History

- \TeX\ created by Donald E. Knuth, released in 1978
- \LaTeX\ created by Leslie Lamport, released in 1985
- After version 3 of \TeX, the version number asymptotically approaches $\pi$ with each new update
  - The current version number of \TeX, as of January 12, 2014, is 3.14159265
MikTeX is a TeX/LaTeX distributor needed to compile files within other programs.

TeXworks is an editor that comes preloaded with MikTeX, but is very basic and not suggested for beginners.

ShareLaTeX (sharelatex.com) is an online editor with pdf viewer. No downloaded software is needed. All files are saved online.

TeXstudio and TeXmaker are common TeX/LaTeX editors used. Both require MikTeX to be installed before downloading.
Introduction to \LaTeX

Alex Milbrand

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TEXmaker Screenshot
TEXstudio Screenshot
Setting Up Your Document (Preamble)

Start off with telling \LaTeX what type of document you are making: \texttt{\documentclass[options]\{class\}}

Class Types:

- PDF Documents: \texttt{\documentclass\{article\}}
- Beamer Presentations: \texttt{\documentclass\{beamer\}}
- Posters
  - \texttt{\documentclass\{baposter\}}
  - \texttt{\documentclass\{tikzposter\}}
  - \texttt{\documentclass\{beamer\}} in conjunction with \texttt{\usepackage\{beamerposter\}}

Packages are ”add-ons” that have extra tools not already equipped in \LaTeX: \texttt{\usepackage[options]\{package\ \textit{name}\}}
Writing Your Document

After your preamble, the code for your document will entirely be nested within:
\begin{document}
\begin{center}
\end{center}
\end{document}

Comments (text that will not show up in document) are added by putting a % before the comment. This can be used in-line with shown text or on its own line.

Since some characters are used for commands/codes, the following characters need a "\" before the symbol:

```
#  $  %  ^  &  _  \{
```

To get "\", type \textbackslash.
New Paragraphs: `\ or `\newcommand{\newline} starts a new line of text, but treats the text as if it was part of the previous paragraph. Double-enter will start a new paragraph.

New Pages: \LaTeX{} will automatically switch to a new page after text/pictures/etc have filled up a page. Inserting `\newpage in your code will force the following text to be on the next page.

White Space: A specific amount of vertical white space can be added using `\vspace{\textit{size}} where the size can be given in most measurements: 0.5cm, 1in, etc. A similar command is used for horizontal space: `\hspace{\textit{size}}.
Basic Example

```latex
\documentclass{article}
\begin{document}
This is a basic example of what an article document would look like. %This text will not appear in the pdf
\vspace{1cm}\
General sentences and words do not require special commands.
\end{document}
```

This is a basic example of what an article document would look like.

General sentences and words do not require special commands.
Include `\usepackage[options]{package name}` in your preamble.

**AMS Packages**

- **amsmath**: substitutes to the `eqnarray` environment; insert plain text inside equation with `\text{blah}`; easy to create matrices
- **amsthm**: adds environment for theorem-like structures
- **amssymb** (which includes `amsfonts`): adds binary relation/operation symbols like \( \cdot \), \( \times \), and \( \boxplus \); adds blackboard bold letters like \( \mathbb{R} \), \( \mathbb{Z} \), and \( \mathbb{Q} \)
Packages

geometry Package

- Can specify the size/type of paper you want to use, such as legal, letter (default), A0, etc.
- Control the margins individually or all at once
- Control the size of the text area, including any headers or footers
- Specify the orientation of the paper; landscape or portrait (default)
Packages

hyperref Package

- Include URL’s with \url{link} or ”hidden” links with \href{link}{description}
- Can create ”mailto” links for email addresses
- Can link within the document with \hyperlink{label}{link caption} and \hypertarget{label}{target caption} like this!
  - Useful for table of contents, indices, and references
polynom Package

- Will compute and display any or all steps for polynomial long division (can even show synthetic division steps)
- Can display Euclidean algorithm for polynomials
- Can display the factorization of a polynomial

For example, \( \texttt{polyfactorize\{2X^3+X^2-7X+3\}} \) will output

\[
2 \left( X - \frac{1}{2} \right) \left( X + \frac{1}{2} + \frac{\sqrt{13}}{2} \right) \left( X + \frac{1}{2} - \frac{\sqrt{13}}{2} \right).
\]

Does not support functions (like \( \sin x \)) or roots and exponents (other than integers). See documentation on package for details.
algorithm2e Package

- Creates environments for writing and displaying algorithms
- Can change keywords or typography of keywords

Example Code

\begin{algorithm}[H]
  \KwData{this text}
  \KwResult{how to write algorithm with \LaTeX2e } initialization;
  \While{not at end of this document}{
    \read current;
    \eIf{understand}{{
      \go to next section;
      current section becomes this one;
    }}{{
      \go back to the beginning of current section;
    }
  }
  \caption{How to write algorithms}
\end{algorithm}

Example Output

\begin{algorithm} 
  \Data{this text} 
  \Result{how to write algorithm with \LaTeX2e initialization;}
  \While{not at end of this document} { 
    \read current; 
    \If{understand}{{
      \go to next section; 
      current section becomes this one; 
    }}{{
      \go back to the beginning of current section; 
    }
  }
  \caption{How to write algorithms}
\end{algorithm}
Math Environments

You can type mathematical equations/expressions in much the same way as you would into google or wolframalpha. For example, \( x^2+y^2=z^2 \) would yield \( x^2 + y^2 = z^2 \).

Two main math environments: inline mode and display mode.

**Inline Mode**

Allows the user to put equations/expressions within a paragraph/sentence, as in the first paragraph above.

- \$ math \$
- \(( math \)\)
- \(\text{begin}{math}...math...\text{end}{math}\)
Math Environments

Display Mode

Equations/expressions written in display mode will be centered and in their own line of text. These can be numbered or unnumbered, based on your code.

- For unnumbered:
  - $$ math $$
  - $$[ math $$
  - \begin{displaymath}...math...\end{displaymath}

- For numbered:
  - \begin{equation}...math...\end{equation}

Note: the amsmath package adds slight variations to these math environments
It’s All Greek to Me!

### Standard Letters

Spell out the name of the letter (after a backslash). Capitalizing the name will give you an uppercase Greek letter.

- `$\delta$` for δ, `$\Delta$` for Δ
- `$\gamma$` for γ, `$\Gamma$` for Γ
- There are no ”capital letters” where you would write the standard latin letter. eq. use Α for a capital alpha

### Variants

Some lowercase letters have different forms to choose from.

- `$\phi$` yields φ and `$\varphi$` yields ϕ
- Standard: ε, θ, κ, φ, π, ρ, σ
- Variant: ε, ϑ, κ, ϕ, ω, ρ, ς
Fractions, Exponents, and Functions

Fractions
Fractions can be inputted using \( \frac{num}{denom} \) (or \( \dfrac{num}{denom} \) for large fractions inline math mode).
\[ \frac{1}{2} \text{ gives } \frac{1}{2} \text{ and } \dfrac{1}{2} \text{ gives } \frac{1}{2} \]

Exponents
Exponents are added with ^ or ^{exponent} (in math mode).
So \( x^{abc} \) results in \( x^{abc} \) but \( x^{\{abc\}} \) results in \( x^{abc} \).
Subscripts are used the same way with _ instead of ^.

Functions
Use \( \sin x \) instead of \( \sin x \). Results in \( \sin x \) and \( \sin x \), respectively. The same applies for other functions, such as logarithms, trigonometric, min/max, etc.
Operators and Relations

<table>
<thead>
<tr>
<th>Basic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operators:</td>
</tr>
<tr>
<td>- $\times$, $\otimes$, $\oplus$, $\cup$, $\cap$</td>
</tr>
<tr>
<td>- $\times$, $\otimes$, $\oplus$, $\cup$, $\cap$</td>
</tr>
<tr>
<td>Relations:</td>
</tr>
<tr>
<td>- $\subset$, $\subseteq$, $\neq$, $\cong$, $\sim$</td>
</tr>
<tr>
<td>- $\subset$, $\subseteq$, $\neq$, $\cong$, $\sim$</td>
</tr>
</tbody>
</table>

It is normally pretty easy to look up the code for any symbol you don’t know.
Operators and Relations

Symbols with Upper/Lower Limits

<table>
<thead>
<tr>
<th>Code</th>
<th>Inline</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lim_{x\to\infty}f(x)$</td>
<td>$\lim_{x\to\infty}f(x)$</td>
<td>$\lim_{x\to\infty}f(x)$</td>
</tr>
<tr>
<td>$\sum_{n=1}^{50}2n$</td>
<td>$\sum_{n=1}^{50}2n$</td>
<td>$\sum_{n=1}^{50}2n$</td>
</tr>
<tr>
<td>$\int_{a}^{b}f(x),dx$</td>
<td>$\int_{a}^{b}f(x),dx$</td>
<td>$\int_{a}^{b}f(x),dx$</td>
</tr>
</tbody>
</table>

Similar coding is done for union (\cup), intersection (\cap), products (\prod), etc. There are ways to make the inline-mode limits actually go above and below your symbols, though it does mess with the spacing of your paragraph lines.
While in a math mode, you do not want functions/operations (like trig functions) in the italics font normally outputted by math modes. Ex:

**BAD**
\[ \sin x + \cos x \]

**GOOD**
\[ \sin x + \cos x \]

Most functions/operations that act like this have a basic code:

\[
\begin{array}{cccccc}
\sin x & \log x & \ln x & \max A & \det A & \gcd A \\
\sin x & \log x & \ln x & \max A & \det A & \gcd A \\
\end{array}
\]
Parenthesis and Brackets

Most bracket types can just be typed out in math mode with the standard keyboard key. So \((2x - 3)|x + 1|\) is coded 
\[(2x-3)|x+1|\].

Self-Scaling Brackets

If you are enclosing larger equations/expressions, you will want your brackets to scale appropriately. You can indicate this by putting \(\text{\textbackslash left}\) and \(\text{\textbackslash right}\) before the symbol:

\[\left(\frac{1}{2}\right)\]  \[\left(\frac{1}{2}\right)\]

You can use \(\text{\textbackslash lbrace}\) for \{, \(\text{\textbackslash langle}\) for \langle, etc.
Aligning Equations

\begin{align*}
2x - 5y &= 8 \\
2x &= 5y + 8
\end{align*}

\begin{array}
2x - 5y &= 8 \\
2x &= 5y + 8
\end{array}
Inserting Images from Files

Package needed: graphicx

\TeX\ will automatically look for pictures in the same folder that your .tex file is saved, though you can indicate which folder(s) to look in by indicating in your preamble. Insert an image by coding:

\includegraphics[dimension changes]{file name}

You can change both the width and height to get a precise image size. Changing only width (height) will automatically scale the height (width) to match the aspect ratio of the image.
Inserting Images from Files

Original:

![Original Image]

Change width and height:

![Changed Image Width and Height]

Change only height:

![Changed Image Only Height]
Package needed: \texttt{pgfplots}

\begin{tikzpicture}
    \begin{axis}[
        scale=0.55, xmin=-4,
        xmax=4, ymin=-5, ymax=15,
        axis lines=center, xlabel=$x$, ylabel={$f(x)$},
        ]
    \addplot [domain=-4:4,samples=200,]
        \{x^2-4\};
    \end{axis}
\end{tikzpicture}
\begin{tikzpicture}
\begin{axis}[scale=0.6,hide axis, colormap/jet]
\addplot3[mesh,samples=50,domain=-8:8,]
{\sin(deg(sqrt(x^2+y^2)))}
/sqrt(x^2+y^2)};
\addlegendentry{\frac{\sin(r)}{r}}
\end{axis}
\end{tikzpicture}
Package needed: \texttt{tikz-cd}

\begin{example}{Fundamental Homomorphism Theorem}
\begin{tikzcd}
G & \varphi & H \\
G/K & f & & h
\end{tikzcd}
\end{example}
Bib\TeX\ works seamlessly with \TeX\ to help manage a bibliography and cite your sources within your document.

You will need to create a separate .bib file that your \TeX\ document will reference. This .bib file should be saved in the same folder as your .tex file.

Within your \TeX\ code, there is no extra package needed. However, if you are using a table of contents and want to include ”References” in your table of contents, be sure to have \usepackage[nottoc]{tocbibind} in your preamble.
Bib\TeX - .bib File

To create a .bib file, simply open a new document in whatever program you are using for \TeX and save the file as a .bib file. In the .bib file, you will only have entries based on your references.

@entrytype{name, info separated by commas}

Example:
@book{dummitfoote,
    author="David S. Dummit and Richard M. Foote,
    title="Abstract Algebra",
    edition="3",
    year="2003",
    publisher="Wiley"}

# BibTeX - Entry Types and Fields

## Common Entry Types

- article
- book
- unpublished
- inbook: just a section, chapter, or part of a book
- misc: good for websites

## Common Fields Used

- author
- booktitle
- title
- edition
- journal
- volume
- year
- url
- chapter
Citing in document

Once you’ve named an entry in your .bib file, to place its reference number within your document, simply put \cite{name} where you are making the reference.

In .tex file

When you are ready to output your reference list, specify the style you would like it in and the .bib file name:
\bibliographystyle{style}
\bibliography{file}
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BibTeX - Example

\documentclass[a4paper,10pt]{article}
\usepackage[utf8]{inputenc}
\usepackage[nottoc]{tocbibind}

\title{Bibliography management: BibTeX}
\author{Share\LaTeX}
\begin{document}
\maketitle
\tableofcontents
\section{First Section}
This document is an example of BibTeX using in bibliography management. Three items are cited:
\section*{References}

\begin{thebibliography}{9}
\bibitem{} Michel Goossens, Frank Mittelbach, and Alexander Samarin. \textit{The \LaTeX\ Companion}. Addison-Wesley, Reading, Massachusetts, 1993.
\bibitem{} Donald Knuth. \textit{Knuth: Computers and typography}.
\end{thebibliography}

\end{document}
You can also manually place "coffee stains" on your documents with the coffee package!


Where to find more information

- Downloads: miktex, texstudio, texmaker, texworks
- The Not So Short Introduction to \LaTeX
- sharelatex.com/learn
- \TeX for gmail
- MathIM: can use "faugrad" chatroom
- \TeX StackExchange
- The Great, Big List of \LaTeX Symbols
- http://detexify.kirelabs.org/classify.html
THANK YOU!