LaTeX: Making Math Accessible for the Blind or Visually Impaired

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People looking at a computer screen together

Figure:
http://www.cdc.gov/ncird/div/DBD/newsletters/2011/fall/communications.html

LaTeX code view of formal business letter

```
\documentclass[
	pagenumber=false, % Removes page numbers from page 2 onwards
	parskip=half, % Separates paragraphs with some whitespace, use parskip=full for more space or comment out to return to default
	fromalign=right, % Aligns the from address to the right
	foldmarks=true, % Prints small fold marks on the left of the page
	addrfield=true % Set to false to hide the addressee section - you will then want to adjust the height of the body of the letter on the page by adding the following in this section: \makeatletter \@setplength{refvpos}{\useplength{toaddrvpos}} \makeatletter
	]{scrlttr2}
\usepackage[english]{babel} % Explicitly load the babel package to stop an error occurring on some LaTeX installations
\renewcommand*{\raggedsignature}{\raggedright} % Stop the signature from indenting
%----------------------------------------------------------------------------------------
%	YOUR INFORMATION AND LETTER DATE
%----------------------------------------------------------------------------------------
\setkomavar{fromname}{John Smith} % Your name used in the from address
\setkomavar{fromaddress}{123 Broadway \\ City, State 12345} % Your address
\setkomavar{signature}{John Smith} % Your name used in the signature

\date{\today} % Date of the letter
%----------------------------------------------------------------------------------------
\begin{document}

\begin{letter}{Director \\ Corporation \\ 123 Pleasant Lane \\ City, State 12345} % Addressee name and address
\opening{Dear Sir or Madam,}

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nullam aliquet tellus vel justo porta et semper libero rutrum. Duis vestibulum sagittis aliquam. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Phasellus ac velit eu dolor lobortis fringilla. Quisque imperdiet porta ante in pretium. Maecenas facilisis varius metus et blandit. Proin rhoncus arcu non ante elementum non vehicula sem varius. Morbi feugiat, elit eget tristique posuere, urna eros vestibulum nibh, at tempus neque justo nec enim.

\closing{Sincerely,}

\setkomavar*{enclseparator}{Attached} % Change the default "encl:" to "Attached:"
\encl{Copyright permission form} % Attached documents
```

Compiled view of the letter in PDF format

John Smith
123 Broadway
City, State 12345

John Smith, 123 Broadway , City, State 12345

Director
Corporation
123 Pleasant Lane
City, State 12345

October 12, 2013

Dear Sir or Madam,

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nullam aliquet tellus vel justo porta et semper libero rutrum. Duis vestibulum sagittis aliquam. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Phasellus ac velit eu dolor lobortis fringilla. Quisque imperdiet porta ante in pretium. Maecenas facilisis varius metus et blandit. Proin rhoncus arcu non ante elementum non vehicula sem varius. Morbi feugiat, elit eget tristique posuere, urna eros vestibulum nibh, at tempus neque justo nec enim.

Sincerely,

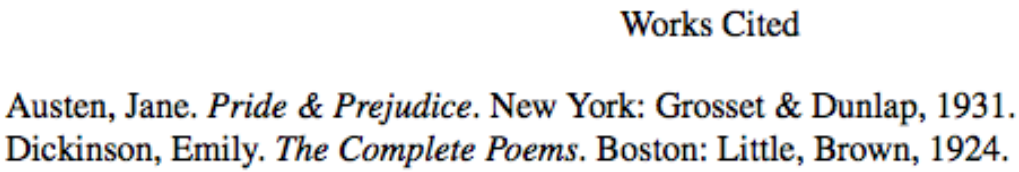
LaTeX code view of reference page of a MLA formatted essay using MLA package

```
\begin{workscited}
\bibent
Austen, Jane. \textit{Pride \& Prejudice}.
New York: Grosset \& Dunlap, 1931.

\bibent
Dickinson, Emily. \textit{The Complete Poems}.
Boston: Little, Brown, 1924.

\end{workscited}
```

Compiled view of the reference page in PDF



Works Cited

Austen, Jane. *Pride & Prejudice*. New York: Grosset & Dunlap, 1931.
Dickinson, Emily. *The Complete Poems*. Boston: Little, Brown, 1924.

Figure: Compiled output of works cited using MLA package

LaTeX coded view of an exercise from a statistics assignment

```
\section*{Exercise 3.41, pg. 92}
Heights of women.  The heights of women aged 20 to 29 follow approximately the N(64.3, 2.7) distribution.  Men the
same age have heights distributed as N(69.9, 3.1). What percent of young women are taller than the mean height of
young men?\\
\\
My Answer:\\
We will first find the proportion of women who are who are 69.9 inches and shorter.
$$z = \frac{x- \mu}{\Sigma}$$
$$2.0740 \approx \frac{69.9 - 64.3}{2.7}$$
$0.9808 \%$ of women are shorter than 69.9 inches which means $2 \%$ of women are taller than 69.9 inches.
```

Compiled view of statistics assignment

Exercise 3.41, pg. 92

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0.9808% of women are shorter than 69.9 inches which means 2% of women are taller than 69.9 inches.

LaTeX coded view of title page which includes name of student, title of project, class (BPK 140 - D100), date, student number

```
\documentclass[12pt]{article}
\usepackage{amsmath}

\title{Assignment 1 \\ BPK 140 - D100}
\author{Smart Student (0123456789)}
\date{\today}

\begin{document}
\maketitle
\newpage
\section*{Question 1}

The answer is...
```

An expression with fractions within fractions, exponents, multiple variables and factors

```
$\frac{\frac{\frac{3}{5}}{2}xy^{\frac{-1}{2}}(z - w^{2})}{y}$
```

$$\frac{\frac{\frac{3}{5}}{2}xy^{\frac{-1}{2}}(z - w^{2})}{y}$$

Quadratic Formula

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

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

Linear Function

```
$f(x) = \frac{4}{7}x+2$
```

$$f(x) = \frac{4}{7}x + 2$$

Basic Exponents

```
$3^{2} * 3^{6} = 3^{2+3} = 3^{5}$
```

$$3^{2} * 3^{6} = 3^{2+3} = 3^{5}$$

LaTeX code view slide from of a math talk, using the Beamer package

```
\begin{frame}
\frametitle{Compiled view of the previous slide}
\begin{theorem}
  In a right triangle, the square of the hypotenuse
  equals the sum of the squares of the two other sides.
\end{theorem}
\end{frame}.
```

Compiled view of the previous slide

Theorem

In a right triangle, the square of the hypotenuse equals the sum of the squares of the two other sides.

Example: Working with Fractions

```
$\frac{1}{2} * \frac{2}{3} = \frac{1 * 2}{2 * 3} =
\frac{2}{6} = \frac{1}{3}$
```

$$\frac{1}{2} * \frac{2}{3} = \frac{1 * 2}{2 * 3} = \frac{2}{6} = \frac{1}{3}$$

Example: Working with Exponents

```
$(x^{3})^{2} = x^{2*3} = x^{6}$
```

$$(x^{3})^{2} = x^{2*3} = x^{6}$$

Example: Completing the square

```
$ax^{2} + bx + c = 0 $
$x^{2} + \frac{bx}{a} + \frac{c}{a} = 0 $
$x^{2} + \frac{bx}{a} + \frac{c}{a} +
(\frac{b}{2a})^{2} = (\frac{b}{2a})^{2}$
$(x + \frac{b}{2a})^{2} = -\frac{c}{a} + (\frac{b}{2a})^{2}$
```

$$ax^2 + bx + c = 0$$

$$x^2 + \frac{bx}{a} + \frac{c}{a} = 0$$

$$x^2 + \frac{bx}{a} + \frac{c}{a} + (\frac{b}{2a})^2 = (\frac{b}{2a})^2$$

$$(x + \frac{b}{2a})^2 = -\frac{c}{a} + (\frac{b}{2a})^2$$

Example: Expanding Expressions

```
$(x+2)(x+3) = x^{2} + 3x +2x + 6 = x^{2} + 5x + 6$
```

$$(x+2)(x+3) = x^2 + 3x + 2x + 6 = x^2 + 5x + 6$$

Advantages of chosen software tools: EdSharp & MiKTeX

- MiKTeX is the engine that enables EdSharp to understand LaTeX and compile documents from LaTeX into visual appealing formats such as PDF where the code is not seen, but their visual results are
- EdSharp (a text-editor, not a word processor) was chosen due to having the ability for the blind user to independently access and manipulate the input window and read the produced work.
- EdSharp also has JAWS scripts which enable the JAWS user to either hear and navigate through the document line by line, character by character or between the individual elements within an equation and to hear math in either regular math notation (the way normal people read math equations during verbal conversation) or as basic LaTeX code.
- With these tools, we avoid the problem of having to memorize entire lines of equations that is mandatory for working with math in other software.

Shortcomings of chosen software tools

- JAWS scripts have little glitches with more advanced math
- When compiling LaTeX into visual output (e.g., PDF files), one will sometimes need feedback from sighted individuals to confirm that the visual output does not need minor formatting changes.

Example of Shortcoming: Flubbed Words

```
$\log_{10} 100$
```

$$\log_{10} 100$$

Example of Shortcoming: Negative Exponents

```
$x^-5$
$x^{-5}$
$2^-1/2$
$z^{-\frac{1}{2}}$
```

x^-5

x^{-5}

$2^-1/2$

$z^{-\frac{1}{2}}$

Example: Multiple ways of indicating multiplication

```
$ a * b $
$ a \cdot b$
$ a \times b $
```

$$a * b$$

$$a \cdot b$$

$$a \times b$$

Example: Fractions, Unions, Intersections, and Infinity

```
Fractions: \frac{numerator}{denominator}
Union: \cup
Intersection: \cap
Infinity: \infty
```

$$\frac{numerator}{denominator}$$

$$\cup$$

$$\cap$$

$$\infty$$

Example: Interval Notation

```
$ (-\infty, -1 ) \cup (1, \infty)$
```

$(-\infty, -1) \cup (1, \infty)$

Example: Inequalities

```
$1 < x \leq 6$
```

$$1 < x \leq 6$$

In closing...

The End - Thank you

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Special Thanks to:

- Tyler Spivey (*spivey@pcdesk.net*): Wrote the readme and compiled *latex_access* for 64-bit windows.
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