LaTeX: Online module 10

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Topics to be covered

- Mathematical accents
- Binary operation symbols
- Relational operators
- Delimiters
- Sub figures
- Exercises

Math accents

Use the following commands to generate mathematical accents:

- `$\hat{x}$`
- `$\vec{y}$`
- `$\tilde{a}$`
- `$\check{b}$`
- `$\grave{z}$`
- `$\acute{y}$`
- `$\breve{b}$`

to get the output as: $\hat{x}$, $\vec{y}$, $\tilde{a}$, $\check{b}$, $\grave{z}$, $\acute{y}$, $\breve{b}$

Binary operations

Use the following commands to generate binary operations:

- `$\pm f(x)$`
  Output: $\pm f(x)$
- `$\mp g(x)$`
  Output: $\mp f(x)$
- `$a \div b$`
  Output: $a \div b$
- `$f(x) \circ g(x) $`
  Output: $f(x) \circ g(x)$ for composition of functions.
- `$M_1\cdot M_2$`
  Output: $M_1 \cdot M_2$
- `$a \ast b$`
  Output: $a * b$

contd...

Some of the binary operations mentioned below are used mostly in mathematical logic.

- `$\cup$`
  Output: $\cup$
- `$\sqcup$`
  Output: $\sqcup$
- `$\cap$`
  Output: $\cap$
- `$\sqcap$`
  Output: $\sqcap$
- `$a \vee b$`
  Output: $a \vee b$
- `$a \wedge b$`
  Output: $a \wedge b$

contd...

Some of them mentioned below are used mostly in linear algebra courses; dagger and ddagger symbols are mostly found in journal articles beside the authors names.

- `$\odot$`
  Output: $\odot$
- `$\oplus$`
  Output: $\oplus$
- `$\ominus$`
  Output: $\ominus$
- `$\otimes$`
  Output: $\otimes$
- `$\dagger$`
  Output: $\dagger$
- `$\ddagger$`
  Output: $\ddagger$

Relational operators

Most of the operators are used in basic calculus courses.

- `$A \parallel B$`
  Output: $A \parallel B$
- `$$A \perp B$$`
  Output: $A \perp B$
- `$x \sim y$`
  Output: $x \sim y$
- `$x \simeq y$`
  Output: $x \simeq y$
- `$a \ll b$`
  Output: $a \ll b$
- `$a \gg b$`
  Output: $a \gg b$

contd...

- `$A \neq B$`
  Output: $A \neq B$
- `$$A \equiv B$$`
  Output: $A \equiv B$
- `$a \approx b$`
  Output: $a \approx b$
- `$x \asymp y$`
  Output: $f(x) \asymp g(x)$
- `$ \mid$`
  Output: $\mid$ (for absolute value)
- `$ a\cong b$`
  Output: $a \cong b$

contd...

Most of them are used in mathematical logic and set theory.

- `$A \subset B$`
  Output: $A \subset B$
- `$A \subseteq B$`
  Output: $A \subseteq B$
- `$A \supset B$`
  Output: $A \supset B$
- `$A \supseteq B$`
  Output: $A \supseteq B$
- `$ f(x) \in D$`
  Output: $f(x) \in D$
- `$ f(x) \ni D$`
  Output: $f(x) \ni D$

contd...

- `$\exists $`
  Output: $\exists$
- `$\forall$`
  Output: $\forall$
- `$\emptyset$`
  Output: $\emptyset$
- `$A \notin B$`
  Output: $A \notin B$
- `$ \Join$`
  Output: $\bowtie$
- `$ f(x)\propto g(x)$`
  Output: $f(x) \propto g(x)$ (proportional symbol)
- `$ \infty$`
  Output: ∞

Variable sized symbols

- `$\coprod $`
  Output: $\coprod$
- `$\bigotimesl$`
  Output: $\bigotimes$
- `$\bigoplus$`
  Output: $\bigoplus$
- `$A \bigvee B$`
  Output: $A \bigvee B$
- `$ \bigwedge$`
  Output: $\bigwedge$

Braces and bars

Braces and bars are useful in denoting specific terms in an equation (or, set of equations)

- `$\widetilde{f(x)g(y)}$`
  Output: $\widetilde{f(x)g(y)}$
- `$\overbrace{f(x)g(y)}$`
  Output: $\overbrace{f(x)g(y)}$
- `$\underbrace{f(x)g(y)}$`
  Output: $\underbrace{f(x)g(y)}$
- `$\widehat{f(x)g(y)}h(z)$`
  Output: $\widehat{f(x)g(y)}h(z)$
- `$ \overline{f(x)g(y)}h(z)$`
  Output: $\overline{f(x)g(y)}h(z)$

contd...

- `$ \underline{f(x)g(y)}h(z)$`
  Output: $\underline{f(x)g(y)}h(z)$
- `$\overrightarrow{f(x)g(y)}$`
  Output: $\overrightarrow{f(x)g(y)}$
- `$\overleftarrow{f(x)g(y)}$`
  Output: $\overleftarrow{f(x)g(y)}$

Notice that vector notation is different from the above arrow notations

Delimiters

Some of the basic delimiters are:

- `$ \langle$`
  Output: $\langle$
- `$ \rangle$`
  Output: $\rangle$
- `$ \lceil$`
  Output: $\lceil$
- `$ \rceil$`
  Output: $\rceil$
- `$ \lfloor$`
  Output: $\lfloor$
- `$ \rfloor$`
  Output: $\rfloor$

contd...

- `$ \slash$`
  Output: /
- `$ \vert$`
  Output: |
- `$ \Vert$`
  Output: ‖
- `$ \updarrow$`
  Output: ↑
- `$ \downarrow$`
  Output: ↓

Sub figures

- We often notice sub figures within a figure
- Use the package \usepackage{*subfig*} in the preamble of the document
- Code for inserting sub figures is the following:

```
\begin{figure}
  \centering
  \subfloat{\includegraphics[width=0.3\textwidth]
  {figurename1}}
  \subfloat{\includegraphics[width=0.3\textwidth]
  {figurename2}}
\end{figure}
```

Example1

Figures Hagey.jpg and three-founders.jpg should be in the same folder as the tex file

```
\begin{figure}
  \centering
  \subfloat{\includegraphics[width=0.3\textwidth]{hagey}}
  \subfloat{\includegraphics[width=0.3\textwidth]
  {three-founders}}
\end{figure}
```

contd...

Without any captions and label

Example2

- Labels and references can be given to any sub figure using the following code:

```
\begin{figure}
  \centering
  \subfloat[Hagey]{\includegraphics[width=0.4
  \textwidth]{hagey}}
  \subfloat[Three founders]{\includegraphics[width=0.4
  \textwidth]{three-founders}}
\caption{Sub figures example}
\label{fig:subfigs}
\end{figure}
```

contd...

With captions and label

(c) Hagey

(d) Three founders

Figure: Sub figures example

Par box command

- Par box command is used to structure the document when tables are encountered in the LaTeX file
- In general, tabular environment takes entire width of a page and using this command restricts the text area
- Any two tables can be placed side by side
- Code for using par box command is displayed in the following two slide

contd...

```
\begin{table}
\parbox{0.5\linewidth}
{ \centering
\begin{tabular}{|c|c|c|}
      Table1
    \end{tabular}
\caption{Table 1}
}
\begin{table}
\parbox{0.5\linewidth}
{ \centering
\begin{tabular}{|c|c|c|}
      Table2
    \end{tabular}
\caption{Table 2}
}
```

Example

```
\begin{table}
\parbox{0.45\linewidth}
{ \centering
\begin{tabular}{ | p{1.9cm}| p{4.1cm} |}
\hline
Department & Description \\ \hline
Applied Math & The Department of Applied
Mathematics was founded in 1967 and is one of five
academic units in the Faculty of Mathematics \\ \hline
Pure Math & Mathematics is both an art and
a science, and Pure Mathematics lies at its heart.
Pure Mathematics explores the boundary of
mathematics and pure reason. \\ \hline
 \end{tabular}
\caption{Sample Table1}
}
```

contd...

```
\hfill
\parbox{0.4\linewidth}{ \centering
\begin{tabular}{|p{1.95cm}|p{2cm}|}
      \hline
      {\it Departments} & {\it Number of faculty members}
      \\\hline
        Applied Math & $100$  \\\hline
      Pure Math & $75$ \\
       \hline
\end{tabular}
\caption{Sample Table2}
}
\end{table}
```

Output

Department	Description
Applied Math	The Department of Applied Mathematics was founded in 1967 and is one of five academic units in the Faculty of Mathematics
Pure Math	Mathematics is both an art and a science, and Pure Mathematics lies at its heart. Pure Mathematics explores the boundary of mathematics and pure reason.

Table: Sample Table1

Departments	*Number of faculty members*
Applied Math	100
Pure Math	75

Table: Sample Table2

Long documents

- Provides a very easy way to handle and break up large document into smaller sub documents
- The command reads contents of another LaTeX file and places it in the main file
- To address lengthy LaTeX files, use the command \input{file name} in the main file
- Example1 : Writing a book is often easier if each chapter is saved in a different file
- Example2 : This command is very much useful in thesis writing

Example

```
\documentclass[12pt]{report}
\usepackage{amssymb}
\usepackage{graphicx}
\usepackage{epsfig}
\usepackage{amsmath}
\usepackage{multirow}
\usepackage{amsmath}
\usepackage{subfig}

\begin{document}
\input{ch1.tex}
\input{ch2.tex}
\input{ch3.tex}
\end{document}
```

contd...

- Following is the content in one of the sub files, say ch1.tex that we had used in the example (go to previous slide)
- Notice that the sub files do not have any preamble nor the \begin{document} and \end{document} commands
- Remember that ch1.tex, ch3.tex, ch3.tex files should be saved in the same folder as the main tex file is located

Example of ch1.tex:

```
\chapter{History of University of Waterloo}
First chapter is written here...
\section{New section}
First section is written here
```

Exercises

- Generate the following equations:

$$\begin{aligned} F(x) &= \overbrace{f(x) \oplus g(x)h(x)} \\ F(x) &= \pm f(x) \bigotimes g(x) \\ F(x) &= \mp \vec{f}(x_1, x_2, x_3, \cdots, x_n) \end{aligned}$$

- Generate the following equation:

$$\forall x \; \exists y \text{ such that } y = f(x)$$

contd...

- Download 3 .jpg figures in your folder and try to generate sub figures within a figure
- Take a sample document which is lengthy and break it up into various sub files. Use the input command to include all the sub documents