LaTex intro

LaTex

Why using LaTex?

Generally,

- Broad range of formatting templates: simple reports to journal articles and books
- Very easy control over large documents having multiple chapters and sections, cross-references, …
- Complete and beautiful set of mathematical symbols and formulas

For this class,

- You will practice working with LaTex math equations
- Beautiful assignments that are easy to read

Overleaf

- We recommend using an online LaTex editor, overleaf
    - No installation requirements
    - Very fast to compile

https://www.overleaf.com/

- Some essential LaTex commands are summarized in this presentation

Full guide: https://www.overleaf.com/learn

Preamble

Editor

PDF

.tex file starts with preamble that includes all information about formatting the document and required packages and parameters.

```latex
1  \documentclass[12pt,letterpaper]{article}
2  \usepackage{fullpage}
3  \usepackage[top=2cm, bottom=4.5cm, left=2.5cm,
   right=2.5cm]{geometry}
4  \usepackage{amsmath,amsthm,amsfonts,amssymb}
5  \usepackage{fancyhdr}
6  \usepackage{xcolor}
7  \usepackage{graphicx}
8  \usepackage{esvect}
9
10 \setlength{\parindent}{0.0in}
11 \setlength{\parskip}{0.05in}
12
13 \newcommand\course{CMPT 727}
14 \newcommand\semester{Spring 2023}
15 \newcommand\hwnumber{1}
16 \newcommand\NetIDa{Your Name}
17 \newcommand\NetIDb{301XXYYZZ}
18
19 \pagestyle{fancyplain}
20 \headheight 35pt
21 \chead{\textbf{\Large Assignment \hwnumber}}
22 \rhead{\course \\ \semester}
23 \lhead{\NetIDa \\ \NetIDb}
```

Preamble

Editor

PDF

\documentclass{12pt,letterpaper}{article}

Document general formatting, font size, physical size, ...

Preamble

\usepackage{fullpage}
\usepackage{top=2cm, bottom=4.5cm, left=2.5cm, right=2.5cm}{geometry}
You can change default options of used documentclass, for example modifying the margins with geometry package.

Preamble

Editor

PDF

\usepackage{amsmath,amsthm,amsfonts,amssymb}
Required commands for typesetting math documents are stored in these packages by American Math Society (ams).

```
1   \documentclass[12pt,letterpaper]{article}
2   \usepackage{fullpage}
3   \usepackage[top=2cm, bottom=4.5cm, left=2.5cm,
    right=2.5cm]{geometry}
4   \usepackage{amsmath,amsthm,amsfonts,amssymb}
5   \usepackage{fancyhdr}
6   \usepackage{xcolor}
7   \usepackage{graphicx}
8   \usepackage{esvect}
9
10  \setlength{\parindent}{0.0in}
11  \setlength{\parskip}{0.05in}
12
13  \newcommand\course{CMPT 727}
14  \newcommand\semester{Spring 2023}
15  \newcommand\hwnumber{1}
16  \newcommand\NetIDa{Your Name}
17  \newcommand\NetIDb{301XXYYZZ}
18
19  \pagestyle{fancyplain}
20  \headheight 35pt
21  \chead{\textbf{\Large Assignment \hwnumber}}
22  \rhead{\course \\ \semester}
23  \lhead{\NetIDa \\ \NetIDb}
```

Preamble

\usepackage{xcolor}
Colored fonts.
\usepackage{graphicx}
Required commands for embedding the image filed in the document.

Editor

PDF

```
1   \documentclass[12pt,letterpaper]{article}
2   \usepackage{fullpage}
3   \usepackage[top=2cm, bottom=4.5cm, left=2.5cm,
    right=2.5cm]{geometry}
4   \usepackage{amsmath,amsthm,amsfonts,amssymb}
5   \usepackage{fancyhdr}
6   \usepackage{xcolor}
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8   \usepackage{esvect}
9
10  \setlength{\parindent}{0.0in}
11  \setlength{\parskip}{0.05in}
12
13  \newcommand\course{CMPT 727}
14  \newcommand\semester{Spring 2023}
15  \newcommand\hwnumber{1}
16  \newcommand\NetIDa{Your Name}
17  \newcommand\NetIDb{301XXYYZZ}
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19  \pagestyle{fancyplain}
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21  \chead{\textbf{\Large Assignment \hwnumber}}
22  \rhead{\course \\ \semester}
23  \lhead{\NetIDa \\ \NetIDb}
```

Preamble

Most commands you need are available in mentioned packages, but you may search for and use other packages for more beautiful or complex typesetting. For example: \usepackage{esvect}

For typesetting vectors, for example different kinds of arrowheads are available.

Preamble

Editor

PDF

You can use \newcommand to define commands (functions) given arguments or parameters.

Preamble

Editor

PDF

Adding the assignment and your information to the fancy header.

The document begins from here.

Text formatting

Text formatting defaults are specified in preamble.

You can still change the formatting of specific words, sentences, paragraphs, …

Font sizes

Command	Output
\tiny	Lorem ipsum
\scriptsize	Lorem ipsum
\footnotesize	Lorem ipsum
\small	Lorem ipsum
\normalsize	Lorem ipsum
\large	Lorem ipsum

Command	Output
\Large	Lorem ipsum
\LARGE	Lorem ipsum
\huge	Lorem ipsum
\Huge	Lorem ipsum

Text formatting

Text formatting defaults are specified in preamble.

You can still change the formatting of specific words, sentences, paragraphs, …

Font styles

style	command	switch command	output
medium	\textmd{Sample Text 0123}	\mdseries	Sample Text 0123
bold	\textbf{Sample Text 0123}	\bfseries	**Sample Text 0123**
upright	\textup{Sample Text 0123}	\upshape	Sample Text 0123
italic	\textit{Sample Text 0123}	\itshape	*Sample Text 0123*
slanted	\textsl{Sample Text 0123}	\slshape	*Sample Text 0123*
small caps	\textsc{Sample Text 0123}	\scshape	SAMPLE TEXT 0123

13

Math equations

```
11
12   The inline equation is \( x^2 + y^2 = 1\).
13
14   In math display mode, you can write the equation in its own paragraph:
15   \[ x^2 + y^2 = 1.\]
16
17   You may need aligning multiline equations using align environment:
18   \begin{align*}
19   y & = (x+y)^2 \\
20   & = x^2 + y^2 + 2xy
21   \end{align*}
22
23
```

The inline equation is $x^2 + y^2 = 1$.

In math display mode, you can write the equation in its own paragraph:

$$x^2 + y^2 = 1.$$

You may need aligning multiline equations using align environment:

$$\begin{aligned} y &= (x+y)^2 \\ &= x^2 + y^2 + 2xy \end{aligned}$$

Basic math operations

Arithmetic:

- 3 + 2 ➜ $3 + 2$
- 3 - 2 ➜ $3 - 2$
- 3 \times 2 ➜ 3×2
- 3 \div 2 ➜ $3 \div 2$
- 3 \cdot 2 ➜ $3 \cdot 2$
- \frac{3}{2} ➜ $\frac{3}{2}$

Subscript and superscript:

- x_2 ➜ x_2
- x^2 ➜ x^2
- x_2^2 ➜ x_2^2
- X_{ij} ➜ x_{ij}
- e^{kx} ➜ e^{kx}

Other math operations and symbols

Arrows

←	\leftarrow	⇐	\Leftarrow
→	\rightarrow	⇒	\Rightarrow
↔	\leftrightarrow	⇌	\rightleftharpoons
↑	\uparrow	↓	\downarrow
⇑	\Uparrow	⇓	\Downarrow
⇔	\Leftrightarrow	↕	\Updownarrow
↦	\mapsto	⟼	\longmapsto
↗	\nearrow	↘	\searrow
↙	\swarrow	↖	\nwarrow
↼	\leftharpoonup	⇀	\rightharpoonup
↽	\leftharpoondown	⇁	\rightharpoondown

Functions

Integrals, sums and products:

\int_{x=0}^{\infty} \ln(x) \ dx $\int_{x=0}^{\infty} \ln(x) \ dx$

\sum_{x=1}^{n} f(x) $\sum_{x=1}^{n} f(x)$

\prod_{x=1}^{n} f(x) $\prod_{x=1}^{n} f(x)$

\prod\limits_{x=1}^{n} f(x) $\prod\limits_{x=1}^{n} f(x)$

Text and spacing in math mode

- Text is also assumed as a math variable by default:

  x^2 + y^2 = 1 and x < y ➜ $x^2 + y^2 = 1 and x < y$

  x^2 + y^2 = 1 \ \text{and} \ x < y ➜ $x^2 + y^2 = 1 \text{ and } x < y$

Tables

Tabular environment is used for drawing tables (**\usepackage{tabularx}**):

```
26  \begin{center}
27  \begin{tabular}{ c c c }
28   cell1 & cell2 & cell3 \\
29   cell4 & cell5 & cell6
30  \end{tabular}
31  \end{center}
32
33  \begin{center}
34  \begin{tabular}{ |c|c|c| }
35  \hline
36   cell1 & cell2 & cell3 \\
37   \hline
38  cell4 & cell5 & cell6 \\
39   \hline
40  \end{tabular}
41  \end{center}
42
```

| cell1 | cell2 | cell3 |
| cell4 | cell5 | cell6 |

cell1	cell2	cell3
cell4	cell5	cell6

Vectors and Arrays

\[\vv{v} = \langle 0,0,1 \rangle \]

$$\vec{v} = \langle 0, 0, 1 \rangle$$

```
\begin{matrix}
1 & 2 & 3\\
a & b & c
\end{matrix}
```

$$\begin{matrix} 1 & 2 & 3 \\ a & b & c \end{matrix}$$

```
\begin{pmatrix}
1 & 2 & 3\\
a & b & c
\end{pmatrix}
```

$$\begin{pmatrix} 1 & 2 & 3 \\ a & b & c \end{pmatrix}$$

```
\begin{bmatrix}
a_{11} & a_{12} & \cdots \\
a_{21} & a_{22} & \cdots \\
\vdots & \vdots & \ddots
\end{bmatrix}
```

$$\begin{bmatrix} a_{11} & a_{12} & \cdots \\ a_{21} & a_{22} & \cdots \\ \vdots & \vdots & \ddots \end{bmatrix}$$

Practicing math functions in overleaf

Graphical models and diagrams

- You may draw some figures and attach their images in your document

  \usepackage{graphicx}

  \includegraphics{/path/to/image}

  \includegraphics[scale = 1, angle = 45]{/path/to/image}

  \includegraphics[height = 4cm, width = 5cm]{/path/to/image}

  \includegraphics[width = \textwidth]{/path/to/image}

Graphical models and diagrams

- It is possible to draw bayesian networks or other diagrams in LaTex using tikz libraries
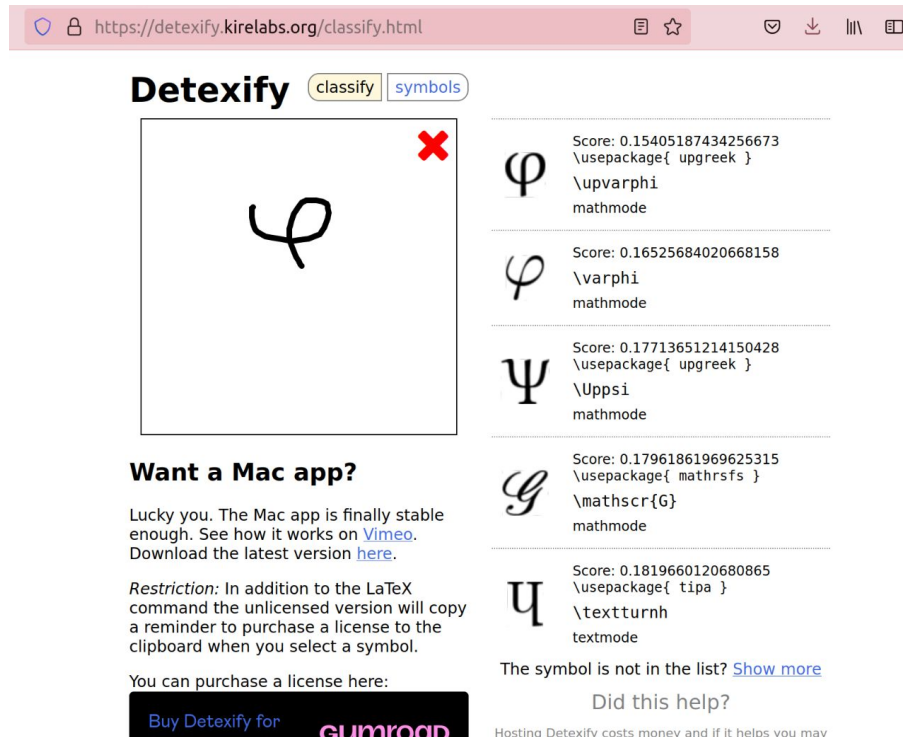
  \usetikzlibrary{bayesnet}

  \usetikzlibrary{arrows}

- Resources:
  - https://github.com/jluttine/tikz-bayesnet
  - https://medium.com/@xinyu.chen/awesome-latex-drawing-a-collection-of-academic-drawing-examples-using-latex-e07916b2c860

Useful tool, detexify

https://detexify.kirelabs.org/classify.html

Hand draw the symbol and it will suggest the closely looked symbols and their LaTex commands.

References

- https://www.overleaf.com/learn
- https://detexify.kirelabs.org/classify.html
- https://www.youtube.com/watch?v=fCzF5gDy60g
- https://github.com/jluttine/tikz-bayesnet
- https://medium.com/@xinyu.chen/awesome-latex-drawing-a-collection-of-academic-drawing-examples-using-latex-e07916b2c860