Introduction to LaTeX

Amitay Isaacs

April 27, 2012

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- It is not a word processor, but a programming language and just as any other language, you lean by practicing it.
- TeX was written by Donald Knuth in '70s, Latex is an extension to TeX in the form of macro packages.

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- It's good for large documents
- Not very easy to learn

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- BibTeX software to maintain bibliographies (JabRef)
  `http://jabref.sourceforge.net`

Useful links

- Latex Project
  `http://www.latex-project.org`
- Comprehensive TeX Archive Network (CTAN)
  `http://www.ctan.org`
- TeX Users Group (TUG)
  `http://www.tug.org`
- Not so Short Introduction to Latex
  `http://tobi.oetiker.ch/lshort/lshort.pdf`

A simple example

```
\documentclass{article}
\title{How to write in Latex}
\author{Amitay Isaacs}
\date{April 2012}
\begin{document}
\maketitle
This is a very simple document.
\end{document}
```

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- This document is an *article*.

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- This document is an *article*.
- Its title is *How to write in Latex*.
- Its author is *Amitay Isaacs*.
- Document consists of a title followed by a line of text.

What goes in Latex file?

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- Basic symbols

52 Letters:	`A B C ...Z  a b c ...z`
10 Digits:	`0 1 2 ...9`
9 Puncuation Marks:	`, ; . ? ! : ‘ ’ -`
4 Parenthesis:	`( ) [ ]`
7 Math symbols:	`/ * + = - < >`
3 Spaces:	*space*, *tab*, *newline*

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  - 13 Special symbols: `# $ % & ~ _ ^ \ { } @ " |`

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Any other character is *invalid* and can not be used in Latex file. As seen from previous example, all Latex commands begin with the backslash “\”.

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- **Optional arguments** are encosed in brackets []:
  `\documentclass[11pt]{article}` - fontsize is optional

Structure of a Latex Document

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Preamble      (for Latex commands only)

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Body      (text with embedded Latex commands)

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- In addition to **article** class, which is a good all-purpose class, other commonly used classes are:
  - report, thesis, book, letter, slides

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- Body: abstract, parts, sections, subsections, etc. These can be numbered or not

Document Class Options

A document class may be modified using options:

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- Size of the paper - `a4paper`, `letterpaper`*
- Duplex printing - `oneside`*, `twoside`
- Columns - `onecolumn`*, `twocolumn`
- Output - `draft`, `final`*

Formatting text

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- Most of the document is in plain text. Latex takes care of
  - spacing between words, sentences, paragraphs
  - heading sizes and numbering
  - page numbering `\pagestyle{..}` plain, empty, headings

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- -- and --- produce – and —

Font sizes

\tiny	sample text
\scriptsize	sample text
\footnotesize	sample text
\small	sample text
\normalsize	sample text
\large	sample text
\Large	sample text
\LARGE	sample text
\huge	sample text
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\begin{center}This is centered.\end{center}
```

This is centered.

Text Alignment

- For left aligned text, use *flushleft* environment
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- For centered text, use *center* environment
- In figures/tables, usually `\centering` command is used instead of center environment

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  - `\chapter{..}`, `\chapter*{..}`
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- First form creates sections with numbers and the second form does not number the headings.
- To create an abstract, place the text in *abstract* environment.

  `\begin{abstract}`
  Your abstract goes here.
  `\end{abstract}`.

Cross-References

```
\chapter{Results}
\label{ch:results}

Experiemental results are in Section~\ref{sec:expt}.

\section{Experiments}
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As mentioned in Chapter~\ref{ch:results} ...
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- `\pageref{..}` puts page number where that label occurs

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Lists - Itemized and Numbered

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```
\begin{itemize}
  \item Item 1
  \begin{itemize}
    \item Sub item 1
    \item Sub item 2
  \end{itemize}
  \item Item 2
\end{itemize}
```

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\end{itemize}
```

- Item 1
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  - Sub item 2
- Item 2

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```
\begin{enumerate}
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```

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```

1. Item 1
    1. Sub item 1
    2. Sub item 2
2. Item 2

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- There are maximum 4 levels of nesting
- The appearance of the bullets and numbers in the slides is different than those in the text.

Descriptions

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```
\begin{description}
  \item[itemize] -- which generate bullet points
  \item[enumerate] -- which generate a numbered list
  \item[description] -- which generates a list like
                        this one
\end{description}
```

Floating objects

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- Tables

  \begin{table}[*options*]

  \end{table}

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  \begin{table}[*options*]
  \end{table}

- Figures

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- You can provide hints to Latex, where to put these objects.
  - h = place table here
  - t = place at top of page
  - b = place at bottom of page

Tables

Tables

```
\begin{tabular}{|lcr||}
\hline
Kiwi & Orange & Pears \\ \hline
Banana & Strawberry & Watermelon \\ \hline
\end{tabular}
```

Tables

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\begin{tabular}{|lcr||}
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Kiwi & Orange & Pears \\ \hline
Banana & Strawberry & Watermelon \\ \hline
\end{tabular}
```

Kiwi	Orange	Pears
Banana	Strawberry	Watermelon

Tabular environment creates the rows and columns structure.

Tables

```
\begin{tabular}{|lcr||}
\hline
Kiwi & Orange & Pears \\ \hline
Banana & Strawberry & Watermelon \\ \hline
\end{tabular}
```

`l`	Left-justified column entry
`c`	Centered column entry
`r`	Right-justified column entry
`p`	Paragraph column entry
`|`	Vertical rule column
`||`	Double vertical rule column

Tables

```
\begin{tabular}{|lcr||}
\hline
Kiwi & Orange & Pears \\ \hline
Banana & Strawberry & Watermelon \\ \hline
\end{tabular}
```

`&`	Moves to the next column
`\\`	Moves to the next row
`\hline`	Draws horizontal rule
`\multicolumn`	Create cells spanning multiple columns

Tables

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```
\begin{table}
\caption{Fruits}
\label{tab:fruits}
\begin{tabular}{l|c|r}
Kiwi & Orange & Pears \\ \hline
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Table: Fruits

Kiwi	Orange	Pears
Banana	Strawberry	Watermelon

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- You can refer to the table as

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Figures

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- `\includegraphics[width=2in]{graph1}`
  - Automatically searches for EPS (graph1.eps) or PNG (graph1.png) image.

Figures

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```
\begin{figure}[h]
\centering\includegraphics[width=5cm]{chart1}
\caption{An example of a chart}
\label{fig:chart}
\end{figure}
```

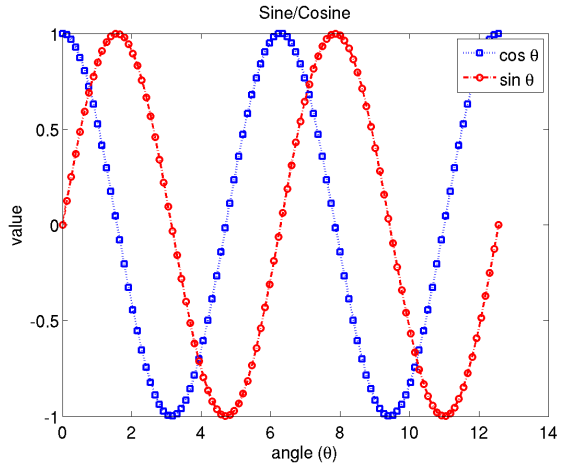

Figure: An example of a chart

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  `as shown in Figure~\ref{fig:chart}`

Mathematical Formulae

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- There are Latex commands for most mathematical operations and symbols

Exponents, Subscripts and Fractions

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  - `$a/b$` becomes a/b
  - `$$ \frac{a/b-c/d}{e/f-g/h} $$` becomes

$$\frac{a/b - c/d}{e/f - g/h}$$

Above and Below

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$$\binom{m+n}{m} = \frac{(m+n)!}{m!n!} = \frac{\overbrace{(m+n)(m+n-1)\cdots(n+1)}^{m \text{ factors}}}{\underbrace{m(m-1)\cdots 1}_{m \text{ factors}}}$$

Above and Below

```
$$
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\frac
 {\overbrace{(m+n)(m+n-1)\cdots(n+1)}^\text{$m$ factors}}
 {\underbrace{m(m-1)\cdots 1}_\text{$m$ factors}}
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```

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$$\sum_{k=0}^{\infty} \frac{(-1)^k}{k+1} = \int_0^1 \frac{dx}{1+x}$$

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- `$$ \lim_{x\rightarrow 0} \frac{\sin x}{x} = 1 $$` produces

$$\lim_{x \to 0} \frac{\sin x}{x} = 1$$

Equations

```
\begin{equation}
\label{eq:test1}
\left\{ \, x \biggm| \int_0^x t^2 \, dt \leq 5 \, \right\}
\end{equation}
```

$$\left\{ x \,\middle|\, \int_0^x t^2 \, dt \leq 5 \right\} \tag{1}$$

Matrices

```
\begin{equation}
\left( \begin{matrix}
 1 & 0 & \cdots & 0 \\
 0 & 1 & \cdots & 0 \\
\vdots & \vdots & \ddots & \vdots \\
 0 & 0 & \cdots & 1 \\
\end{matrix} \right)
\end{equation}
```

$$\begin{pmatrix} 1 & 0 & \cdots & 0 \\ 0 & 1 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & 1 \end{pmatrix} \tag{2}$$

Multiple Equations

```
\begin{gather}
  x_1 x_2 + x_1^2 x_2^2 + x_3, \\
  x_1 x_3 + x_1^2 x_3^2 + x_2, \\
  x_1 x_2 x_3.
\end{gather}
```

$$x_1 x_2 + x_1^2 x_2^2 + x_3, \tag{3}$$
$$x_1 x_3 + x_1^2 x_3^2 + x_2, \tag{4}$$
$$x_1 x_2 x_3. \tag{5}$$

Aligned Equations

```
\begin{align}
 f(x) &= x + yz         & g(x) &= x + y + z \notag \\
 h(x) &= xy + xz + yz & k(x) &= (x + y)(x + z)(y + z)
\end{align}
```

$$f(x) = x + yz \qquad g(x) = x + y + z$$
$$h(x) = xy + xz + yz \qquad k(x) = (x + y)(x + z)(y + z) \qquad (6)$$

Greek Letters

\alpha	α
\beta	β
\gamma	γ
\delta	δ
\epsilon	ϵ
\zeta	ζ
\eta	η
\theta	θ
\iota	ι
\kappa	κ
\lambda	λ
\mu	μ
\nu	ν
\xi	ξ
\pi	π
\rho	ρ
\sigma	σ
\tau	τ
\upsilon	υ
\phi	ϕ
\chi	χ
\psi	ψ
\omega	ω
\Gamma	Γ
\Delta	Δ
\Theta	Θ
\Lambda	Λ
\Xi	Ξ
\Pi	Π
\Sigma	Σ
\Upsilon	Υ
\Phi	Φ
\Psi	Ψ
\Omega	Ω

Binary Relations and Operators

<	$<$	\in	$\in$	+	$+$
>	$>$	\ni or \owns	$\ni$	-	$-$
=	$=$	\notin	$\notin$	\pm	$\pm$
\neq	$\neq$	\equiv	$\equiv$	\times	$\times$
:	$:$	\subset	$\subset$	\div	$\div$
\leq or \le	$\leq$	\subseteq	$\subseteq$	\cap	$\cap$
\geq or \ge	$\geq$	\supset	$\supset$	\cup	$\cup$
\ll	$\ll$	\supseteq	$\supseteq$	\wedge or \land	$\wedge$
\gg	$\gg$	\perp	$\perp$	\vee or \lor	$\vee$
\sim	$\sim$	\parallel	$\parallel$	\ast	$\ast$
\approx	$\approx$	\in	$\in$	\cdot	$\cdot$
				\bullet	$\bullet$

Arrows and Misc Symbols

\leftarrow	$\leftarrow$
\rightarrow or \to	$\rightarrow$
\leftrightarrow	$\leftrightarrow$
\Leftarrow	$\Leftarrow$
\Rightarrow	$\Rightarrow$
\Leftrightarrow	$\Leftrightarrow$
\uparrow	$\uparrow$
\downarrow	$\downarrow$
\updownarrow	$\updownarrow$
\iff	$\Longleftrightarrow$
\mapsto	$\mapsto$

\imath	$\imath$
\jmath	$\jmath$
\partial	∂
\nabla	∇
\infty	∞
\prime	$\prime$
\emptyset	$\emptyset$
\forall	$\forall$
\exists	$\exists$
\P	¶
\S	§
\dag	†
\ddag	‡

Operators

\sin	sin
\cos	cos
\tan	tan
\sinh	sinh
\cosh	cosh
\tanh	tanh
\exp	exp
\ln	ln
\log	log
\lim	lim
\min	min
\max	max

\int_{a}^{b}	$\int_a^b$	$\int_a^b$
\oint_{a}^{b}	$\oint_a^b$	$\oint_a^b$
\sum_{a}^{b}	$\sum_a^b$	$\sum_a^b$
\prod_{a}^{b}	$\prod_a^b$	$\prod_a^b$
\bigcap_{a}^{b}	$\bigcap_a^b$	$\bigcap_a^b$
\bigcup_{a}^{b}	$\bigcup_a^b$	$\bigcup_a^b$

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BibTex database

```
@article{ isaacs_multiobjective_2009,
 title = {Multiobjective Design Optimization Using Multiple
         Adaptive Spatially Distributed Surrogates},
 author = "A. Isaacs and T. Ray and W. Smith",
 journal = "International Journal of Product Development",
 year = "2009",
 pages = "188--217",
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BibTex entry types

article	an article in a journal or magazine
book	a book with an author (or editor) and a publisher
inbook	a part of a book, such as chapter or a page range
incollection	a part of a book with its own title
proceedings	the proceedings of a conference
inproceedings	an article in a conference proceedings with its own title and author
masterthesis	a master's thesis
phdthesis	a Ph.D. thesis
techreport	a report published by a school or institution

BibTex fields

address
author
booktitle
chapter
crossref
edition
editor
howpublished
institution
journal
key
language
month
note
number
organization
pages
publisher
school
series
title
type
volume
year

BibTex fields

address	institution	pages
author	journal	publisher
booktitle	key	school
chapter	language	series
crossref	month	title
edition	note	type
editor	number	volume
howpublished	organization	year

Do all entries require all the fields?

BibTex entries and fields

Entry type	Required fields	Optional fields
article	author, title, journal, year, pages	volume, number, language, note
book	author/editor, title, publisher, year	edition, series, volume, number, address, month, language, note
inbook	author/editor, title, chapter/pages, publisher, year	series, volume, number, type, address, edition, month, pages, language, note
incollection	author, title, booktitle, publisher, year	editor, series, volume, number, address, edition, month, note, pages, language
inproceedings	author, title, booktitle, year	address, editor, series, volume, number, organization, publisher, month, note, pages, language
phdthesis	author, title, school, year	type, address, month, note, pages
techreport	author, title, institution, year	type, number, address, month, note

Questions?