LATEXLecture 2

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1 Figures

1.1 Single Figure

Figures need graphicx package.

```
\usepackage{graphicx}.
```

```
\begin{figure}[h]
\centering
\includegraphics[width=0.3\textwidth]{buetlogo.png}
\caption{Logo of BUET}
\label{fig:logobuet}
\end{figure}
```


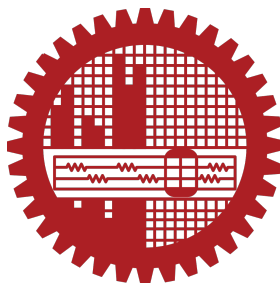Figure 1: Logo of BUET

1.2 Multiple Figures

You have to include subcaption package for side by side images.

```
\usepackage{subcaption}
```

```
\begin{figure}[h]
```

```
\centering
\begin{subfigure}{0.4\textwidth}
\centering
\includegraphics[width=0.8\textwidth]{ubuntulogo.png}
\caption{Ubuntu}
\end{subfigure}
~
\begin{subfigure}{0.4\textwidth}
\centering
\includegraphics[width=0.8\textwidth]{kalilogo.png}
\caption{Kali Linux}
\end{subfigure}
\caption{Linux Distributions}
\end{figure}
```


(a) Ubuntu   (b) Kali Linux

Figure 2: Linux distributions

2   Equation

2.1   Simple Equation

This is a simple equation: $a + a = 2a$
`$a + a = 2a$`
This is not math mode: a + a = 2a.

3   Superscript and Subscript

Use _ for subscript, e.g. `$a_n$` shows a_n.
Use ^ for superscript, e.g. `$a^n$` shows a^n.
Use {} to group more than one characters, e.g. `$a_{in}$` shows a_{in}.
Also `$^nP_r$` gives us ^nP_r.

More complex equation, `$$\sum_{i=0}^n a_i$$` shows

$$\sum_{i=0}^{n} a_i$$

.

3.1   Mathematical Environments

Inline: `$\sum_{i=0}^n a_i$`
Inline with displaystyle: `$\displaystyle\sum_{i=0}^n a_i$`
Block level: `$$\sum_{i=0}^n a_i$$`
Block level with equation number:

```
\begin{equation}
\sum_{i=0}^n a_i
\end{equation}
```

Block level without equation number:

```
\begin{equation*}
\sum_{i=0}^n a_i
\end{equation*}
```

Notice the difference in output.
Inline: $\sum_{i=0}^n a_i$

Inline with displaystyle: $\displaystyle\sum_{i=0}^{n} a_i$

Block level:

$$\sum_{i=0}^{n} a_i$$

Block level with equation number:

$$\sum_{i=0}^{n} a_i \tag{1}$$

Block level without equation number:

$$\sum_{i=0}^{n} a_i$$

3.2   Equation Labeling

$$\sum_{i=0}^{n} a_i \tag{2}$$

```
\begin{equation}
\label{eq:sum}
\sum_{i=0}^n a_i
\end{equation}
```

Equation 2 shows sum of numbers from zero to n.

3.3 Equation Alignment

$$A = \frac{\pi r^2}{2}$$
$$= \frac{1}{2} \pi r^2$$

```
\begin{align*}
A & = \frac{\pi r^2}{2} \\
 & = \frac{1}{2} \pi r^2
\end{align*}
```

3.4 Cases

$$|x| = \begin{cases} x & \text{if } x \geq 0 \\ -x & \text{if } x < 0 \end{cases} \qquad (3)$$

```
\begin{equation}
    |x| =
    \begin{cases}
    x & \textrm{if } x \geq 0\\
    -x & \textrm{if } x < 0\\
    \end{cases}
\end{equation}
```

3.5 Miscellaneous

For some of the commands, you need to include `amsmath` package.

Comparisons:
`$ < \leq $` shows, $<\leq$
`$ > \geq $` shows, $>\geq$

Set operations:
`\forall x \in X, \exists y \leq \epsilon`

$$\forall x \in X, \exists y \leq \epsilon$$

A \cap B, A \cup B

$$A \cap B, A \cup B$$

Limits and Infinity:
\lim_{x \to \infty} \exp(-x) = 0

$$\lim_{x \to \infty} \exp(-x) = 0$$

Fractions:
\frac{a}{b}

$$\frac{a}{b}$$

Binomials:
\binom{n}{k}

$$\binom{n}{k}$$

Times:
a \times b

$$a \times b$$

Root:
square root: $\sqrt{a}$, \sqrt{a}
nth root: $\sqrt[n]{a}$, \sqrt[n]{a}

Modular:
a \bmod b, a \pmod b, a \equiv b

$$a \bmod b, a \pmod{b}, a \equiv b$$

Integrals:
\int_a^b xdx

$$\int_a^b xdx$$

Plus minus:
a \pm 5, a \mp 5

$$a \pm 5, a \mp 5$$

Trigonometry:
\cos2\theta = \cos^2 - \sin^2

$$\cos 2\theta = \cos^2 - \sin^2$$

Derivatives:

`\frac{du}{dt} \quad \frac{\partial u}{\partial t}`

$$\frac{du}{dt} \quad \frac{\partial u}{\partial t}$$

Custom operator:

`\textrm{cos}2\theta = \textrm{cos}^2 - \textrm{sin}^2`

$$\cos2\theta = \cos^2 - \sin^2$$

3.6 Find More Symbols

Visit `http://detexify.kirelabs.org/classify.html` and draw symbol by hand.

3.7 Autometic Sizing of Parentheses/Braces/Brackets

`(\frac{a}{b})`

$$(\frac{a}{b})$$

`\left(\frac{a}{b}\right)`

$$\left(\frac{a}{b}\right)$$

3.8 Matrices

matrix

```
\begin{equation}
\begin{matrix}
1 & 0 & 0\\
0 & 1 & 0\\
0 & 0 & 1\\
\end{matrix}
\end{equation}
```

$$\begin{matrix} 1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & 1 \end{matrix} \tag{4}$$

pmatrix

```
\begin{equation}
\begin{pmatrix}
1 & 0 & 0\\
0 & 1 & 0\\
0 & 0 & 1\\
\end{pmatrix}
\end{equation}
```

$$\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \tag{5}$$

bmatrix

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \tag{6}$$

Change the matrix environment to $pbBvV$ matrix in the following equation and observe the output:

4 Bibliography

Process of compiling external bib file (assuming tex file name is doc.tex, it does not matter what the bib file name is):

```
pdflatex doc.tex
bibtex doc
pdflatex doc.tex
pdflatex doc.tex
```

Refer to a work/paper/journal by `\cite{tag}`. You can get BibTex from Google Scholar.

For example, Convolutional Neural Network (CNN) [2] has been sucessfully applied in various areas of computer vision. Large datasets like ImageNet [1] can be used in trainning a CNN.

References

[1] Jia Deng, Wei Dong, Richard Socher, Li-Jia Li, Kai Li, and Li Fei-Fei. Imagenet: A large-scale hierarchical image database. In *2009 IEEE conference on computer vision and pattern recognition*, pages 248–255. Ieee, 2009.

[2] Yann LeCun, Léon Bottou, Yoshua Bengio, Patrick Haffner, et al. Gradient-based learning applied to document recognition. *Proceedings of the IEEE*, 86(11):2278–2324, 1998.