A $\LaTeX$ Tutorial

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Why $\LaTeX$?

- Best way to typeset mathematics
  (vastly better than MS-Word)
- Most popular typesetting system among computer scientists
- Can be used to produce beautiful output

How to use LaTeX?

1. Create `hw1.tex` with your favorite text editor.
2. Compile: `latex hw1.tex`
   This produces `hw1.dvi`.
3. Make PDF: `dvipdf hw1.dvi hw1.pdf`
   This produces `hw1.pdf`.
4. View: `acroread hw1.pdf`

Sample document

Input:

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

Output:

Hello, world!

Sample document

From here on in, I'll omit the `\documentclass{...}`, `\begin{document}` and `\end{document}`. Thus:

Input: `Hello, world!`

Output: Hello, world!

Paragraphs

```
Line breaks in latex source
are irrelevant, except that
blank lines indicate the start
of a new paragraph.

See how this
works?
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Commands

```
Commands use a backslash.
Arguments are indicated with curly braces.

Let's try some \emph{italized} text.
```

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Let's try some *italized* text.

Mathematics

```
In-line mathematics is enclosed
within dollar signs.

$1+2=3$ looks better than 1+2=3.

$12x+5 > y$ looks better than 12x+5 > y.
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Superscripts

```
Squaring: $x^2$.  Higher powers: $x^n$.
Or: $(2n+1)^3 = 8n^3 + 12n^2 + 6n + 1$.

Warning: If you have more than
one character in the exponent, you
must use curly braces for grouping.
Correct: $x^{2n}$.  Wrong: $x^2n$.
```

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Warning: If you have more than one character in the exponent, you must use curly braces for grouping. Correct: x^{2n}. Wrong: x^2n.

Subscripts

```
Index: $x_i$ and $2x_i + 1$.

Beware: curly braces needed for grouping,
as before.
Correct: $x_{2j+1}$.  Wrong: $x_2j+1$.
```

Index: x_i and $2x_i + 1$.

Beware: curly braces needed for grouping, as before. Correct: x_{2j+1}. Wrong: x_2j+1.

Equations

```
$1+1 = 2$.   $x \not= y$.

$5 < 6$.  $5 \le 7$.   $5 \ge 0$.

$x \in S$.   $y \not\in S$. $S \subseteq T$.
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$5 < 6$. $5 \le 7$. $5 \ge 0$.

$x \in S$. $y \not\in S$. $S \subseteq T$.

Logic

```
$\neg P$.  $P \lor Q$.  $R \land S$.

$T \implies U$.  $P \lor P \equiv P$.

I claim that $\forall x\in S . P(x)$.
Moreover, $\exists x\in S . Q(x)$.
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Some examples

```
Consider any integer $n>2$.
Then the equation $x^n + y^n = z^n$
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Some examples

```
Define $f(1) = 1$,
$f(n) = f(2n+1)$ if $n$ is odd,
and $f(n) = f(n/2)$ if $n$ is even.
Goldbach conjectured that $f(n)$
always terminates and returns 1.
```

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Displayed equations

```
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its own line, like this:
\[ (x-3)^2 \ge 0. \]
```

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$$(x-3)^2 \geq 0.$$

Sums, products, and fractions

```
Useful:
\[ 1^2 + 2^2 + \ldots + n^2
= \sum_{i=1}^n i^2
= \frac{n(n+1)(2n+1)}{6}. \]
\[ n! = \prod_{j=1}^n j. \]
```

Useful:

$$1^2 + 2^2 + \ldots + n^2 = \sum_{i=1}^n i^2 = \frac{n(n+1)(2n+1)}{6}.$$

$$n! = \prod_{j=1}^n j.$$

Environments

```
\begin{quote}
Q: How many Stanford students does it take
to screw in a light bulb?

A: One, dude.
\end{quote}
```

> Q: How many Stanford students does it take to screw in a light bulb?
>
> A: One, dude.

Environments

```
\begin{verbatim}
Q: How many professors does it take to
screw in a light bulb?
A: Only one, but they get three tech.
reports out of it.
\end{verbatim}
```

```
Q: How many professors does it
take to screw in a light bulb?
A: Only one, but they get three
tech. reports out of it.
```

Environments

```
\begin{center}
Q: How many slides does it take
until we get to a joke that is
actually funny?

A: $\infty$.
\end{center}
```

Q: How many slides does it take until we get to a joke that is actually funny?

A: ∞.

Lists

```
How do you catch a blue elephant?
\begin{itemize}
\item With a blue elephant net, of course.
\item But it better be a friggin' big net.
\end{itemize}
```

How do you catch a blue elephant?

- Use a blue elephant net, of course.
- But it better be a friggin' big net.

Numbered lists

```
How do you catch a red elephant?
\begin{enumerate}
\item Hold his nose until he turns blue.
\item Then use a blue elephant net.
\item[(iv)] Hey, my younger brother
thought it was funny.  Once.
\end{enumerate}
```

How do you catch a red elephant?

1. Hold his nose until he turns blue.
2. Then use a blue elephant net.

(iv) Hey, my younger brother thought it was funny. Once.

Multi-line equations

```
\begin{align*}
(x-y)(x+y)  &= x^2-y^2\\
   &= x^2-9+9-y^2\\
   &= (x-3)(x+3) + (3-y)(3+y)
\end{align*}
```

$$
\begin{aligned}
(x-y)(x+y) &= x^2-y^2\\
&= x^2-9+9-y^2\\
&= (x-3)(x+3)+(3-y)(3+y)
\end{aligned}
$$

Equations with justifications

```
\begin{align*}
f(n) &= f(n-1) + n \tag{by defn of $f$}\\
 &= (n-1)n/2 + n \tag{by inductive hyp}\\
 &= n(n+1)/2 \tag{simple algebra}\\
\end{align*}
```

$$
\begin{align*}
f(n) &= f(n-1) + n \tag{by defn of f}\\
&= (n-1)n/2 + n \tag{by inductive hyp}\\
&= n(n+1)/2 \tag{simple algebra}
\end{align*}
$$

Theorems and proofs

```
\begin{theorem} A ham sandwich is better
than good sex.  \end{theorem}
\begin{proof} A ham sandwich is better
than nothing.  Also, nothing is better
than good sex.  The result follows by
transitivity.  \end{proof}
```

Theorem 1. *A ham sandwich is better than good sex.*

Proof. A ham sandwich is better than nothing. Also, nothing is better than good sex. The result follows by transitivity. □

Pitfalls

Beware: Some characters are special, and can’t be used from within text mode. This includes `\%$#&_{}<>~^`.

Many of them can be produced by prepending a backslash. For instance, 55% is produced by typing “`55\%`”, and $\{1,2,3\}$ by “`$\{1,2,3\}$`”.

Error messages

```
Since x^2=1$, we know $x=1$ or $x=-1$.
```

```
This is TeX, Version 3.14159 (Web2C 7.3.1)
...
! Missing $ inserted.
<inserted text>
                $
l.25 Since x^
              2=1$, we know $x=1$ or $x=-1$.
?
```

Type “`h`” for help, then “`x`” to exit. Next, go look at line 25 of the source document. LaTeX is telling you that there is a “`$`” missing somewhere near there.

Summary

$\LaTeX$ is cool stuff. Give it a try.

We'll have resources posted on the web page.

And ask us if you have questions.