

# An Introduction to L<sup>A</sup>T<sub>E</sub>X

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CIS400 – Senior Design Tutorial  
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- Introducing TeX/LaTeX
- Benefits and potential difficulties
- Installation and use on Unix/Mac/Windows
- Compiling PDF documents from LaTeX
- Basic document formatting
- Typesetting mathematics and special characters
- Environments: tables, graphics, and references
- Setting document-wide parameters
- BibTeX citation system

- TeX: A markup language for typesetting
- Hasn't changed since 1982 (Donald Knuth)
- LaTeX: Makes TeX somewhat user-friendly
- Pronunciation: 'lay-tech', or 'lah-tech'  
But never, ever, 'latex' (like the rubber gloves)
- A standard in computer science write-ups
- Is the opposite of WYSIWYG editors like MS-Word
- Documents must be “compiled” in order to see the results

- Typeset mathematics with ease

- Try typesetting  
in MS Word

$$0 = \frac{\partial}{\partial \mu} \log \left( \left( \frac{1}{2\pi\sigma^2} \right)^{n/2} \exp \left( -\frac{\sum_{i=1}^n (x_i - \bar{x})^2 + n(\bar{x} - \mu)^2}{2\sigma^2} \right) \right)$$

- Separates formatting from authoring
- Global changes can be made from one location
- Style files: Instant conformity to journal standards
- Consistency: LaTeX is a standard!
- Dynamic referencing and labeling

- It is not a WYSIWYG editor
- You can't see the 'result' as you are typing
- May be syntax errors in your 'code'
- Installation can be tricky (is it still?)
- Has a bit of a learning curve
- Lack of GUI will frustrate some
- No convenient help button (or paperclip) if you get stuck

Sometimes I just popup for no particular reason, like now.



- The TeX/LaTeX back end files (engine)
- Mac: MacTeX(<https://tug.org/mactex/>)
- Linux: TeX-Live (<http://www.rna.nl/tex.html>) (apt-get)
- Windows: MiKTeX (<http://www.miktex.org/>)
- Always completely free and open-source
- A simple text editor, e.g., Notepad, Emacs, Gedit
- A terminal in which to run programs
- Windows calls this 'command prompt'
- Or the terminal/shell included with your Unix distro

# Development Cycle

example.tex

```
example.tex
1
2 % A. West - An example LaTeX file
3
4 \documentclass{article}
5 \begin{document}
6 Hello world!
7 \end{document}
8
```

COMPILE

```
> pdflatex example.tex
```

COMPILE ERRORS? FIX

Compilation  
Success

example.pdf



FORMAT ERRORS?  
or CONTINUE  
AUTHORING

```
example2.tex
1
2 % A. West - An example LaTeX file
3
4 \documentclass{article}
5
6 % The preamble
7
8 \begin{document}
9
10 Hello world!
11
12 \end{document}
13
```

COMMENTS: Lines beginning with a '%' are not compiled

DOCUMENT\_CLASS: Specify a broad formatting style

PREAMBLE: Global formatting elements are set here

BEGIN\_DOCUMENT: Delimit start of document body

The body of the document

END\_DOCUMENT: Delimit end of document body



```
example2.tex
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# Basic Text Formatting

```
8 \begin{document}
9
10 Let's cover basic text formatting in \LaTeX
11
12 ``Quotations'' are a little unusual
13
14 Sometimes we want \emph{emphasis} on words
15
16 Other times one needs to be \textbf{bold}
17
18 \tiny small text or \Large big text and \normalsize normal again
19
20 Shortcuts can save \$ or \pounds
21
22 Today is \today
23
24 \begin{itemize}
25   \item Even lists
26   \item are easy \ldots
27 \end{itemize}
28
29 \end{document}
30
```

## Example 3

Let's cover basic text formatting in L<sup>A</sup>T<sub>E</sub>X

“Quotations” are a little unusual

Sometimes we want *emphasis* on words

Other times one needs to be **bold**

small text or **big text** and normal again

Shortcuts can save \$ or £

Today is October 1, 2008

- Even lists
- are easy ...

# Basic Text Formatting



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29 \end{document}
30
```

## Example 3

Commands begin with '\ (forward-slash)

Here we highlight 'single character' and macro commands. They print some specific characters/word

Let's cover basic text formatting in  $\text{\LaTeX}$   
"Quotations" are a little unusual  
Sometimes we want *emphasis* on words  
Other times one needs to be **bold**  
small text or **big text** and normal again  
Shortcuts can save \$ or £  
Today is **October 1, 2008**

- Even lists
- are easy ...

# Basic Text Formatting



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```

Example 3

Using quotations is a little non-traditional

Opening quotes are denoted by 2 left quotes (by '1' on the keyboard), and ended with 2 right quotes (next to 'enter')

Note to editors: A frequent error

Let's cover basic text formatting in L<sup>A</sup>T<sub>E</sub>X

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29 \end{document}
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```

Example 3

Bracketed commands add some effect to the text contained within the brackets according to the pattern:

```
\style{text to be affected}
```

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```

Example 3

In contrast, these text commands apply until another command of the same type 'overwrites' the previous

How do you know what command is what type? Experience and documentation

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29 \end{document}
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```

Example 3

Here we see our first 'environment'.  
Environments are delimited by  
`\begin{environ}` and `\end{environ}`  
They are used for structures that span 1+  
lines of text. Here we see the  
`itemize` environment

Let's cover basic text formatting in L<sup>A</sup>T<sub>E</sub>X  
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- Even lists
- are easy ...

- There are thousands upon thousands of special characters like those in example.
- For example: Four different lengths of hyphen
- No one just 'knows' LaTeX – even experienced users keep a reference handy for look up
- Anything your standard word processor can do, LaTeX can do, and whole lot more...



```

9
10 Typesetting math is very similar to text.
11
12 But math needs to be enclosed by \$ signs
13
14 Greek letters:  $\alpha$   $\beta$   $\Phi$   $\Omega$ 
15
16 Fractions:  $\frac{2+2}{6 + \epsilon}$ 
17
18 Powers like  $x^n$  and indices like  $n_i$ 
19
20 and square roots as well:  $\sqrt[n]{x}$ 
21
22 Or we can use the 'equation' environment:
23 \begin{equation}
24 x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}
25 \end{equation}
26
    
```

Example 4

Typesetting math is very similar to text.  
 But math needs to be enclosed by \$ signs  
 Greek letters:  $\alpha$   $\beta$   $\Phi$   $\Omega$   
 Fractions:  $\frac{2+2}{6+\epsilon}$   
 Powers like  $x^n$  and indices like  $n_i$   
 and square roots as well:  $\sqrt[n]{x}$   
 Or we can use the 'equation' environment:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad (1)$$

```

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```

Example 4

Typesetting math is similar to normal text

One major difference is in-line math expressions are always enclosed by '\$' signs

Here we see some simple symbols used

Typesetting math is very similar to text.  
But math needs to be enclosed by \$ signs

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Or we can use the 'equation' environment:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad (1)$$

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24 x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}
25 \end{equation}
26
    
```

Example 4



Bracketed commands are also similar:  
 $\frac{\text{numerator}}{\text{denominator}}$

Square brackets preceding regular brackets are a chance to provide OPTIONAL params

$$\sqrt[\ ]{x} == \sqrt{x}$$

Typesetting math is very similar to text.  
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 Powers like  $x^n$  and indices like  $n_i$   
 and square roots as well:  $\sqrt[n]{x}$   
 Or we can use the 'equation' environment:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{1}$$

```

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12
13
14 Greek letters:  $\alpha$   $\beta$   $\Phi$   $\Omega$ 
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16 Fractions:  $\frac{2+2}{6 + \epsilon}$ 
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25 \end{equation}
26
    
```

## Example 4

Superscripts and subscripts are a piece-of-cake. Brackets here are optional:

$$x^n == x^{\{n\}}$$

**BUT**

$$x^{12} \neq x^{\{12\}}$$

Editor's: Variables in italics!

Typesetting math is very similar to text.  
But math needs to be enclosed by \$ signs

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Fractions:  $\frac{2+2}{6+\epsilon}$

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26
    
```

Example 4

Here we see the `equation` environment, which sets-off, centers, and numbers a mathematical expression.

Note the power of nested commands, which can be extended infinitely.

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 and square roots as well:  $\sqrt[n]{x}$   
 Or we can use the 'equation' environment:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad (1)$$

```
12 \begin{center}
13
14 \begin{tabular}{| l || c || r | }
15
16 \hline
17 1040 & 2 & &  $\Sigma$  \\ \hline
18 4 & 5397 & &  $\nu$  \\ \hline
19 N &  $N$  & &  $\cdots$  \\ \hline
20
21 \end{tabular}
22
23 \end{center}
24
25 \end{document}
```

Example 5

Here we see a simple table:

1040	2	$\Sigma$
4	5397	$\nu$
N	$N$	$\cdots$

```
12 \begin{center}
13
14 \begin{tabular}{| l || c || r | }
15
16 \hline
17 1040 & 2 & &  $\Sigma$  \\ \hline
18 4 & 5397 & &  $\nu$  \\ \hline
19 N &  $N$  & &  $\cdots$  \\ \hline
20
21 \end{tabular}
22
23 \end{center}
24
25 \end{document}
```

Example 5

Here we see a simple table:

1040	2	$\Sigma$
4	5397	$\nu$
N	$N$	$\cdots$

```

12 \begin{center}
13
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19
20 4 & 5397 & &  $\nu$  \\ \hline
21
22 N &  $N$  & &  $\cdots$  \\ \hline
23
24 \end{tabular}
25
26 \end{center}
27
28 \end{document}
29

```

Example 5

The `tabular` environment is used for tables

Here we specify the alignment for each column (and therefore the # of columns), and whether vertical separators should be present

`l` = left-justified column

`c` = center-justified column

`r` = right-justified column

`|` = vertical separator between columns

Here we see a simple table:

1040	2	$\Sigma$
4	5397	$\nu$
N	$N$	$\cdots$



```

12 \begin{center}
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14 \begin{tabular}{| l || c || r | }
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16 \hline
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18 1040 & 2 & & $\Sigma$ \\ \hline
19 4 & 5397 & & $\nu$ \\ \hline
20
21 N & $N$ & & $\cdots$ \\ \hline
22
23
24 \end{tabular}
25
26 \end{center}
27
28 \end{document}
29

```

Example 5

`\hline` = Draws a horizontal separator  
`&` = Separates cells in a row  
`\\` = Starts a new row

Simple, right? Yep!

But things can get a little intimidating to 'read'.  
Imagine a table of mathematical expressions

Here we see a simple table:

1040	2	$\Sigma$
4	5397	$\nu$
N	$N$	...

- **Include the `GraphicX` package: i.e. put `\usepackage{graphicx}` in preamble**

- **Then:**

```
\includegraphics{graph.jpg}  
\includegraphics{graph.png}  
\includegraphics{graph.pdf}  
\includegraphics{graph.eps}
```

```

10 \begin{table}[t]
11
12   \begin{tabular}{| c | c |}
13     \hline $\Sigma$ & N \\ \hline
14     $\Phi$ & $\Psi$ \\ \hline
15   \end{tabular}
16
17   \caption{Greek letters}
18
19   \label{tab:greek}
20
21 \end{table}
22
23 As Table \ref{tab:greek} on page
24 \pageref{tab:greek} shows $\ldots$
25

```

Example 6

$\Sigma$	N
$\Phi$	$\Psi$

Table 1: Greek letters

As Table 1 on page 1 shows ...

```

10 \begin{table}[t]
11
12   \begin{tabular}{| c | c |}
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23 As Table \ref{tab:greek} on page
24 \pageref{tab:greek} shows $\ldots$
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```

Example 6

Large structures (i.e. those in environments) like tables and figures/graphics are usually wrapped in a large 'floating' environment.

Here we see `table`, `figure` is the other popular choice

Those items inside are 'floated' meaning they have no fixed position. Some control can be had via parameters like `t {h,!,b,a}`

$\Sigma$	N
$\Phi$	$\Psi$

Table 1: Greek letters

As Table 1 on page 1 shows ...

```

10 \begin{table}[t]
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12   \begin{tabular}{| c | c |}
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19   \label{tab:greek}
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21 \end{table}
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23 As Table \ref{tab:greek} on page
24 \pageref{tab:greek} shows $\ldots$
25

```

Example 6

We've seen this before, this is just a simple table!

$\Sigma$	N
$\Phi$	$\Psi$

Table 1: Greek letters

As Table 1 on page 1 shows ...

```

10 \begin{table}[t]
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21 \end{table}
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23 As Table \ref{tab:greek} on page
24 \pageref{tab:greek} shows $\dots$
25

```

Example 6

We add two new commands inside our float:

`\caption{}`: Which allows us to describe whatever we are floating

`\label{ }`: Which is a descriptor no one will see, but is used for internal references

$\Sigma$	N
$\Phi$	$\Psi$

Table 1: Greek letters

As Table 1 on page 1 shows ...

```

10 \begin{table}[t]
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12   \begin{tabular}{| c | c |}
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19   \label{tab:greek}
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21 \end{table}
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24 \pageref{tab:greek} shows $\ldots$
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```

Example 6

And all these gives us the ability to 'reference' these floats within the text body.

Dynamic numbering!

Applies to tables, equations, figures, graphics, sections, etc.

Create a TOC in one command!

$\Sigma$	N
$\Phi$	$\Psi$

Table 1: Greek letters

As Table 1 on page 1 shows ...

```
example2.tex
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2 % A. West - An example LaTeX file
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8 \begin{document}
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10 Hello world!
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12 \end{document}
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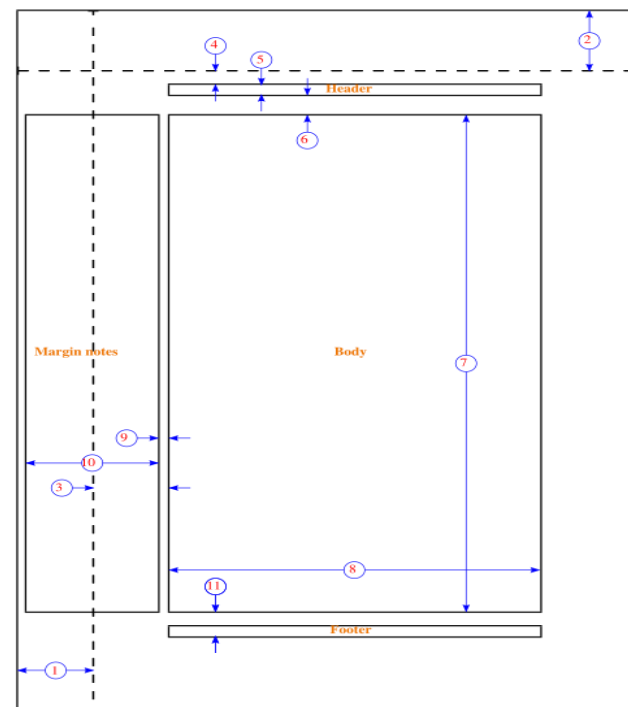
The body of the document

END\_DOCUMENT: Delimit end of document body



```
1
2 % A. West - An example LaTeX file
3
4 \documentclass[10pt, letterpaper, twocolumn]{article}
5
6 \usepackage[top=1.5in, bottom=0.75in,
7             left=0.75in, right=0.75in]{geometry}
8 \usepackage{graphicx}
9 \usepackage{amsmath}
10
11 \setlength{\parskip}{0cm}
12 \linespread{2.0}
13
14 \bibliographystyle{plain}
15
16 \begin{document}
17 .. bla bla bla ...
18 \end{document}
19
```

Example 7



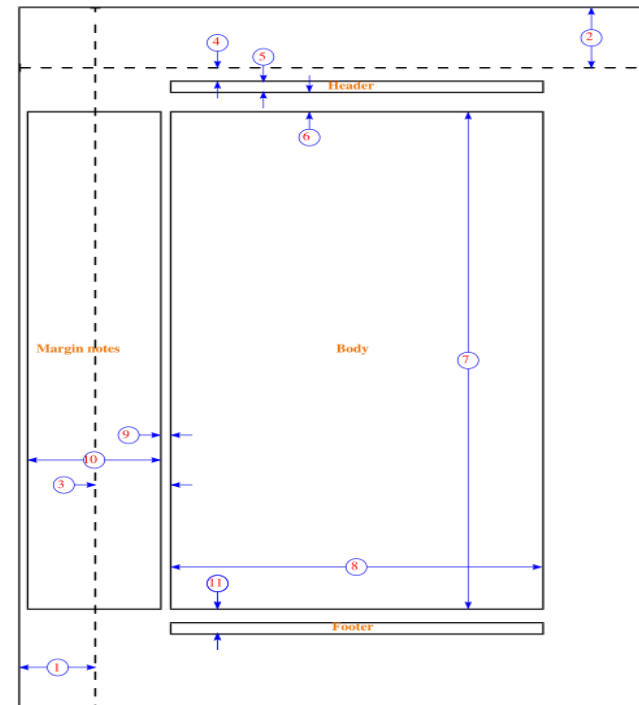
The `\documentclass[]{}`  command provides 99% of the necessary setup

Our doc-style is `article`. `Book`, `report`, or a style file are other common options

Major parameters are given in square brackets. Here we will use a 10pt font, print to letter sized paper, and use a two-column layout

```
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2
3
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Example 7

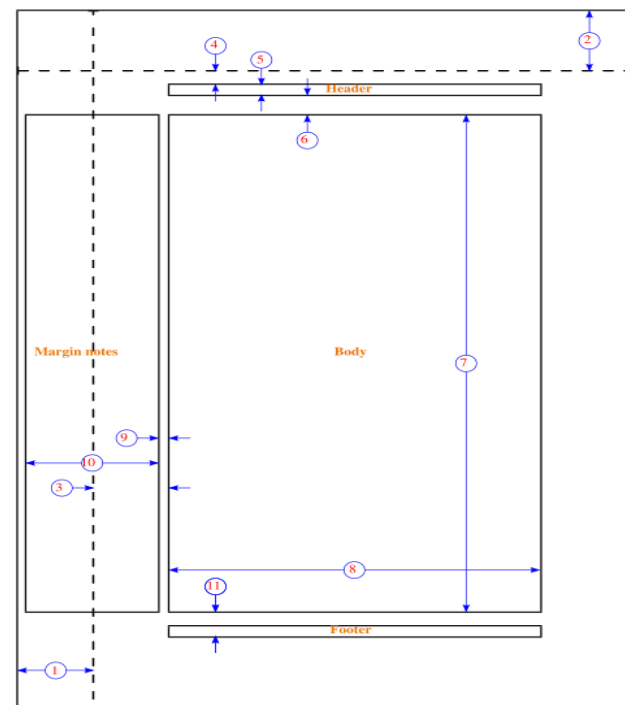


Also in the preamble; import necessary packages (extensions) for use

Note: These packages are included in the LaTeX download. But, they aren't part of the default command set because they may overwrite some default commands and because full inclusion would slow down compilation

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```

Example 7



STOP! The people who wrote LaTeX and the `article` style are way better than you are at it. Change only what is absolutely necessary!

**LaTeX ethos: Worry about writing content, not format or layout**

Here we choose to use block style paragraphs, and double-line space text

- Introducing BibTex
- What is it? A bibliography and citation creation tool for LaTeX
- Advantages of BibTex
- Bibliography files (libraries) are completely re-usable
- Write bibliographies in a universal format, but output them in a specific one (APA, MLA, Chicago, etc.)
- Ditto for (parenthetical) citations
- Disadvantages of BibTex
  - The slightest of learning curves
  - But... No worse than learning punctuation of APA/MLA

example8.bib

```
example8.bib
1
2 % A. West - An example BibTeX file
3
4 @ARTICLE{ieee_article,
5   author = "Huaizhi Li and Mukesh Singhai",
6   title = "Trust Management in Distributed Systems",
7   journal = "IEEE Computer",
8   year = "2007",
9   volume = "40",
10  number = "2",
11  pages = "45-53",
12  month = "February"
13 }
14
15 @BOOK{cis505_text,
16  author = "Andrew S. Tanenbaum and Maarten van Steen",
17  title = "Distributed Systems: Principles and Paradigms",
18  publisher = "Prentice Hall",
19  year = "2006",
20  edition = "2nd"
21 }
22
23 % ... insert other resources here ....
```

BibTeX files:

- \* Should have a \*.bib extension and same name as LaTeX file
- \* Act as a library. Have a single massive BIB file for a project. If a paper doesn't cite a resource, it won't appear.

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22
23 % ... insert other resources here ....
```

First provide a general descriptor of what will be cited:

Article, book,  
conference,  
inproceedings,  
misc, techreport,  
unpublished...

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19  year   = "2006",
20  edition = "2nd"
21 }
22
23 % ... insert other resources here ....
```

Then, similar to the idea of a label we saw with floats, give the resource an (invisible) name by which you can identify it.

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23 % ... insert other resources here .... |
```

Next, provide everything you know about the source in the most complete form possible.

e.x. 'February' instead of 'Feb'

-----  
A note on authors:

List them all, using full names, and only place the word 'and' between them.

-----  
**REMEMBER:** This is a universal format



example8.bib

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```

example8.te

```

1
2 % A. West - An example LaTeX file
3
4 \documentclass{article}
5
6 \begin{document}
7
8 While Li and Signhai \cite{ieee_article}
9 advocate the first option, my friends Tanenbaum
10 and van Steen \cite{cis505_text} feel $\ldots$
11
12 \bibliographystyle{plain}
13
14 \bibliography{example8}
15
16 \end{document}
17

```

`pdflatex example8.tex`  
`bibtex example8.aux`  
`pdflatex example8.tex`  
`pdflatex example8.tex`

While Li and Signhai [1] advocate the first option, my friends Tanenbaum and van Steen [2] feel ...

## References

- [1] Huaizhi Li and Mukesh Singhai. Trust management in distributed systems. *IEEE Computer*, 40(2):45–53, February 2007.
- [2] Andrew S. Tanenbaum and Maarten van Steen. *Distributed Systems: Principles and Paradigms*. Prentice Hall, 2nd edition, 2006.

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example8.tex

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While Li and Signhai [1] advocate the first option, my friends Tanenbaum and van Steen [2] feel ...

## References

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- [2] Andrew S. Tanenbaum and Maarten van Steen. *Distributed Systems: Principles and Paradigms*. Prentice Hall, 2nd edition, 2006.

We use the `\cite{}` command just like `\ref{}` previously, using the label/keyword to identify the cited source

While Li and Signhai [1] advocate the first option, my friends Tanenbaum and van Steen [2] feel ...

## References

- [1] H. Li and M. Singhai. Trust management in distributed systems. *IEEE Computer*, 40(2):45–53, February 2007.
- [2] A. S. Tanenbaum and M. van Steen. *Distributed Systems: Principles and Paradigms*. Prentice Hall, 2nd edition, 2006.

While Li and Signhai [LS07] advocate the first option, my friends Tanenbaum and van Steen [TvS06] feel ...

## References

- [LS07] Huaizhi Li and Mukesh Singhai. Trust management in distributed systems. *IEEE Computer*, 40(2):45–53, February 2007.
- [TvS06] Andrew S. Tanenbaum and Maarten van Steen. *Distributed Systems: Principles and Paradigms*. Prentice Hall, 2nd edition, 2006.

While Li and Signhai [Li and Singhai, 2007] advocate the first option, my friends Tanenbaum and van Steen [Tanenbaum and van Steen, 2006] feel ...

## References

- [Li and Singhai, 2007] Li, H. and Singhai, M. (2007). Trust management in distributed systems. *IEEE Computer*, 40(2):45–53.
- [Tanenbaum and van Steen, 2006] Tanenbaum, A. S. and van Steen, M. (2006). *Distributed Systems: Principles and Paradigms*. Prentice Hall, 2nd edition.

Top Left: Abbrv

Top Right: Alpha

Bottom Left: APA-like

- The resultant PDF format isn't too flexible...
- Utilities exist to convert documents to HTML
- For example, Wikipedia has this functionality built in
- Equations -> images. Great for inclusion in presentations
  
- And to make up for what LaTeX is 'missing'...
- Spell check? Grammar check?
  - Some text-editors have the capability to do former
  - Copy-paste final document to word processor
  - Editor's note: Look for these things!

- No one really knows LaTeX!
- If you don't know how to do something, look it up
  - Tables, matrices, figures may take time to get right
- Detexify - <http://detexify.kirelabs.org/classify.html>
- Ask the TA's!

• The LaTeX Wikibook. (User friendly)

<http://en.wikibooks.org/wiki/LaTeX>

• Comprehensive LaTeX Symbol Guide. (4947 of 'em)

<http://www.ctan.org/tex-archive/info/symbols/comprehensive/>

• A Less Comprehensive List. (and perhaps more useful)

<http://omega.albany.edu:8008/Symbols.html>

• Official LaTeX Site. (Often a bit on the technical side)

<http://www.latex-project.org/>