

Introduction to $\text{T}_{\text{E}}\text{X}$ & $\text{L}_{\text{A}}\text{T}_{\text{E}}\text{X}$

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$\text{L}_{\text{A}}\text{T}_{\text{E}}\text{X}$ Intro

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<https://hadisafari.ir/courses/latex>



What is $\text{L}_{\text{A}}\text{T}_{\text{E}}\text{X}$?

What is $\text{L}_{\text{A}}\text{T}_{\text{E}}\text{X}$?

- 1 What is $\text{L}_{\text{A}}\text{T}_{\text{E}}\text{X}$?
- 2 How to get $\text{L}_{\text{A}}\text{T}_{\text{E}}\text{X}$?
- 3 $\text{L}_{\text{A}}\text{T}_{\text{E}}\text{X}$ 'Hello World'
 - Document Structure
 - Special Behaviours
- 4 Formatting Texts
- 5 More Basic Commands
 - Lists
 - Floats
 - Simple Graphics
 - Simple Mathematical Typesetting
- 6 Document Structure & Layout
 - Simple Tables
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 - Scientific Typesetting
 - Document Class
 - Title & Abstract
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 - Margins & Spaces
 - Penalties
 - Macros



T_EX

- is pronounced /'tɛx/, like the final consonant of *Bach*, or /'tɛk/
- source files: plain-text .tex files
- a markup languages describing how your document should look
- created by *Donald Knuth*
- 1977
- frustrated at result of *Art of Computer Programming*, realized high quality digital typesetting system was necessary
- The version numbers of T_EX are converging toward π , with a current version number of 3.1415926.

L^AT_EX

- a set of macros for T_EX, to simplify T_EX typesetting
- created by *Leslie Lamport*
- 1983
- L^AT_EX 2_ε is the current version of L^AT_EX, since it replaced L^AT_EX 2.09 in 1994.
- L^AT_EX Project Public License (LPPL)



L^AT_EX vs WYSIWYG

- **WYSIWYG** What You See Is What You Get, such as Microsoft Word, Apple Pages, and LibreOffice Writer
- WYSIWYG programs combine composition and typesetting
- bibliographies, cross-references, figure labels, and mathematical typesetting is usually hard and should be done manually in WYSIWYG programmes
- the final version of the document usually is not visible when editing it in mark-up languages (like L^AT_EX)
- generally it's necessary to know commands for writing in mark-up languages (such as L^AT_EX)

L^AT_EX vs WYSIWYGL^AT_EX Pros

- allows you to focus on content
- consistency throughout document
- automation of tedious tasks (cross-references, bibliographies, mathematical typesetting, etc.)
- document source is plain text, so:
 - document sources can be read with any text editor and understood
 - tables, figures, equations, etc. can be generated programmatically with any language
 - large files are easy to handled
 - What about spell-checking? spell-checkers like `ispell`, `aspell`, and `aspell`

```
ispell -t yourfile.tex
aspell --mode=tex -c yourfile.tex
hunspell -l -t -i utf-8 yourfile.tex
```



L^AT_EX vs WYSIWYGL^AT_EX Cons

- undeniable learning curve
- complex formatting may occasionally take more time than a word processor (e.g. tables)

L^AT_EX is not a word processor! Don't expect it to behave like one.

How to get L^AT_EX?

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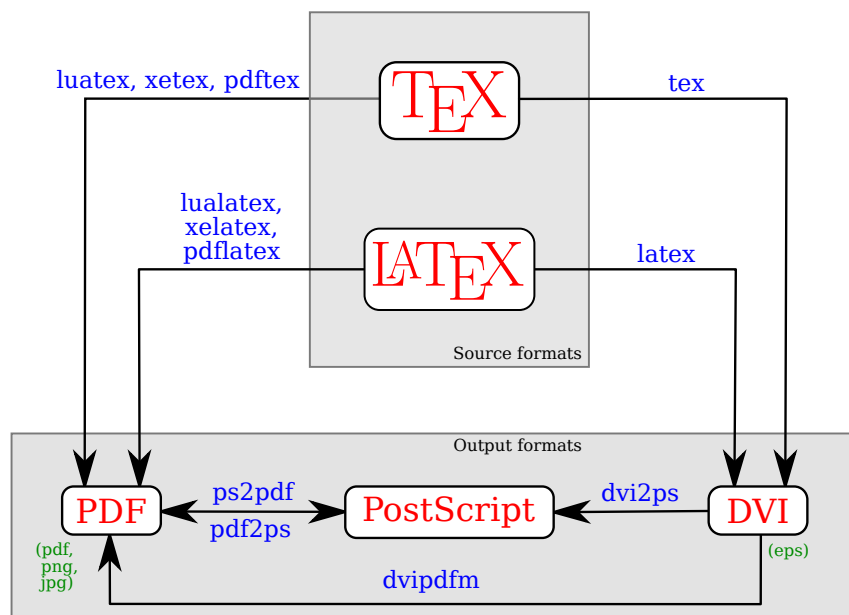
T_EX Distributions

- MikT_EX
 - <https://miktex.org/>
- T_EXLive
 - <https://www.tug.org/texlive/quickinstall.html>
 - each version will be frozen at February of the next year
 - `tlmgr --help`
 - also available over docker image, e.g. `volkerraschek/docker-latex`
- MacT_EX
 - based on T_EXLive
 - <https://www.tug.org/mactex/>
 - BasicT_EX: <https://www.tug.org/mactex/morepackages.html>
 - install usign HomeBrew (macOS): `brew cask install mactex | basictex`



Compilation

[3, Basic]



Compilation

- L^AT_EX to *pdf* compilers:
 - pdfL^AT_EX
 - X_YL^AT_EX
 - supports Unicode (UTF-8)
 - X_YPersian
 - LuaL^AT_EX
- should be compiled multiple times (up to three) to handle references and etc.
- `latexmk -pdf -xelatex file.tex`
- files, lots of files...
 - `tex, aux, bbl, bib, blg, bst, cls, dtx, ins, fd, log, toc, lof, lot, idx, ind, ilg, sty, etc.`



Editor

- online
 - Overleaf <https://www.overleaf.com>
 - ShareL^AT_EX (merged into Overleaf) <https://www.sharelatex.com>
 - Authorea (WYSIWYG) <https://www.authorea.com>
 - Paperia <https://paperia.com>
- offline
 - T_EXstudio (supports X_YPersian since v2.12.10).... <https://www.texstudio.org>
 - LyX <https://www.lyx.org>
 - T_EXShop <https://pages.uoregon.edu/koch/texshop>
 - T_EXworks <http://www.tug.org/texworks>
 - T_EXMaker <https://www.xmlmath.net/texmaker>
 - Gummi <https://github.com/alexandervdm/gummi>
 - Kile <https://kile.sourceforge.io>
 - VimL^AT_EX(over Vim)..... <http://vim-latex.sourceforge.net>
 - L^AT_EXTools (over Sublime Text) <https://lathetools.readthedocs.io>
- any text editor



L^AT_EX 'Hello World'

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Document Structure

Preamble

everything before `\begin{document}`

```
\documentclass{article}
```

```
\begin{document}
Hello, world!
\end{document}
```

Body

everything in the document environment



Document Structure

```

\documentclass{article} — Document Class
\usepackage[inline]{enumitem} — Package
\usepackage[colorlinks,urlcolor=magenta]{hyperref}
                                     Package Options (comma-separated)

\begin{document}
\thispagestyle{empty}
This is a test. % for what? — Comment
See \href{http://hadisafari.ir/courses/latex}{course website} for — Command with Multiple Argument
more {\small more} details. — No new line in output

\begin{itemize}[noitemsep] — Environment Optional Arguments (comma-separated)
  \item item~1 — Command Without Argument
  \item item~2\quad $e = mc^2$ — Inline Maths
  \item[\#] item~\#3 — Special Characters
\end{itemize} — Command Optional Argument (comma-separated)
\end{document}
                                     Environment
    
```

This is a test. See [course website](#) for more more details.

- item 1
- item 2 $e = mc^2$
- # item #3



Spaces & New Lines

- LaTeX compiler normalises whitespace
 - all whitespace characters, including single new line, are treated as a single space
 - several consecutive spaces are treated as one
 - spaces at opening a line is generally ignored
 - it does not matter whether you enter one or several spaces after a word
- a double line break (an empty line) defines the end of a paragraph
 - multiple empty lines are also treated as the end of a paragraph
 - `\par`, also, starts a new paragraph
 - `\\` breaks the line without starting a new paragraph
 - `\newline` does the same
- more spaces can be added by `\`, or `\thinspace`, `\:`, `\;`, `\enspace`, `\quad`, `\qquad`, and `_`
- negative space can be added by `\!`



Spaces & New Lines

the story of period

- L^AT_EX optimizes spaces between sentences
- a period after a capital letter signifies an abbreviation or an initial
- every other period signifies the end of a sentence
- if an abbreviation does not end with a capital letter and is not the last word in the sentence, then follow the period with an inter-word space (`_`)
- if a capital letter is followed by a period and is at the end of a sentence, precede the period with `\@`



Quotation Marks

- single and double quotation marks should be written as `` ` ' '` & `` ` _ ' '`
- L^AT_EX will convert them to opening and closing quotation marks



Dashes

- hyphen (-) intra-word dash a single dash (-)
- en-dash (–) dash between numbers, etc. double dashes (--)
- em-dash (—) mark an abrupt change in thought triple dashes (---)



Special Characters

- ‘#’, ‘\$’, ‘^’, ‘&’, ‘_’, ‘{’, ‘}’, ‘~’, ‘\’, and ‘%’ are special characters
- use ‘\#’, ‘\\$’, ‘\^{}’, ‘\&’, ‘_’, ‘\{’, ‘\}’, ‘\textasciitilde{}’, ‘\textbackslash{}’, and ‘\%’ to enter those characters



Accents & Ellipses

- accents could be added using combination of commands, e.g. `\"a` (ä), `\'e` (é), and `\~o` (ô).
- ellipses could be added by `\ldots` (...), `\dots` (...), or `\cdots` (⋯, math mode only)



Formatting Texts

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Text Decorations

Command	Declaration	Effect
<code>\emph{text}</code>	<code>\em</code>	<i>emphasized</i>
<code>\textbf{text}</code>	<code>\bfseries</code>	bold
<code>\textit{text}</code>	<code>\itshape</code>	<i>italic</i>
<code>\textsc{text}</code>	<code>\scshape</code>	SMALL CAPS
<code>\textup{text}</code>	<code>\upshape</code>	upright shape
<code>\textrm{text}</code>	<code>\rmfamily</code>	Roman (Serif)
<code>\textsf{text}</code>	<code>\sffamily</code>	Sans Serif
<code>\texttt{text}</code>	<code>\ttfamily</code>	typewriter type
<code>\textsl{text}</code>	<code>\slshape</code>	<i>slanted shape</i>

- `\emph` could be used nested:

```
\emph{\emph{\emph{nested} nested} emphasized} text
```

nested nested emphasized text



Text Decorations

soul package

Command	Effect
<code>\ul{text}</code>	<u>underline</u>
<code>\st{text}</code>	strike through
<code>\hl{text}</code>	highlight
<code>\so{text}</code>	letter spacing

- it's possible to change the colours by `\setstcolor{colour}`, `\sethlcolor{colour}`, and `\setulcolor{colour}`.



Text Justification

Environment	Declaration	Effect
<code>\begin{flushright}text\end{flushright}</code>	<code>\raggedright</code>	right justified
<code>\begin{center}text\end{center}</code>	<code>\centering</code>	centred
<code>\begin{flushleft}text\end{flushleft}</code>	<code>\raggedleft</code>	left justified



Text Size

Declaration	Effect
<code>\tiny</code>	tiny text
<code>\scriptsize</code>	scriptsize text
<code>\footnotesize</code>	footnotesize text
<code>\small</code>	small text
<code>\normalsize</code>	normalsize text
<code>\large</code>	large text
<code>\Large</code>	Large text
<code>\LARGE</code>	LARGE text
<code>\huge</code>	huge text
<code>\Huge</code>	Huge text



Text Colour

Colour Definition

- \LaTeX has got some predefined colours: black, blue, brown, cyan, darkgray, gray, green, lightgray, lime, magenta, olive, orange, pink, purple, red, teal, violet, white, and yellow.
- xcolor package is used to add extra features
- you may consider using usernames, dvipsnames, svgnames, and x11names options to access more predefined colours (see <https://en.wikibooks.org/wiki/LaTeX/Colors>)
- new colours could be defined using `\definecolor{name}{model}{spec}`, where *model* is one of gray (0-1), rgb (0-1), RGB (0-255), HTML (00-FF), or cmyk (0-1).
- you can also combine colours:

```
\color{blue!20} % 20% blue and 80% white
\color{blue!20!black} % 20% blue and 80% black
\color{blue!20!black!30!green}
% [(20% * 30%) blue, ((100% - 20%) * 30%) black] and (100% - 30%) green
\colorlet{notgreen}{blue!50!yellow} % define new colour
```



Text Colour

Colour Usage

- `\color[model]{colour}` declaration and `\color[model]{colour}{text}` command can be used to colourize texts
- `\colorbox{colour}{text}` can be used to change background colour of a text
- it can be used nested, too:

```
\colorbox{Green}{\colorbox{Yellow}{\textcolor{Red}{text}}}
```



- `\fcolorbox[framecolour]{bgcolour}{text}` can be used to change background & frame colour of a text
- `\pagecolor{colour}` can be used to change the background colour of the whole page



Footnotes

- `\footnote{text}` is used to create footnotes
- be careful about the space before the `\footnote{text}` command, which may create extra space in the final output
- footnotes could not be inserted in section titles and float tables
 - consider using `\protect` and *short title* for section titles
 - consider using `longtable` packages for tables or put `tabular` inside a `minipage` environment



Text Font

- in X_YL^AT_EX & LuaL^AT_EX it's possible to use TTF & OTF fonts by `fontspec` package

```
\usepackage{fontspec}
\setmainfont[Ligatures=TeX]{Georgia}
\setsansfont[Ligatures=TeX]{Arial}
```

- see <https://en.wikibooks.org/wiki/LaTeX/Fonts> for more details



More Basic Commands

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Lists

- \LaTeX has got three types of lists
 - `itemize` bullet lists
 - `enumerate` numbered lists
 - `description` labeled lists (key-value lists) all items should have got a label
- example:


```

\begin{itemize}
  \item Hello
  \item Hi
  \item[$\circ$] Al-salaam
\end{itemize}

```

list environment

list item

list item label

- Hello
 - Hi
 - Al-salaam
- consider using `enumitem` for list personalization, specially `inline` option and starred version of list environments
- lists can be nested



Floats

- some parts of document in \LaTeX are *float*, e.g. `figure` & `table` environments
- \LaTeX tries to put floats in a proper position automatically, usually at the top or bottom of the page, instead of putting them in the middle of texts
- the following positioning options are available:
 - `t` top
 - `b` bottom
 - `h` approximately here
 - `p` float-only page
 - `!` override internal parameters \LaTeX uses for determining *good* float positions
 - `H` precisely here requires `float` package
- a combination of options is acceptable, too
 e.g. when using `ht` \LaTeX will try to put the float at the insertion point, then on the top of the next page if it happens to violate its typesetting rules
 consider using `[!htb]` if you want not to use `float` package



Cross-Reference

- labels can be created using `\label{key}` command, usually after caption or section
- `\ref{key}` & `\pageref{key}` can be used to refer to labels
- *keys* traditionally are like *type:name*, when *type* is one of `fig`, `tab`, `chap`, `sec`, `eq`, and `fn`
- `\nameref{key}` from `nameref` package can be used to automatically add prefix to references



Simple Graphics

- to add external graphics (pictures, images, graphs, etc.) to \LaTeX document, you need `graphicx` package
- `\includegraphics[options]{file}` command can be used to add graphics, then
- usually, the inserted graphic is put in a `figure` environment, making it float
- it has got an optional argument for positioning
- you may want to use `\centering` declaration at the beginning of figure
- it's possible to add a caption to the float by the `\caption{title}` command
- caption usually should be placed at the bottom of the picture in the scientific documents
- however, you may want to put the caption at the top of picture to make picture visible after clicking a cross-reference to it



Simple Graphics

Example

```
\usepackage{graphicx}
...
\begin{figure}[h]
  \centering
  \includegraphics[width=0.5\textwidth]{ut}
  \caption{Logo of
    \textit{University of Tehran}}
  \label{fig:ut-logo}
\end{figure}
```



Figure: Logo of *University of Tehran*



Simple Mathematical Typesetting

Environment

- inline formulas can be written between $\$ \$$ (T_EX) or $\backslash(_)\backslash$ (L^AT_EX)
- displayed formulas can be written between $$$ \$\$$ (T_EX) or $\backslash[_]\backslash$ (L^AT_EX)
- equations also could be written in `equation`, `equation*` and `displaymath` environments
- the first one numbers the equations, too, and you can label the equation
- spacing after a comma is different in math and text unless the comma is part of the mathematical notation, you generally want it outside of math mode
- you may consider using `amsmath` package
- to write text inside math mode use `\text{cnt}` command (from `amsmath` package) or font formatting commands like `\textit{cnt}`
- see <https://en.wikibooks.org/wiki/LaTeX/Mathematics>



Simple Mathematical Typesetting

Commands

- `a * b` $a * b$
- `a / b` a / b
- `a_{n}` a_n
- `a \times b` $a \times b$
- `\frac{1}{2}` $\frac{1}{2}$
- `a^{n}` a^n
- `a \cdot b` $a \cdot b$
- `{1}\over{2}` $\frac{1}{2}$
- `a \div b` $a \div b$
- `\sqrt[4]{-\sqrt{-1}}` $\sqrt[4]{-\sqrt{-1}}$
- `\int_a^b x^2 dx` $\int_a^b x^2 dx$
- `\Lambda \binom{k}{n}` $\Lambda \binom{k}{n}$
- `\lim_{x \to \infty} f(x)` $\lim_{x \rightarrow \infty} f(x)$
- `\sum_{n=1}^{\vartheta} n` $\sum_{n=1}^{\vartheta} n$
- `\prod_{i=a}^b f(i)` $\prod_{i=a}^b f(i)$



Simple Mathematical Typesetting

Braces & symbols

- `1+\Big(2+\big(3+(4+5)\big)\Big)` $I + \left(2 + \left(3 + \left(4 + 5 \right) \right) \right)$
- `(\big(\Big(\bigg(\Bigg(` $((((($
- `s = \{\langle 0, 1\rangle, \langle 0, 2\rangle\}` $s = \{ \langle 0, 1 \rangle, \langle 0, 2 \rangle \}$
- `\left(2 * \binom{k}{n} \right)` $\left(2 * \binom{k}{n} \right)$
- `\left. \frac{x^3}{3} \right|_0^1` $\left. \frac{x^3}{3} \right|_0^1$
- `\rightarrow \Rightarrow \longrightarrow` $\rightarrow \Rightarrow \longrightarrow$
- `R \mathnormal{R} \mathrm{R} \mathbf{R} \mathfrak{R} \mathbb{R}` .. $R R R R \mathfrak{R} \mathbb{R}$
`\mathbb{text}` requires `amsfonts` or `amssymb` package



Simple Mathematical Typesetting

Accents & Symbols

- `a'` a'
- `\overrightarrow{a}` \vec{a}
- `\tilde{a}` \tilde{a}
- `a''` a''
- `\overline{a}` \bar{a}
- `\widehat{a}` \hat{a}
- `\dot{a}` \dot{a}
- `\hat{a}` \hat{a}
- `\not{a}` \not{a}

for *i* & *j* in mathematical environments, `\imath` & `\jmath` may be used:

`\hat{\jmath}`

- `\pm` \pm
- `\forall` \forall
- `\exists` \exists
- `\not\exists` \nexists
- `\rightarrow` \rightarrow
- `\to` \rightarrow
- `\leftarrow` \leftarrow
- `\gets` \leftarrow
- `\Rightarrow` \Rightarrow
- `\implies` \Rightarrow
- `\Leftrightarrow` \Leftrightarrow
- `\iff` \Leftrightarrow
- `\emptyset` \emptyset
- `\varnothing` \emptyset



Multiline Mathematical Typesetting

```
\begin{gather*}
  k = \frac{1}{2} m v^2 \\
  u = m g h \\
\end{gather*}
```

$$k = \frac{1}{2} m v^2$$

$$u = m g h$$

```
\begin{align*}
  f(x) &= \\
  &\int_{-\infty}^{\infty} \alpha h(x) dx \\
  &= \alpha \\
  &\int_{-\infty}^{\infty} h(x) dx \\
  &= \alpha g(x) \\
\end{align*}
```

$$f(x) = \int_{-\infty}^{\infty} \alpha h(x) dx$$

$$= \alpha \int_{-\infty}^{\infty} h(x) dx$$

$$= \alpha g(x)$$



Matrices

```
A_{m,n} =
\begin{pmatrix}
  a_{1,1} & a_{1,2} & \cdots & a_{1,n} \\
  a_{2,1} & a_{2,2} & \cdots & a_{2,n} \\
  \vdots & \vdots & \ddots & \vdots \\
  a_{m,1} & a_{m,2} & \cdots & a_{m,n}
\end{pmatrix}
```

$$A_{m,n} = \begin{pmatrix} a_{1,1} & a_{1,2} & \cdots & a_{1,n} \\ a_{2,1} & a_{2,2} & \cdots & a_{2,n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m,1} & a_{m,2} & \cdots & a_{m,n} \end{pmatrix}$$



Mathematical Typesetting

Example

```
\begin{align}
(p \rightarrow r), (q \rightarrow r), (p \wedge q) & \vdash p \wedge q & (\text{\varepsilon}) & \text{\label{eq:1.1}} \\
(p \rightarrow r), (q \rightarrow r), (p \wedge q) & \vdash p & (\text{\wedge-}, 1) & \text{\label{eq:1.2}} \\
(p \rightarrow r), (q \rightarrow r), (p \wedge q) & \vdash p \rightarrow r & (\text{\varepsilon}) & \text{\label{eq:1.3}} \\
(p \rightarrow r), (q \rightarrow r), (p \wedge q) & \vdash r & (\text{\rightarrow-}, 3, 2) & \text{\label{eq:1.4}} \\
(p \rightarrow r), (q \rightarrow r) & \vdash (p \wedge q) \rightarrow r & (\text{\rightarrow+}, 4) & \text{\label{eq:1.5}} \\
\quad \square & & & 
\end{align}
```

$$\begin{array}{lll}
 (p \rightarrow r), (q \rightarrow r), (p \wedge q) \vdash_N p \wedge q & (\varepsilon) & (1) \\
 (p \rightarrow r), (q \rightarrow r), (p \wedge q) \vdash_N p & (\wedge-, 1) & (2) \\
 (p \rightarrow r), (q \rightarrow r), (p \wedge q) \vdash_N p \rightarrow r & (\varepsilon) & (3) \\
 (p \rightarrow r), (q \rightarrow r), (p \wedge q) \vdash_N r & (\rightarrow-, 3, 2) & (4) \\
 (p \rightarrow r), (q \rightarrow r) \vdash_N (p \wedge q) \rightarrow r & (\rightarrow+, 4) \quad \square & (5)
 \end{array}$$



Simple Tables

- `\begin{tabular}{cols}cnt\end{tabular}` environment can be used to add tables
- `cols` describes the columns of the table, by a combination of the following symbols:

- l left-justified column
- c centred column
- r right-justified column

- `p{width}` vertically aligned paragraph at top
- `m{width}` vertically aligned paragraph at middle requires array package
- `b{width}` vertically aligned paragraph at bottom requires array package
- | vertical line
- || double vertical line

- usually, the inserted table is put in a `table` environment, making it float
- it has got an optional argument for positioning
- you may want to use `\centering` declaration at the beginning of figure
- it's possible to add a caption to the float by the `\caption{title}` command
- caption usually should be placed at the top of the table in the scientific documents



Simple Tables

Cont.

- each row of table consists of fields (up to the number of columns described in the first argument of `tabular` environment)
- fields of each row should be separated by `&`
- at the end of each row, except perhaps last row, `\\` should be used
- rows *could* be separated by one or more `\hlines`



Simple Tables

Example

```
\begin{table}[h]
\centering
\caption{List of universities}
\label{tab:universities}
\begin{tabular}{cc}
\hline
\textbf{University} &
\textbf{City}\\
\hline
\hline
Tehran & Tehran\\
Sharif & Tehran\\
Ferdowsi & Mashad\\
Isfahan & Isfahan\\
\hline
\end{tabular}
\end{table}
```

Table: List of universities

University	City
Tehran	Tehran
Sharif	Tehran
Ferdowsi	Mashad
Isfahan	Isfahan



Simple Bibliography

- manual bibliography can be created by
`\begin{thebibliography}{widestlabel}\end{thebibliography}`
- *widestlabel* should be a number with the same length as the number of items
- each item can be added by `\bibitem[label]{citekey}description`
- it's possible to refer to items by `\cite[text]{keylist}`
- you may need to use `\nocite{keylist}` or even `\nocite{*}` to add a hidden reference
- manual bibliography should be sorted manually
- you may want to use `\renewcommand\refname{title}` (article class) or `\renewcommand\bibname{title}` (report & book classes) to change bibliography title
- you may want to use `tocbibind` package or use `\phantomsection\addcontentsline{toc}{section}{References}` to add bibliography to table of contents



Simple Bibliography

Example

See `\cite[p1]{wikibooks18}`. Also, see `\cite{wikibooks18,alex17}`.
`\nocite{wikibooks18}`

```
\begin{thebibliography}{9}
  \bibitem{alex17} Alex. 2017. Assert and \texttt{static\_assert}. Retrieved
    from
    \url{https://www.learncpp.com/cpp-tutorial/7-12a-assert-and-static_assert/}.
  \bibitem{wikibooks18} Wikibooks. 2018. ``Unit Tests.'' In
    \textit{Wikibooks, The Free Textbook Project}. Retrieved from
    \url{https://en.wikibooks.org/wiki/Introduction_to_Software_Engineering/Testing/Unit_}
\end{thebibliography}
```

See [2, p1]. Also, see [2, 1].

References

- [1] Alex. 2017. Assert and `static_assert`. Retrieved from https://www.learncpp.com/cpp-tutorial/7-12a-assert-and-static_assert/.
- [2] Wikibooks. 2018. "Unit Tests." In *Wikibooks, The Free Textbook Project*. Retrieved from https://en.wikibooks.org/wiki/Introduction_to_Software_Engineering/Testing/Unit_Tests.



hyperref Package

- `hyperref` package can be used to clickable links
- `hyperref` needs to be the last package you load
- `hyperref` package accepts some options, e.g.:
 - `breaklinks` allow links to be broken across several lines
 - `colorlinks` colour the text of the links and anchors
 - `linkcolor` colour for normal internal links
 - `anchorcolor` colour for anchor texts
 - `citecolor` colour for bibliographic citations in text



hyperref *pdf* options

- `bookmarks` write a set of *pdf* bookmarks
 - `pdftitle` document information *Title* field
 - `pdfauthor` document information *Author* field
 - `pdfsubject` document information *Subject* field
 - `pdfcreator` document information *Creator* field
 - `pdfproducer` document information *Producer* field
 - `pdfkeywords` document information *Keywords* field

These options can be added with either `\usepackage{hyperref}` or `\hypersetup{options}` command



hyperref Commands

- `\url{URL}` make a link (*url* package)
- `\href{URL}{text}` make a link
- `\hyperref[label]{text}` make text a link to where `\ref{label}` would point



Cross-Reference

- labels can be created using `\label{key}` command, usually after caption or section
- `\autoref{key}` & `\autopageref{key}` can be used to cross-refer to labels with better linking
- `\nameref{key}` from `nameref` package can be used to automatically add prefix to references
- `hyperref` package includes `nameref` package itself
- starred version of the aforementioned commands could be used to insert cross-references without links



Cross-Reference

Example

```
\caption{UT logo}\label{fig:ut}
...
\begin{itemize}
  \item Figure~\ref{fig:ut}
  \item page~\pageref{fig:ut}
  \item \nameref{fig:ut}
  \item \autoref{fig:ut}
  \item \autopageref{fig:ut}
\end{itemize}
```



Figure 1: UT logo

- Figure 1
- page 1
- UT logo
- Figure 1
- page 1



Theorem

- `amsthm` package provides environments for typesetting theorems
- example:

```
\newtheorem{definition}{Definition}
\begin{definition}
  Here is a new definition
\end{definition}
```

Definition 1. *Here is a new definition*



Preformatted Texts

- `verbatim` environment provides environments for typesetting texts which are not preprocessed
- everything input between the begin and end commands are processed as if by a typewriter
- all spaces and new lines are reproduced as given
- is displayed in an appropriate fixed-width font
- any \LaTeX command will be ignored and handled as plain text
- `\verb` command is the equivalent inline command
- see https://en.wikibooks.org/wiki/LaTeX/Paragraph_Formatting#Verbatim_text
- you may want to use `fancyvrb` package



Source Code

- `listings` package provides facilities to typesetting source code in the document
- `listings` package offers multiple commands, e.g.
 - `\lstlisting` environment
 - `\lstinline{src}`
 - `\lstinputlisting{addr}` to read from file
- example:

```

\begin{lstlisting}[language=c++]
int main(int argc, char const    1  int main(int argc, char const
    *argv[]) {                    *argv[]) {
    std::cout << "Hello World" << 2  std::cout << "Hello World" <<
        std::endl;                std::endl;
    return 0;                      3  return 0;
}                                  4  }
\end{lstlisting}

```

- see https://en.wikibooks.org/wiki/LaTeX/Source_Code_Listings



Algorithms & Pseudo-codes

- `algorithmicx` (`\usepackage{algpseudocode}`) package provides facilities to typesetting pseudo-codes & algorithms in the document
- `algorithm` package provides floating environments with numbered algorithms
- example:

```

\begin{algorithm}[h]
\caption{An example algorithm}
\begin{algorithmic}
\If {$i \geq \maxval$}
  \State $i \gets 0$
\Else
  \If {$i+k \leq \maxval$}
    \State $i \gets i+k$
  \EndIf
\EndIf
\end{algorithmic}
\end{algorithm}

```

Algorithm 1 An example algorithm

```

if  $i \geq \maxval$  then
   $i \leftarrow 0$ 
else
  if  $i + k \leq \maxval$  then
     $i \leftarrow i + k$ 
  end if
end if

```

- see <https://en.wikibooks.org/wiki/LaTeX/Algorithms>



Document Structure & Layout

- 1 What is L^AT_EX?
- 2 How to get L^AT_EX?
- 3 L^AT_EX 'Hello World'
 - Document Structure
 - Special Behaviours
- 4 Formatting Texts
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 - Lists
 - Floats
 - Simple Graphics
 - Simple Mathematical Typesetting
- 6 Document Structure & Layout
 - Document Class
 - Title & Abstract
 - Sectioning
 - Page Style
 - Margins & Spaces
 - Penalties
 - Macros



Document Classes

article for articles in scientific journals, presentations, short reports, program documentation, invitations, etc.

proc for proceedings, based on the *article* class

report for longer reports containing several chapters, small books, thesis, etc.

book for real book

letter for letters completely different structure

minimal for test

And there are other non-standard packages like...

memoir a class based on *book* with many options

beamer for presentations



Document Class Options

10pt, 11pt, 12pt the size of the main font

a4paper, letterpaper, ... paper size... needs **geometry** package with same option to change pdf page size

titlepage, notitlepage whether a new page should be started after the document title or not

twoside, oneside whether double or single sided output should be generated
L^AT_EX distinguishes between odd and even pages in two-sided output.

openright, openany makes chapters begin either only on right-hand pages or on the next page available



Document Class Options

Cont.

- `fleqn` typesets displayed formulas left-aligned instead of centred
- `leqno` places the numbering of formulas on the left-hand side instead of the right
- `twocolumn` typeset the document in two columns instead of one
- `landscape` landscape layout
- `draft` makes \LaTeX indicate hyphenation and justification problems with a small square in the right-hand margin of the problem line and shows only a frame where images would normally occur, so that document could be compiled faster



Top Matter & Abstract

```
\title{A Sample \LaTeX{} Document}
\author{
  Hadi Safari
  \thanks{Corresponding author}
  \\\University of Tehran
  \and
  Colleagues
}
\date{\today} — default
```

```
\begin{document}
\maketitle
\begin{abstract}
  As you may know or not, this is abstract
  of this simple sample document\ldots
\end{abstract}
```

```
\ldots and this is the main context.
\end{document}
```

A Sample \LaTeX Document

Hadi Safari* Colleagues
University of Tehran

August 1, 2019

Abstract

As you may know or not, this is abstract of this simple sample document...

...and this is the main context.

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.

*Corresponding author



Sectioning

- \LaTeX knows multiple levels of sectioning:
 - part level -1
 - chapter only *book* and *report* classes
 - section
 - subsection
 - subsubsection
 - paragraph
 - subparagraph
- e.g. `\section{\LaTeX{}}` vs MS Word
- anything between a section command and the next one is considered as the content of that section



Sectioning

Cont.

- there are starred versions of those commands
 - which do not have numbering,
 - but also do not appear in table of contents automatically
- e.g. `\section*{title}`
- a more complicated example:


```
\section[e = mc\^{}2]{ $e=mc^2$ \protect\footnote{a well-known equation}}
```

 - there is an optional argument for providing short simple-text version of long titles or titles including special characters to show in references by name, pdf bookmarks, etc.
 - `\protect` should be used before some commands in section titles



Sectioning

book class

`\frontmatter`, `\mainmatter`, `\appendix`, and `\backmatter` commands used in *books* to change section numbering and page style

- front matter** The front matter chapters will not be numbered. Page numbers will be printed in roman numerals. Front matter is not supposed to have sections.
- main matter** The main matter chapters works as usual. The command resets the page numbering. Page numbers will be printed in arabic numerals.
- appendix** The `\appendix` macro can be used to indicate that following sections or chapters are to be numbered as appendices. Appendices can be used for the article class too.
- back matter** The back matter behaves like the front matter. It has the same issue with section numbering.



Table of Contents

- table of contents can be created automatically by `\tableofcontents` command
- there are also:
 - `\listoffigures`
 - `\listoftables`
 - `\listofalgorithms` algorithm package
 - `\lstlistoflistings` listings package



Table of Contents

Adding Sections Manually

- it's possible to add some section to table of contents manually by:

```
\section*{Introduction}
\addcontentsline{toc}{section}{Introduction}
```

- `\phantomsection` command from `hyperref` package should be used to correct pdf bookmarks' reference:

```
\phantomsection
\addcontentsline{toc}{section}{Introduction}
\section*{Introduction}
```

- for *chapters*, `\cleardoublepage` command may be used too:

```
\cleardoublepage
\phantomsection
\addcontentsline{toc}{chapter}{Bibliography}
```



Page Style

- `\pagestyle{style}` command can be used in preamble to determine page style
- the following *styles* are available:

plain blank header, footer contains only the page number (default)

empty empty header and footer

headings header provided by document class, empty footer

myheadings header determined by `\markrightand{}` &

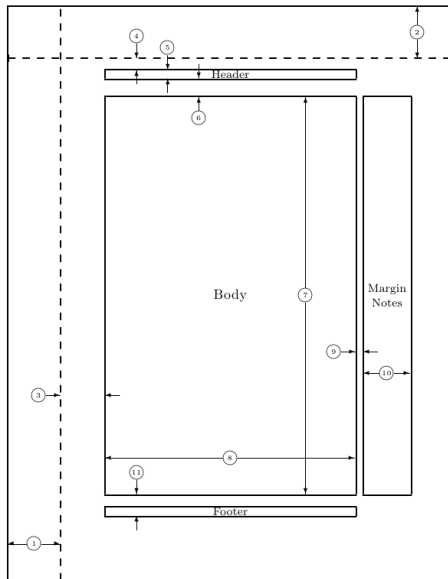
`\markboth{left}{right}`

- `\thispagestyle{style}` changes only the page style of current page
- package `fancyhdr` gives you more control on page style

```
\fancypagestyle{name}
{
  \lhead{} \chead{} \rhead{}
  \lfoot{} \cfoot{} \rfoot{}
  % use \thepage everywhere to get page number
  \renewcommand{\headrulewidth}{0pt}
  \renewcommand{\footrulewidth}{0pt}
}
\pagestyle{name}
```



Margins



```

1 one inch + \hoffset      2 one inch + \voffset
3 \oddsidemargin = 62pt   4 \topmargin = 16pt
5 \headheight = 12pt     6 \headsep = 25pt
7 \textheight = 550pt    8 \textwidth = 345pt
9 \marginparsep = 11pt   10 \marginparwidth = 85pt
11 \footskip = 30pt      \marginparpush = 5pt (not shown)
                          \offset = 0pt
                          \paperwidth = 614pt
                          \paperheight = 794pt

```

- you can manually set the margin parameters with commands like `\setlength{parameter}{length}` and `\addtolength{parameter}{length}`
- take a look at `calc` and `geometry` packages, too



Margins

geometry package

- `geometry` package can be used to control margins
- you can use e.g. `margin=1in`, `top=1.5in`, `height=8in`, or `width=4in` options when including package
- use `showframes` to show page frames
- `landscape` and some options like `a4paper` are also available in `geometry` package



Breaks

- double new lines and `\par` indicates beginning of a new paragraph
- `\\` and `\newline` break the lines without beginning a new paragraph
- `\newpage` begins a new page
- `\clearpage` prints remaining *floats* and begins a new page



More on Spaces

- you can change all the length parameters with `\setlength{parameter}{length}` and `\addtolength{parameter}{length}` commands, e.g.
`\setlength{\baselineskip}{1.5\baselineskip}`
- minus & plus commands could be used to show tolerable change range, e.g.
`\setlength{\parskip}{1ex plus 0.5ex minus 0.2ex}`
- `\baselineskip` length parameter is used to determine space between lines
- `\parindent` length parameter is used to determine paragraph indentation
- `\parskip` length parameter is used to determine space between paragraphs
- you can use `\indent` & `\noindent` commands to add indentation to a paragraph or remove it
- you may want to use `indentfirst` package



More on Spaces

- horizontal & vertical spaces could be added by `\hspace{length}` & `\vspace{length}` commands, respectively
- you may consider using starred version of those commands to be effective even at the start and end of line or page
- `\stretch{n}` could be used to divide the space by weight n

`x\hspace{\stretch{1}}`
`x\hspace{\stretch{3}}x`

X	X	X
---	---	---

- you may consider using `\[length]`, `\bigskip`, and `\smallskip`, too
- commands `\vfil`, `\vfill`, `\hfil`, `\hfill`, `\hlinefill`, and `\dotfill` could be used to fill the spaces between texts



Units of Length

- in addition to `mm` (millimetre), `cm` (centimetre), `in` (inch), and `pt` (point), the relative units `em` (approx width of an M in the current font) and `ex` (approx height of an x in the current font) are available



Rules & Boxes

- in \LaTeX , everything is positioned inside a *box*
- `\mbox{text}`, `\fbox{text}`, `\makebox[width][position]{text}`, `\framebox[width][position]{text}`, `\parbox[position]{width}{text}`, `\begin{minipage}[position]{width}text\end{minipage}`, and `\raisebox{distance}[extendabovebaseline][extendbelowbaseline]{text}` may be used to work with boxes
- `\rule[lift]{width}{thickness}` could be used to draw lines
- `\strut` is defined as `\rule[-.3\baselineskip]{0pt}{\baselineskip}`



Multi-column

- `\begin{multicols}{n}cnt\end{multicols}` environment from `multicol` package make it possible to typeset texts in multiple columns
- it balances the columns automatically, the starred version of environment don't



Penalties

- use `\tolerance=5000` (with a number up to 10000) to deal with *overflow lines*, which are indicated with black square in draft mode
- use `\widowpenalty=300` and `\clubpenalty=300` (with a number up to 10000) to increase widow and orphan penalty



Counters

- counters are what L^AT_EX uses to keep the right number attached to equations, pages, theorems, etc.
- e.g. equation, figure, footnote, page, table, chapter, section, subsection, subsubsection, enumi, enumii, enumiii, and enumiv
- for every counter name there is a `\thename` command which shows the current value of the name counter
- `\setcounter{counter}{value}` is used to set the value of a counter
- `\stepcounter{counter}` is used to increment a counter by one
- `\addtocounter{counter}{value}` is used to increment a counter by *value*
- usually, L^AT_EX increments the counter and then generates the appropriate number
- exception: page
if you want the first page in your paper to be page 45, you should put `\setcounter{page}{45}` line directly after `\begin{document}`



Defining New Commands

- it's possible to define new commands in \LaTeX
- \LaTeX has got three commands for this
 - `\newcommand{cmd}[args][default]{def}`
define a new already-undefined command
 - `\renewcommand{cmd}[args][default]{def}`
redefine an already-defined command
 - `\providecommand{cmd}[args][default]{def}`
define a command regardless of that previous definitions
- `\newenvironment{name}[num][default]{before}{after}` and similar commands are used to define new environments
- see <https://en.wikibooks.org/wiki/LaTeX/Macros>







Arithmetic & Conditionals

- `calc` package provides the common infix notation, e.g. in counter-related calculations
- see <https://en.wikibooks.org/wiki/LaTeX/Macros>
- `ifthen` package provides conditional commands by means of `\ifthenelse{cond}{then}{else}` command



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