

An Introduction to L^AT_EX

Ketan Kotwal

IIT Bombay

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Outline

- 1 Diving into \LaTeX
- 2 How does \LaTeX document look?
- 3 Text Typesetting
- 4 Math Typesetting
- 5 Float Placement
- 6 Referencing
- 7 Thanks

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What is \TeX ?

- \TeX is a low level markup language for typesetting text and mathematical formulae.
- Written by Donald E. Knuth in 1977.
- Purpose was to explore the potential of digital printing equipment.

What is \LaTeX ?

- \LaTeX is a macro package that uses \TeX formatter for typesetting.
- More powerful than \TeX for typesetting of mathematical formulae.
- Enables user to publish work at the highest typographical quality, using a predefined, professional layout.
- Originally written by Leslie Lamport, now maintained by Frank Mittelbach.
- Resources: www.ctan.org

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i.e., Advantages of \LaTeX

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Why L^AT_EX?

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- Very convenient to manage complex and big projects.
- Typesetting maths formulae is way better !
- Large number of add-on packages are available.
- Portable and Free !! 😊

Disadvantages of \LaTeX

- Need to know (a few) commands.
- Not like any other WYSIWYG editors.
- You may not have control over exact appearance of document.
- Design of new layout is a tough job.


Some common misconceptions

- TeXworks, WinEdt, LyX, or Kile do not mean \TeX or \LaTeX . They are just the editors or IDEs.

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In fact, pdflatex does not work with eps files.

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- I need eps image for inclusion. No, you may as well work with png, jpeg, tif, or tiff files.
In fact, pdf \LaTeX does not work with eps files.
- \LaTeX produces very dull text. No, you can make it quite colorful as well !! 

Special characters

Don't forget to take care of these!!!

- Like every other programming language, L^AT_EX has a set of special characters.
- # \$ % ^ & _ { } ~ \
- Printing them directly will lead to some mess, instead use them with backslash (\), i.e.,

```
\#    \$    \%    \^    \&
\_    \{    \}    \~    \textbackslash
```

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Commands

- Start with `\`, and are followed by the command name consisting of letters only.
- Or, start with `\` followed by exactly one non-letter.
- For certain commands, a star can be appended to the command name.
- Command arguments are given in `{ }`, and the optional parameters are given in `[]`.
`\command[option1, option2, ...]{arg1, arg2, ...}`

Example

This is an example of `\textbf{bold}` text.

This is an example of **bold** text.

Environments

- Similar to commands, used for larger parts.
- The whole document is an environment itself.
- Enclosed using `\begin` and `\end` commands.

```
\begin{environment name}  
    ...  
\end{environment name}
```

Comments

- Lines can be commented using `%`, similar to Matlab.

Example

```
This is a  
% general example of  
comment.
```

Output: This is a comment.

- One can use `comment` environment as well.

Structure of L^AT_EX document

<code>\documentclass{...}</code>	the first command
<code>\usepackage{...}</code>	include required packages
<code>...</code>	preamble
<code>\begin{document}</code>	start writing in document environment
<code>...</code>	the matter
<code>\end{document}</code>	terminate the document environment

Steps in creating a document

- 1 Create a new file with `.tex` extension, and open it using any text editor.
- 2 Enter the content, save the file.
- 3 Compile for `pdflatex` two times.
`pdflatex <filename.tex>`
- 4 If compiled for `latex`, then you may want to convert into `ps`, or `pdf` using `dvi2ps` and `dvi2pdf` utilities.

My first \LaTeX document!

Example

```
1 \documentclass{article}
```

My first L^AT_EX document!

Example

```
1 \documentclass{article}
2 \begin{document}

5 \end{document}
```

My first L^AT_EX document!

Example

```
1 \documentclass{article}
2 \begin{document}
3 Hello, World!
   This is my first document in \LaTeX.
4
5 \end{document}
```

My first L^AT_EX document!

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2 \begin{document}
3 Hello, World!
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Example

Output:

Hello, World! This is my first document in L^AT_EX.

Files associated with \LaTeX

`tex` \LaTeX (or \TeX) input file.

`sty` \LaTeX macro package (`usepackage`).

`cls` \LaTeX class file (`documentclass`).

`bib` Bibliographic entries.

`bak` Backup file of tex document.

`log` Logging of last compilation.

`aux`, `toc`, `lof`, `lot`, `bbl` Auxiliary files to store compiler output.

Sections of Document

A \LaTeX document begins with `\documentclass[options]{class}`

Typical document classes supported by \LaTeX :

`article` scientific journals, short reports, presentations.

`report` thesis, small books.

`book` complex class for books

`letter` letters, drafts

`minimal` basic minimum configuration for debugging

`slides /beamer` for presentations (like this!)

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Typical options for `\documentclass`:

Font size `10pt`, `11pt` `12 pt`.

Paper size `a4paper`, `a5paper`, `letterpaper`.

No. of columns `onecolumn`, `twocolumn`.

No. of sides `oneside`, `twoside`.

Packages

- Packages contain various functions similar to utilities.
- These are basically collection of L^AT_EX commands.
- Include in the tex file using `\usepackage` command in the preamble.
- If not available locally, download from <http://tug.ctan.org/search.html>.

Parts of document

A report or a paper consists of several sections many of them are supported by \LaTeX .

- Regular text:
 - part
 - chapter
 - section
 - subsection
 - subsubsection
 - paragraph
 - subparagraph
- Abstract is an environment. (`\begin{abstract}`)
- `\appendix` can be added and separately numbered.

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Fonts

`\textbf{...}`

This is **bold** text.

`\textit{...}`

A sample of *italics* text.

`\emph{...}`

Almost no difference in *emphasized* text.

`\textsl{...}`

However *slanted* text is different.

`\textsf{...}`

Sans-serif font for emails.

`\textrm{...}`

This is Roman style.

`\textsc{...}`

SMALL CAPS is useful for headings or captions.

`\underline{...}`

Specific words can also be underlined.

Font sizes

tiny	Introduction to L ^A T _E X.
scriptsize	Introduction to L ^A T _E X.
footnotesize	Introduction to L ^A T _E X.
small	Introduction to L ^A T _E X.
large	Introduction to L ^A T _E X.
Large	Introduction to L ^A T _E X.
LARGE	Introduction to L ^A T _E X.
huge	Introduction to L ^A T _E X.
Huge	Introduction to L ^A T _E X.

Text as it is

At some places you may want the text to appear “as is”.

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WEL phone no is: +91 22 25764412.

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WEL phone no is: +91 22 25764412.

- `\fbox` does the same along with box around it.

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Hyphenation

L^AT_EX provides 3 (or 4) types of hyphen-

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`en-dash` page 128--142
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`hyphen` technology-based
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`en-dash` page 128--142
page 128–142

`em-dash` Will you come---yes or no?
Will you come—yes or no?

`minus sign (math mode)` $\$10-5=5\$$
 $10 - 5 = 5$

The “Quotations”

- We wish to quote “this” way, and not ”this” way.
The starting single quote (‘) is typeset by ‘ and not by ’ this.
- Starting double quote is ‘ ‘
- To end single quoted statement, use ’.
- For double quote, either ’ ’ or ” can be used.

Exercise

THIS is the **first** exercise in *latex* just to illustrate the use of different font-families including— roman, and sans serif. It also provides teletype fonts, e.g.: `www.yahoo.com`. It also provides “`—`” command to keep the text together in a box, like- 98989 98989.

Solution

`\textsc{This}` is the `\textbf{first}` exercise in `\textit{latex}` just to illustrate the use of different font-families including---
`\textrm{roman}`, and `\textsf{sans serif}`. It also provides teletype fonts, e.g.: `\texttt{www.yahoo.com}`. It also provides ‘‘ ---’’ command to keep the text together in a box, like- `\fbox{98989 98989}`.

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- `\!` inserts “negative space” of width $\frac{-3}{18}$ quad.
- One or more empty lines mark end of paragraph.
- To indicate a forced end of sentence (usually after uppercase character) use `\@`.
- To insert an unbreakable space, use `\sim`.
- To avoid ligatures, use `\{ }`, so that its not “fi”, but its “fi”.

Listing I

\LaTeX provides 3 structures for listing:

```
\begin{itemize}
  \item first ..
  \item second...
\end{itemize}
```

```
\begin{enumerate}
  \item first ..
  \item second...
\end{enumerate}
```

Example

- first ..
- second...

Example

- 1 first ..
- 2 second...

Listing II

```
\begin{description}
  \item first ..
  \item [second] ...
\end{description}
```

```
\begin{itemize}
  \item first ..
  \item{
    \begin{itemize}
      \item nested first
      \item nested second
    \end{itemize}}
\end{itemize}
```

Example

```
first ..
second ...
```

Example

- first ..
- - nested first
 - nested second

Miscellaneous

- Accents: `H\^{o}tel`, `Na\"{i}ve`, `\c{c}a va` will produce
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Hôtel, Naïve, ça va
- `\footnote{text}` can be used to create footnotes.¹
- `\url` from the `url` package to create hyperlinks.
`www.yahoo.com`

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Exercise

THIS completes an overview of most of the text typesetting commands. It mainly includes-

- font types
- font sizes
- ‘quotations’
- hyphens

These listing environments are quite efficient.² However `s p a c i n g` is bit tricky. For any extra help, you may always use www.google.com.

²It allows nesting as well.

Solution

`\textsc{This}` completes an `\underline{overview}` of most of the text typesetting commands.

It mainly includes-

`\begin{itemize}`

`\item font types`

`\item font sizes`

`\item 'quotations'`

`\item hyphens`

`\end{itemize}`

These listing environments are quite

efficient.`\footnote{It allows nesting as well.}`

However `\verb"s p a c i n g"` is bit tricky. For any extra help, you may always use `\fbox{\url{www.google.com}}`.

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For typesetting advanced math formulae, we need *AM*ST_EX package.
Add `\usepackage{amsmath}` in preamble.
Equations can be written only in math mode.

- In-line equations are typeset within $\$$, or within `\(\)`.
- A stand alone equation should be written using equation environment.

Symbols, symbols, and symbols

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- Trigonometric and logarithmic identities:
`\sin`, `\cosh`, `\exp`, `\log`, `\ln`
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- Calculus: `\sum`, `\prod`, `\int`, `\iint`, `\oint`
 \sum , \prod , \int , \iint , \oint

Powers, Indices, and Fractions

- \LaTeX uses \wedge for superscript, and $_$ for subscript.

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Example

`a^2, x^y, \theta_s`

$a^2, \quad x^y, \quad \theta_s$

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`\int_{-\infty}^{\infty} \sin(4\pi + \theta) \, d\theta`

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- \LaTeX uses `^` for superscript, and `_` for subscript.

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Example

`\frac{x^k}{\sum_{i=0}^k (x-1)^k}`
 $\frac{x^k}{\sum_{i=0}^k (x-1)^k}$

Exercise

$$\lim_{x \rightarrow \infty} e^{(-x)} = 0$$

$$\frac{\frac{1}{x} + \frac{1}{y}}{x + y}$$

$$\nabla \times B = \mu_0 J + \mu_0 \epsilon_0 \frac{\partial E}{\partial t}$$

$$\frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{x^2}{2\sigma^2}}$$

`\nabla` = ∇ `\times` = \times `\partial` = ∂ `\to` = \rightarrow

Solution

$$\lim_{x \rightarrow \infty} e^{(-x)} = 0$$

$$\frac{\frac{1}{x} + \frac{1}{y}}{x+y}$$

$$\nabla \times \mathbf{B} = \mu_0 \mathbf{J} + \mu_0 \epsilon_0 \frac{\partial \mathbf{E}}{\partial t}$$

$$\frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{x^2}{2\sigma^2}}$$

Vectors and Matrices

- `\overrightarrow` produces \overrightarrow{z} vectors.
- Matrix or array entries are similar to those of table. Various matrix environments are available:

```
pmatrix ( )
bmatrix [ ]
Bmatrix { }
vmatrix | |
```

- You may use `\cdots`, `\vdots`, and `\ddots` to fill up a matrix.
- Any math symbol or operator can be used as a part of the matrix element.

Brackets and Delimiters

- As math expressions have varying sizes, it is important to have delimiters to suitable size.

- \LaTeX provides automatic sizing using `\left` and `\right`.

Without auto sizing: $\frac{1}{\sqrt{(2\pi\sigma^2)}} \exp(-\frac{x^2}{2\sigma^2})$

With auto sizing: $\frac{1}{\sqrt{(2\pi\sigma^2)}} \exp\left(-\frac{x^2}{2\sigma^2}\right)$

- Manual sizing is possible via a series of big commands.

 $(((((\{ \} \} \} \} \}$

Multiline Equations

- `\align` environment allows multiple equation.
 - Use `\\` to enter next line.
 - Use `\nonumber` if equation is not to be numbered.
 - Use `&` to align the equations on multiple lines.

Example

```
\begin{align}
z &= a_1 + a_2 + a_3 \nonumber \\
&+ a_4 + \epsilon \\
\end{align}
```

$$\begin{aligned}
 z &= a_1 + a_2 + a_3 \\
 &+ a_4 + \epsilon
 \end{aligned} \tag{1}$$

- Alternatively you may use `\eqnarray` environment.

Maths and Text

<code>\mathbf{...}</code>	A B a b
<code>\mathit{...}</code>	<i>A B a b</i>
<code>\mathfrak{...}</code>	$\mathfrak{A} \mathfrak{B} \mathfrak{a} \mathfrak{b}$
<code>\mathcal{...}</code>	$\mathcal{A} \mathcal{B} \neg \lfloor$
<code>\mathrm{...}</code>	A B Y Z
<code>\mathbb{...}</code>	$\mathbb{A} \mathbb{B} \mathbb{Y} \mathbb{Z}$
<code>\boldsymbol{...}</code>	$\alpha \zeta$

You can use `\text{...}` to include text inside math mode.

Exercise

$$\oint_{\partial S} \mathbf{E} \cdot d\mathbf{l} = -\frac{\partial \Phi_{B,S}}{\partial t}$$

$$H_x = - \int |\psi(x)|^2 \log_n |\psi(x)|^2 dx$$

$$\lambda = B \left(\frac{n^2}{n^2 - 4} \right) \qquad n = 3, 4, \dots$$

$$\left\| \int_a^b v(t) dt \right\| \leq \int_a^b \|v(t)\| dt, \text{ where, } v : [a, b] \rightarrow \mathbb{R}^m$$

Solution

```
\oint_{\partial S} \mathbf{E} \cdot \mathrm{d}
\mathbf{l} = - \frac{\partial \{\Phi\}_{B, S}}{\partial t}
```

```
H_x = - \int | \psi(x) |^2 \, , \, \log_n | \psi(x) |^2 \, , \, dx
```

```
\lambda = B \left( \frac{n^2}{n^2 - 4} \right)
\qquad \qquad n = 3, 4, \cdots
```

```
\left| \int_a^b v(t) \, dt \right| \leq \int_a^b
\left| v(t) \right| \, dt, \text{ where, }
v: [a,b] \rightarrow \mathbb{R}^m
```


Outline

- 1 Diving into \LaTeX
- 2 How does \LaTeX document look?
- 3 Text Typesetting
- 4 Math Typesetting
- 5 Float Placement**
- 6 Referencing
- 7 Thanks

What are floats?

- Floats are essentially the items that cannot be broken over a page.
- One can start a new page for every such entry, or use two environments provided by \LaTeX - *figure*, and *table*.
- Usually they are numbered, and have a caption; however we can eliminate the numbering and caption.

Figures

Figure environment:

```
\usepackage{graphicx}
```

```
\begin{figure}[pos]  
... figure contents ...  
\end{figure}
```

pos stands for positioning options:

h here

t top of the page

b bottom of the page

p on a separate page

! override other parameters

Including images

```
\includegraphics[arg1 = val1, ..]{path\to\figure}
\epsfig{width=XX, file=path\to\figure}
```

- `path\to \figure` is a filename of actual figure.
- File path is relative to the directory of main tex file.
- Do not use file extension.

Options for figures:

`width` Defines width of image.

`height` Defines height of image (Don't use both to preserve aspect ratio).

`scale` Defines scaling factor, can be a fraction.

`angle` Rotates image, angle measured counter clockwise.

`trim / b r t` Crops the image from all 4 directions.

Typical figure layout

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

```
\end{figure}
```

Typical figure layout

```
\begin{figure}[pos]  
  \centering
```

```
\end{figure}
```

- `\centering` is used to place figure at the center of allocated space for the float.

Typical figure layout

```
\begin{figure}[pos]  
  \centering  
  \caption{...}  
  
\end{figure}
```

- `\centering` is used to place figure at the center of allocated space for the float.
- `\caption` to assign caption to the figure.

Typical figure layout

```
\begin{figure}[pos]
  \centering
  \caption{...}
  \includegraphics[...]{...}

\end{figure}
```

- `\centering` is used to place figure at the center of allocated space for the float.
- `\caption` to assign caption to the figure.

Typical figure layout

```
\begin{figure}[pos]
  \centering
  \caption{...}
  \includegraphics[...]{...}
  \label{...}
\end{figure}
```

- `\centering` is used to place figure at the center of allocated space for the float.
- `\caption` to assign caption to the figure.
- `\label` for figure referencing (to be covered later...).

Subfloats

```
\usepackage{subfig}

\begin{figure}[pos]
\centering
\subfloat [caption]{
    \label{...}
    \includegraphics[opt]{filename}
}
...
...
\caption{...}
\label{...}
\end{figure}
```

Tables

```
\begin{tabular}{structure}
... table contents ...
\end{tabular}
```

l Left justified column

c Center justified column

r Right justified column

p{*width*} Top aligned text

| Vertical line

|| Double vertical line

Additional commands for tables

`&` Column separator

`\\` New line

`hline` Horizontal line

`cline{i-j}` Partial horizontal line (from column i to j)

`*{num}{style}` For multiple columns of similar nature

Example of table

Code:

```
\begin{tabular}{l | c || r | }
  1 & $\beta$ & 3 \\
  4 & 5 & 6 \\ \hline
  7 & 8 & Nine \\
\end{tabular}
```

Example

Output:

1	β	3
4	5	6
7	8	Nine

Typical table layout

```
\begin{table}[pos] [size]
```

```
\end{table}
```

size (optional) entry can be used to change the font size globally. e.g.:
`\scriptsize`, `\footnotesize`.

Typical table layout

```
\begin{table}[pos] [size]  
  \centering
```

```
\end{table}
```

size (optional) entry can be used to change the font size globally. e.g.:
`\scriptsize`, `\footnotesize`.

Typical table layout

```
\begin{table}[pos] [size]
  \centering
  \begin{tabular}

    \end{tabular}

\end{table}
```

size (optional) entry can be used to change the font size globally. e.g.:
`\scriptsize`, `\footnotesize`.

Typical table layout

```
\begin{table}[pos] [size]
  \centering
  \begin{tabular}
    ... table contents ...
  \end{tabular}
\end{table}
```

size (optional) entry can be used to change the font size globally. e.g.:
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Typical table layout

```
\begin{table}[pos] [size]
  \centering
  \begin{tabular}
    ... table contents ...
  \end{tabular}
  \caption{...}
  \label{...}
\end{table}
```

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Referencing with labels

\LaTeX provides 3 basic commands for referencing:

`label{marker}` To be given to the object to be referenced.

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Referencing with labels

\LaTeX provides 3 basic commands for referencing:

`label{marker}` To be given to the object to be referenced.

`ref{marker}` To be used while referencing the corresponding object.

`pageref{marker}` To be used while referencing the page number of the corresponding object.

You should compile the tex file twice as in 1st compilation \LaTeX creates a list of labels, and in 2nd compilation it replaces the ref tags.

A better usage of `\label`

We can label to almost everything that may need to be referenced. However, to avoid confusion some conventional prefixes are used before markers.

`fig` figure

`tb /tab` table

`eq` equation

`chap` chapter

`sec` section

`ss` subsection

e.g.: To label figure *test*, you may use: `\label{fig:test}`.

To reference the same in the text, you may use:

... in Fig.~`\ref{fig:test}`.

Creating bibliography

- You may append bib entries to the tex file itself.
- Or, you may create a separate file (reusable across projects).

Using embedded bibliography

- Use the environment `\thebibliography`.
- Every entry inside is a `\bibitem{cite-key}`.

You may download the bib entries in plain text format, or create one (which may require a little bit of text formatting such as *italic* or *emphasized names of journals*).

Example

```
\bibitem{proakis}
John G. Proakis and Dimitris G. Manolakis. 1996. \emph{Digital
Signal Processing (3rd Ed.): Principles, Algorithms, and
Applications.} Prentice-Hall, Inc., Upper Saddle River, NJ, USA.
```

Output:

John G. Proakis and Dimitris G. Manolakis. 1996. *Digital Signal Processing (3rd Ed.): Principles, Algorithms, and Applications*. Prentice-Hall, Inc., Upper Saddle River, NJ, USA.

Using BibTeX

- BibTeX allows you to separately create a list of necessary entries stored in *bibtex* format.
- The bib file should be included into the main tex file using `\bibliography{bib1, bib2,...}` command.
- Additionally, you may specify the style or appearance of the reference section using `\bibliographystyle{style}` command.
- Common examples of *style* are *plain*, *ieeetr*, *alpha*, *abbrv*.
- bib file should be merged using `bibtex tex filename` command.

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- Allows multiple files to be used.
- Inserts entries for only those items which have been referred in the tex document.
- Changing the style or appearance is accomplished by replacing just one word.
- Almost every quality journal, conference, book, etc. provide readymade bib entry.
- Reusable.
- Several tools for managing bibtex data are available.

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References

This is a compiled work.

For more details refer to any good text on \LaTeX , or search over the net.

This was a brief introduction.

Thanks

Thank you for your attention !! 😊