.pdf` of the article

FIRST LATEX EXAMPLE III

- In the terminal type (be in the right directory!):

```
$ pdflatex FirstExample.tex
$ pdflatex FirstExample.tex
$ bibtex FirstExample
$ pdflatex FirstExample.tex
$ pdflatex FirstExample.tex
```

- This should produce the file `FirstExample.pdf`

A Simple Document

Your Name

Abstract

Man, this paper was the shit!

1 Introduction

BUt I didn't understand anything

2 Materials & Methods

One of the most famous equations is:

$$E = mc^2 \tag{1}$$

This equation was first proposed by Einstein in 1905 [1].

References

[1] A. Einstein. Does the inertia of a body depend upon its energy-content? *Annalen der Physik*, 18:639–641, 1905.

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A BRIEF LATEX TOUR I

- Spaces, new lines and special characters:
    - Several spaces in your text editor are treated as one space in the typeset document
    - Several empty lines are treated as one empty line
    - One empty line defines a new paragraph
    - Some characters are "special":# $ % ^ & _ { } ~ \.
    - To type these special characters, you have to add a "backslash" in front, e.g., \$ produces $.

A BRIEF LATEX TOUR II

- Document structure:
  - Each LATEX command starts with \ (e.g., to get LATEX, you need \LaTeX
  - The first command is always \documentclass defining the type of document (e.g., article, book, report, letter.
  - You can set several options. For example, to set size of text to 10 points and the letter paper size:
    \documentclass[10pt,letterpaper]{article}.

A BRIEF LATEX TOUR III

- After having declared type of document, you can specify packages you want to use. The most useful are:
    - `\usepackage{color}`: use colors for text in your document.
    - `\usepackage{amsmath,amssymb}`: American Mathematical Society formats and commands for typesetting mathematics.
    - `\usepackage{fancyhdr}`: fancy headers and footers.
    - `\usepackage{graphicx}`: include figures in pdf, ps, eps, gif and jpeg.
    - `\usepackage{listings}`: typeset source code for various programming languages.
    - `\usepackage{rotating}`: rotate tables and figures.
    - `\usepackage{lineno}`: line numbers.

- Once you select the packages, you can start your document with `\begin{document}`, and end it with `\end{document}`.

- There a lots of useful LATEXtemplates out there
- As an example of structure of a document, take the article template provided by the journal PNAS.

```
   \documentclass{pnastwo}
2  \usepackage{amssymb,amsfonts,amsmath}
   %% For PNAS Only:
4  \contributor{Submitted to Proceedings
   of the National Academy of Sciences of the United States of America}
6  \url{www.pnas.org/cgi/doi/10.1073/pnas.0709640104}
   \copyrightyear{2014}
8  \issuedate{Issue Date}
   \volume{Volume}
10 \issuenumber{Issue Number}

12 \begin{document}
   \title{My Title}
14 \author{Some Name \affil{1}{Imperial College London, UK} \and
   Some O. Name\affil{2}{University of Exeter, Penryn, Corwall, UK}}
16 \maketitle
   \begin{article}
18 \begin{abstract}
   Mind blowing abstract.
20 \end{abstract}
   \keywords{term1 | term2 | term3}
22
```

LATEX TEMPLATES II

```
%% Main text of the paper
24  \dropcap{I}n this work, we show how \LaTeX can be used to typeset a PNAS paper. Lorem ↩
        ipsum dolor sit amet, consectetur adipiscing elit. Phasellus sodales consectetur ↩
        lobortis. Proin tincidunt eros dapibus ipsum faucibus sed rhoncus augue mollis. ↩
        In lectus velit, interdum at adipiscing quis, imperdiet sed justo. Praesent ↩
        commodo, mi iaculis tincidunt mollis, sapien lectus aliquam neque, ac faucibus ↩
        arcu est eu sem. Ut non lacus lacus, eu suscipit odio. Aliquam erat volutpat. ↩
        Vivamus dapibus pretium nunc, et placerat turpis bibendum mollis. Fusce eu mi ut ↩
        nulla accumsan viverra. In nulla tellus, ultrices ut venenatis nec, laoreet eget ↩
        diam. Pellentesque aliquam facilisis ultricies. Vestibulum sollicitudin leo non ↩
        neque vehicula a volutpat eros faucibus. Vestibulum nec lorem dui.

26  \begin{materials}
    These are the materials and methods.
28  \end{materials}

30  \begin{acknowledgments}
    -- text of acknowledgments here, including grant info --
32  \end{acknowledgments}

34  \end{article}
    \end{document}
```

- I have added some templates in the `CMEEMasteRepo` that you should have a look and play around with

TYPESETTING MATH I

- There are two ways to display math
- First, one can produce inline mathematics (i.e., within the text).
- Second, one can produce stand-alone, numbered equations and formulae.
- For inline math, the "dollar" sign flanks the math to be typeset
- For example, the code:

```
$\int_0^1 p^x (1-p)^y dp$$
```

- Becomes $\int_0^1 p^x (1 - p)^y dp$

TYPESETTING MATH II

- For numbered equations (almost always a great idea),
  LaTeX provides the `equation` environment:

```
\begin{equation}
\int_0^1 \left(\ln \left( \frac{1}{x} \right)
\right)^y dx = y!
\end{equation}
```

- Becomes:

$$\int_0^1 \left(\ln \left(\frac{1}{x} \right) \right)^y dx = y! \tag{1}$$

- LaTeX has a full set of symbols and operators (plenty of lists online)

- Long documents can be split into separate `.tex` documents and combined using `input`

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- Figures can be included using the `graphicx` package

- You can use Mendeley to export and maintain `.bib` files

You can redefine environments and commands in the preamble

READINGS

- The Visual LaTeX FAQ: sometimes it is difficult to describe what you want to do!
  http://get-software.net/info/visualFAQ/visualFAQ.pdf

- Myriad online resources for LaTeX, including:
  www.http://en.wikibooks.org/wiki/LaTeX/Introduction,
  www.ctan.org/tex-archive/info/lshort/english/
  http://ftp.uni-erlangen.de/mirrors/CTAN/info/lshort/
  english/lshort.pdf

- Beautiful presentations in LaTeX:
  http://tug.org/pracjourn/2005-2/miller/miller.pdf

- Bibliographies in LaTeX:
  http://schneider.ncifcrf.gov/latex.html