

CS213: Software Systems Laboratory

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Recap

- Bash commands: sed, awk, tar
- Makefile, libraries and linking
- Networking commands:
 - ping, traceroute, ifconfig, netstat, curl, wget, tcpdump, ssh, scp, rsync



Unix

- *Basics: shell, file system, permissions, process hierarchy, process monitoring, ssh, rsync*
- *Tools: grep, find, head, tail, tar, cut, sort, sed, awk*
- *Bash scripting: I/O redirection, pipes, makefile, libraries and linking*

Recap

- Latex Introduction

What is LATEX?

- **Typesetting**: is the composition of [text](#) by means of arranging [physical type](#) (or *sort*) in mechanical systems
- **Typesetter**: *a person who typesets the text*
- **TeX**: is a [typesetting system](#) → designed and written → Prof. [Donald Knuth](#) and first released in 1978.
- **LaTeX**: (*program*) is a special version of TeX → created by → Prof. Leslie Lamport and first released in 1984.

LaTeX



The **L^AT_EX** Project

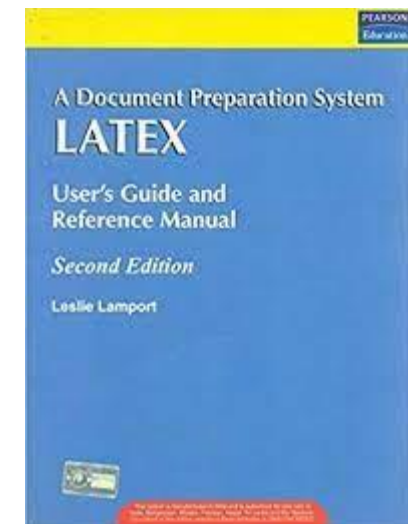
Original author(s)	Leslie Lamport
Initial release	1984; 39 years ago
Stable release	June 2023 LaTeX release ^[1] / June 2023; 3 months ago
Repository	github.com/latex3/latex2e
Type	Typesetting
License	LaTeX Project Public License (LPPL)
Website	latex-project.org

TeX

Developer(s)	Donald Knuth
Initial release	1978; 45 years ago
Stable release	3.141592653 / February 2021; 2 years ago
Repository	www.tug.org/svn/texlive/
Written in	WEB/Pascal
Operating system	Cross-platform
Type	Typesetting
License	Permissive free software
Website	tug.org

TeX

Filename extension	.tex
Internet media type	application/x-tex [a]
Initial release	1978; 45 years ago
Type of format	Document file format



Why LATEX?

- **WYSIWYG** → *What You See Is What You Get*



Pros

Free!

Looks pretty, especially math

Consistent formatting

- Good for long documents, such as dissertation and books

Supporting ecosystem

- Most journals have their LaTeX *style* files

Good bibliography management

- Bibtex supported widely

Cons

Steep learning curve

Hard to learn, but powerful

Can meet most user requirements

- but tricky to find out *how*

Not WYSIWYG

- Plain text with markup vs. Formatted text

LATEX : Components

hello.tex

`\documentclass{article}` → Component 1

`\begin{document}` → Component 2

Hello World! % body of the content

`\end{document}` → Component 3

- Commands start with a backslash (“\”)
- Every document starts with a “`\documentclass`” command
 - `\documentclass {<document type>}` → LATEX what kind of document we are creating:
 - **article**
 - **report**
 - **book**
 - **letter**
- The body of the document must present between the `\begin{document}` and `\end{document}`
- Any text that comes after the `\end{document}` command will be ignored

Offline mode

- Download and install
 - Backend: MikTeX
 - Frontend: Editor
 - TeXStudio, WinEdt, Emacs, vi, TeXlipse, ...

Online mode

- Overleaf
- ShareLaTeX

Document class

article	For articles in scientific journals, presentations, short reports, program documentation, invitations, ...
IEEEtran	For articles with the IEEE Transactions format
proc	A class for proceedings based on the article class
report	For longer reports containing several chapters, small books, thesis, ...
book	For real books
slides	For slides
memoir	For changing sensibly the output of the document. It is based on the book class, but you can create any kind of document with it
letter	For writing letters
beamer	For writing presentations

```
\documentclass[options]{report}
```

Document class options

10pt, 11pt, 12pt	Sets the size of the main font in the document. Default: 10pt.
a4paper, letterpaper,...	Defines the paper size. Default: letterpaper.
fleqn	Typesets displayed formulas left-aligned instead of centered.
leqno	Places the numbering of formulas on the left hand side instead of the right.
twocolumn	Instructs LaTeX to typeset the document in two columns instead of one.

```
\documentclass[11pt,a4paper]{report}
```


Document Environment

Top matter

```
\documentclass[11pt,a4paper]{report}

\begin{document}
\title{How to Structure a LaTeX Document}
\author{Leslie Lamport}
\date{December 1984}
\maketitle
\end{document}
```

Sectioning Commands

Command	Level
<code>\part{"part"}</code>	-1
<code>\chapter{"chapter"}</code>	0
<code>\section{"section"}</code>	1
<code>\subsection{"subsection"}</code>	2
<code>\subsubsection{"subsubsection"}</code>	3
<code>\paragraph{"paragraph"}</code>	4
<code>\subparagraph{"subparagraph"}</code>	5

Itemize

- Used in LaTeX environment to create unordered lists

```
\begin{itemize}  
  \item <Sentence1>  
  \item <Sentence2>  
  \item <Sentence3>  
\end{itemize}
```

- Basic example of using itemize

```
\begin{itemize}  
  \item Bullet point 1  
  \item Bullet point 2  
  \item Bullet point 3  
\end{itemize}
```

Output:

- ▶ Bullet point 1
- ▶ Bullet point 2
- ▶ Bullet point 3

Itemize (1)

Change the labels using `in itemize`

```
\documentclass{article}
\usepackage{amssymb} % to access $\blacksquare$
\begin{document}
```

Changing labels:

```
\begin{itemize}
\item Using normal label for itemize
\item Using another normal label for itemize
\item[!] A point to exclaim something!
\item[$\blacksquare$] Using Black Square.
\item[NOTE] This entry has no bullet
\item[] A blank label
\end{itemize}
\end{document}
```

- `\usepackage[option1,option2,option3]{package_name}`

Output:

Changing labels:

- Using normal label for itemize
- Using another normal label for itemize
- ! A point to exclaim something!
- Using Black Square.

NOTE This entry has no bullet

A blank label

enumerate

- Used in LaTeX environment to create ordered lists

```
\begin{enumerate}  
  \item <Sentence1>  
  \item <Sentence2>  
  \item <Sentence3>  
\end{enumerate}
```

- Basic example of using enumerate

```
\begin{enumerate}  
  \item First item  
  \item Second item  
  \item Third item  
\end{enumerate}
```

Output:

1. First item
2. Second item
3. Third item

enumerate (1)

- **Change the labels using in enumerate**

```
\documentclass{article}
\usepackage{amssymb} -> to access $\blacksquare$
\begin{document}
```

Changing labels:

```
\begin{enumerate}
\item Using normal label for enumerate
\item Using another normal label for enumerate
\item[!] A point to exclaim something!
\item[$\blacksquare$] Using Black Square.
\item[NOTE] This entry has no bullet
\item[] A blank label
\end{enumerate}
\end{document}
```

Output:

Changing labels:

1. Using normal label for enumerate
2. Using another normal label for enumerate

! A point to exclaim something!

■ Using Black Square.

NOTE This entry has no bullet

A blank label

Nested Lists using itemize and enumerate

```
\documentclass{article}
\begin{document}
\begin{enumerate}
  \item The labels consist of sequential numbers
  \begin{itemize}
    \item Normal \emph{itemize} example
    \item The text in the entries may be of any length
  \begin{itemize}
    \item[Note:] I would like to describe something here
    \item[Wait!] And give a warning here
  \end{itemize}
  \end{itemize}
\end{enumerate}
\item Normal \emph{enumerate} example
\end{document}
```

Output:

1. The labels consist of sequential numbers
 - Normal *itemize* example
 - The text in the entries may be of any length

Note: I would like to describe something here

Wait! And give a warning here
2. Normal *enumerate* example

Note: \emph is used to emphasise the text usually by putting it in italics

Tables

\begin{tabular}[pos]{table spec}

table spec	l	left-justified column
	c	centered column
	r	right-justified column
	p{'width'}	paragraph column with text vertically aligned at the top
	m{'width'}	paragraph column with text vertically aligned in the middle (requires array package)
	b{'width'}	paragraph column with text vertically aligned at the bottom (requires array package)
		vertical line
		double vertical line
pos	b	bottom
	c	center (default)
	t	top

Tabular

- Used in LaTeX environment to create tables using `\begin{tabular}` and `\end{tabular}` commands

```
\begin{tabular}{c c c}
.....
.....
\end{tabular}
```

- Basic example of using tabular

Output:

```
\documentclass{article}
\begin{document}
\begin{center}
\begin{tabular}{c c c}
cell1 & cell2 & cell3 \\
cell4 & cell5 & cell6 \\
cell7 & cell8 & cell9
\end{tabular}
\end{center}
\end{document}
```

cell1	cell2	cell3
cell4	cell5	cell6
cell7	cell8	cell9

Tabular (1)

- Add lines between columns and rows in a table

```
\documentclass{article}
```

```
\begin{document}
```

```
\begin{center}
```

```
\begin{tabular}{|c|c|c|}
```

```
\hline
```

```
cell1 & cell2 & cell3 \\ \hline
```

```
cell4 & cell5 & cell6 \\ \hline
```

```
cell7 & cell8 & cell9 \\ \hline
```

```
\end{tabular}
```

```
\end{center}
```

```
\end{document}
```

Output:

cell1	cell2	cell3
cell4	cell5	cell6
cell7	cell8	cell9

Latex: Figures

- Used in LaTeX environment to add figures using `\begin{figure}` and `\end{figure}` commands

```
\begin{figure}[h]
\centering
\includegraphics{Image-Name}
\caption{Figure description}
\end{figure}
```

- Basic example of using figure

```
\documentclass{article}
\usepackage{graphicx} % Package for adding figures
\begin{document}
\begin{figure}[h]
\centering
\includegraphics{galaxy.jpg}
\caption{Galaxy of Stars}
\end{figure}
\end{document}
```

- Output:



Figure 1: Galaxy of Stars

Note the size of the image can be changed using `[scale= value]` after `includegraphics`

LATEX: math

- LaTeX's features for typesetting mathematics make it a compelling choice for writing technical documents.
- LaTeX allows two writing modes for mathematical expressions:
 - Inline math mode → Used to write formulas that are part of a paragraph
 - Display math mode → Used to write expressions that are not part of a paragraph, and are therefore put on separate lines

To produce an inline expression, place the math expression between dollar signs (“\$”).

hello.tex

```
\documentclass{article}
\begin{document}
Let $y=mx+b$ be \ldots
Let $y = mx+b$ be \ldots
\end{document}
```

Output:

Let $y = mx + b$ be . . .
Let $y = mx + b$ be . . .

Output:

```
\documentclass{article}
\usepackage{amsmath}
\begin{document}
\[\sqrt{x^2+1}\]
\end{document}
```

$$\sqrt{x^2 + 1}$$

LATEX: math (1)

Description	Command	Output
Plus or minu	<code>\pm</code>	\pm
Multiplication (times)	<code>\times</code>	$*$
Multiplication (dot)	<code>\dot</code>	$.$
Division symbol	<code>\div</code>	\div
Not equal	<code>\ne</code>	\neq
Infinity	<code>\infinity</code>	∞
Less than or equal to	<code>\le</code>	\leq
Greater than or equal to	<code>\ge</code>	\geq
Dots	<code>1, 2, 3, \ldots</code>	$1, 2, 3, \dots$
Dots	<code>1+2+3+\cdots</code>	$1 + 2 + 3 + \dots$
Fraction	<code>\frac{a}{b}</code>	a/b

LATEX: matrix

- Matrix with different delimiters → manipulation to a plain matrix

```
\documentclass{article}
\usepackage{amsmath}
\begin{document}
\left\lceil
\begin{matrix}
1 & 2 & 3 \\
a & b & c
\end{matrix}
\right\rceil
And
\left\langle
\begin{matrix}
1 & 2 & 3 \\
a & b & c
\end{matrix}
\right\rvert
\end{document}
```

Output:

$$\left[\begin{array}{ccc} 1 & 2 & 3 \\ a & b & c \end{array} \right]$$

And

$$\left\langle \begin{array}{ccc} 1 & 2 & 3 \\ a & b & c \end{array} \right|$$

LATEX: matrix (1)

Description	Command	Output
Vector	<code>\vec{v}</code>	\vec{v}
Vector	<code>\mathbf{v}</code>	\mathbf{v}
Norm	<code> \vec{v} </code>	$ \vec{v} $
Matrix	<code>\left[\begin{array}{ccc} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{array} \right]</code>	$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{bmatrix}$
Determinant	<code>\det(A)</code>	$\det(A)$
Trace	<code>\operatorname{tr}(A)</code>	$\operatorname{tr}(A)$
Dimension	<code>\dim(V)</code>	$\dim(V)$

LATEX: algorithm

- To typeset algorithms or pseudocode in LaTeX you can use one of the following options:
 - `algpseudocode`; `algcompatible`; and `algorithmic` packages to typeset algorithm bodies
 - `algorithm` package for captioning the algorithm.
 - `algorithm2e` package.

```
\documentclass{article}
\usepackage{algpseudocode}
\begin{document}
\begin{algorithmic}
\State $i$ \gets 10$
\If{$i \geq 5$}
  \State $i$ \gets $i-1$
\Else
  \If{$i \leq 3$}
    \State $i$ \gets $i+2$
  \EndIf
\EndIf
\end{algorithmic}
\end{document}
```

Output;

```
 $i \leftarrow 10$ 
if  $i \geq 5$  then
   $i \leftarrow i - 1$ 
else
  if  $i \leq 3$  then
     $i \leftarrow i + 2$ 
  end if
end if
```

Note:

Need not to load the `algorithm2e`, `algcompatible`, `algorithmic` packages if you have already loaded `algpseudocode`.

LATEX : algorithm

- To typeset algorithms or pseudocode in LaTeX you can use one of the following options:
 - With the **algorithm2e**

hello.tex

```
\documentclass{article}
\usepackage{algorithm2e}
\begin{document}
\begin{algorithm}
  $\text{\texttt{i}} \text{\texttt{gets}} 10$;
  \text{\texttt{elf}}{$\text{\texttt{i}} \geq 5$}
  {
    $\text{\texttt{i}} \text{\texttt{gets}} \text{\texttt{i}} - 1$;
  }
  \text{\texttt{If}}{$\text{\texttt{i}} \leq 3$}
  {
    $\text{\texttt{i}} \text{\texttt{gets}} \text{\texttt{i}} + 2$;
  }
}
\end{algorithm}
\end{document}
```

output

```
 $i \leftarrow 10;$ 
if  $i \geq 5$  then
  |  $i \leftarrow i - 1;$ 
else
  | if  $i \leq 3$  then
  | |  $i \leftarrow i + 2;$ 
  | end
end
```


LATEX : Calculus

Description	Command	Output
Derivative	<code>\frac{df}{dx}</code>	$\frac{df}{dx}$
Partial derivative	<code>\frac{\partial f}{\partial x}</code>	$\frac{\partial f}{\partial x}$
Integral	<code>\int</code>	\int
Double integral	<code>\iint</code>	\iint
Limits	<code>\lim_{x \rightarrow \infty}</code>	$\lim_{x \rightarrow \infty}$
Summation	<code>\sum_{n=1}^{\infty} a_n</code>	$\sum_{n=1}^{\infty} a_n$

thank you!

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