

Another Short Tutorial for L^AT_EX 2_ε

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1 Introduction

This is a short, easy, nontechnical introduction to $\text{\LaTeX 2}_{\epsilon}$. It's a tutorial designed for students who do not have a lot of time, who do not need to become overnight experts in $\text{\LaTeX 2}_{\epsilon}$, and prefer a shallow learning curve to a boot camp approach. After you have worked through it, you will be able to create professional documents, and have the ability to teach yourself how to extend your $\text{\LaTeX 2}_{\epsilon}$ skills — to become a $\text{\LaTeX 2}_{\epsilon}$ guru if you want to or need to.

What about $\text{\LaTeX 2}_{\epsilon}$? First, it's *free* in the sense that you do not have to pay for it. Second, it's *easy*, given that you know how to use it. As always, there are trade-offs, and “easy” to an expert tends to be hard for a beginner, and *vice versa*. Third, it's *stable*, the first version released in 1985. Fourth, it's *well documented*, not surprising since its purpose is document preparation. Fifth, it's *professional*, as you will soon come to see. I will touch on these points from time to time in this tutorial.

How does this introduction work? Each “lesson” consists of the introduction of a few commands, some text to copy, paste, and compile, and a couple of questions. Each lesson should not take more than fifteen minutes to complete. It uses the “baby talk” principle — you imitate what you see and explore it by making slight changes. If you complete one lesson a day, within several weeks you will have a good foundation with $\text{\LaTeX 2}_{\epsilon}$, and begin to create professional quality documents. You will also see how the things I wrote in the preceding paragraph are true.

Please note that this tutorial *is not* a $\text{\LaTeX 2}_{\epsilon}$ reference; you will need to find a good reference that details the options and arguments for each command. It's also not a user guide. Nor is it a full introduction to $\text{\LaTeX 2}_{\epsilon}$, although it will introduce it to students not previously familiar with it. It gives an ideosyncratic view of $\text{\LaTeX 2}_{\epsilon}$ (my own). It promises only to be short, easy, and useful, not long-winded or difficult, even if it does omit some necessary details.

2 Document Basics

A `tex` document consists of plain text, and special characters, commands, and environments. I will generally refer to special characters, commands, and environments with the word *commands*; you don't need to know the difference between them now, but you shortly will without being told. You *must* precede commands with a backslash (`\`) for the compiler to know that they are commands. This is easy to forget, so I will remind you the first couple of times.

What should I have? You should have a working $\text{\LaTeX} 2_{\epsilon}$ program. If you do not have one, see Appendix A below on page 42. You will also need a text editor, and you will probably want to get an integrated editor, compiler, and printer. See Appendix B on page 42. You can also use the old fashioned command line, I cover this in Appendix C on page 42.

2.1 Basic document

- `documentclass`
- `begin/end` document
- plain text
- comments

A basic document begins with a document class, and has a preamble and contents. Type (or copy) the following, save it as a `.tex` document and compile it. The percent signs (`%`) are comments and do not have any effect on the document.

```
\documentclass{article}
    %this is the preamble
\begin{document}
    %this is the contents section
    It works! %plain text prints as it
\end{document}
```

Exercise: $\text{\LaTeX} 2_{\epsilon}$ has a number of different document classes. Name four of them.

Exercise: A `documentclass` command can take optional arguments, like this: `documentclass[optional arguments]{document class}`.¹ Name two optional arguments.

¹Don't forget to type a backslash before the command, like this: `\documentclass`

2.2 Basic title

- title
- author
- date
- maketitle

A basic document usually title and author information in the preamble. You specify the title with the `title` command. You specify the author(s) with the `author` command. You may optionally specify a date with the `date` command. In the body of the document, you create the title with the `maketitle` command. Create and compile a second document like this:

```
\documentclass{article}
  \title{Title, Author, and Date}
  \author{Charles Carter}
  \date{July 4, 1776}
\begin{document}
  \maketitle{}
  This document has a title, author, and date.
\end{document}
```

Exercise: What happens if you use the command `today{}`² as the date parameter (replacing July 4, 1776)?

Exercise: What happens if you use the command `thanks{email address}`³ after your name in the `author{}` command?

2.3 Basic sections

- section
- subsection
- subsubsection
- label

L^AT_EX 2_ε provides a number of useful section levels, including part and chapter. Two of the most useful are `section` and `subsection`. Create and compile the following document.

²Remember, `\date{}`

³`\thanks{}`

The `label{}` is used to create cross-references in documents. It's also very helpful in organizing your thoughts. The argument to `label{argument}` does not appear in the document. I cover the `ref` and `pageref` commands below in subsection 4.1 on page 23. These are used to create references back to the label.

```
\documentclass{article}
  \title{Basic Sections}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \section{Introduction}
  \label{Introduction}
  \section{Body}
  \label{Body}
  \section{Conclusion}
  \label{Conclusion}
\end{document}
```

Exercise: What do the commands `subsection{}` and `subsubsection{}` do?

Exercise: What does `section*{}` do? Note the asterisk (*) after `section`. You can also use this starred version for `subsections` and `subsubsections`.

2.4 Basic paragraphs

- paragraph
- subparagraph

We have reached the point where you need some real content. I will use the text of Abraham Lincoln's Gettysburg Address to illustrate paragraphs. Notice that ordinary paragraphs do not need a special command – the “paragraph command” is simply two blank lines to create an empty new line between the paragraphs, as if they were double spaced. Create and compile the following document.

```
\documentclass{article}
  \title{Basic Paragraphs}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \section{Introduction}
  \label{Introduction}
  \section{Body}
  \label{Body}
```

Four score and seven years ago our fathers brought forth on this continent a new nation, conceived in liberty, and dedicated to the proposition that all men are created equal.

Now we are engaged in a great civil war, testing whether that nation, or any nation so conceived and so dedicated, can long endure. We are met on a great battlefield of that war. We have come to dedicate a portion of that field, as a final resting place for those who here gave their lives that that nation might live. It is altogether fitting and proper that we should do this.

But, in a larger sense, we can not dedicate, we can not consecrate, we can not hallow this ground. The brave men, living and dead, who struggled here, have consecrated it, far above our poor power to add or detract. The world will little note, nor long remember what we say here, but it can never forget what they did here. It is for us the living, rather, to be dedicated here to the unfinished work which they who fought here have thus far so nobly advanced. It is rather for us to be here dedicated to the great task remaining before us, that from these honored dead we take increased devotion to that cause for which they gave the last full measure of devotion, that we here highly resolve that these dead shall not have died in vain, that this nation, under God, shall have a new birth of freedom, and that government of the people, by the people, for the people, shall not perish from the earth.

```
\section{Conclusion}
\label{Conclusion}
\end{document}
```

Exercise: What happens if you include the `paragraph{}` or `subparagraph{}` commands before each paragraph?

Exercise: What happens if you include arguments with the `paragraph{argument}` or `subparagraph{argument}` commands?

2.5 Basic packages

- `usepackage`
- `lipsum`

Much of L^AT_EX 2_ε functionality is contained in external packages. To use this functionality, you include the command `usepackage{}` in the preamble. Of course, you first have to install the package on your computer, but the MiKTeX distribution does that automatically. The `lipsum` package generates generic text (in Latin, of course). The `lipsum{}` command generates text. Notice that you can control the

number of paragraphs to include. Below, I have included paragraph 1 in the introduction, paragraphs 2 through 4 in the body, and paragraph 5 in the conclusion.

Notice the paragraph indentation. First paragraphs are *not* indented. Following paragraphs *are* indented. This is normal typographic practice.

```
\documentclass{article}
  \usepackage{lipsum}
  \title{Using Packages}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \section{Introduction}
  \label{Introduction}
  \lipsum[1]{}
  \section{Body}
  \label{Body}
  \lipsum[2-4]{}
  \section{Conclusion}
  \label{Conclusion}
  \lipsum[5]{}
\end{document}
```

Exercise: What is CTAN, the Comprehensive T_EX Archive Network? How many packages are currently on CTAN?

Exercise: What are the most popular L^AT_EX 2_ε packages?

2.6 Basic contents

- tableofcontents

Creating a table of contents is easy. Just include the `tableofcontents{}` command. You may have to compile the document twice to ensure that the table of contents is generated properly.

```
\documentclass{article}
  \usepackage{lipsum}
  \title{Table of Contents}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \tableofcontents{}
  \section{Introduction}
  \label{Introduction}
  \lipsum[1]{}
\end{document}
```



```

\section{Body}
\label{Body}
\lipsum[2-4]{}
\section{Conclusion}
\label{Conclusion}
\lipsum[5]{}
\end{document}

```

Exercise: The `section[argument]{Section Title}` command takes an optional argument. How does this argument affect the table of contents?

Exercise: What other kinds of content tables can L^AT_EX 2_ε generate? To start with, look at figures and tables.

2.7 Basic decorations

- `textit`
- `textsf`
- `texttt`
- `textbf`
- `textsc`
- `underline`

In this section, you will fiddle with the appearance of text. To *create text in italics*, use `textit`. To create text in sans serif, use `textsf`. To create text in monospace font, use `texttt`. To **create text in boldface**, use `textbf`. To CREATE TEXT USING SMALL CAPS, use `textsc`. You should almost never underline text! If you choose to do so, use `underline`.

To *create text in italics*, use `textit`.

To create text in sans serif, use `textsf`.

To create text in monospace font, use `texttt`.

To **create text in boldface**, use `textbf`.

To CREATE TEXT USING SMALL CAPS, use `textsc`.

You should almost never underline text! If you choose to do so, use `\underline`.

```
\documentclass{article}
  \title{Font Appearance}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \section{Introduction}
  \label{Introduction}
  \section{Body}
  \label{Body}
    \paragraph{}In this section, you will fiddle with the appearance of text.
    \paragraph{}To \textit{create text in italics}, use \texttt{\textit{}}.
    \paragraph{}To \textsf{create text in sans serif}, use \texttt{\textsf{}}.
    \paragraph{}To \texttt{create text in monospace font}, use \texttt{\texttt{}}.
    \paragraph{}To \textbf{create text in boldface}, use \texttt{\textbf{}}.
    \paragraph{}To \textsc{create text using Small Caps}, use \texttt{\textsc{}}.
    \paragraph{}\underline{You should almost never underline text}!
    If you choose to do so, use \texttt{\underline{}}.
  \section{Conclusion}
  \label{Conclusion}
\end{document}
```

Exercise: As with much else in $\text{\LaTeX 2}_{\epsilon}$, there are multiple ways to italicize or bold-face text. Can you find other ways?

2.8 Basic fontsizes

- tiny
- scriptsize
- footnotesize
- small
- normalsize
- large
- Large
- LARGE
- huge
- Huge

L^AT_EX 2_ε has several different ways to alter the size of the font. Perhaps the simplest way is to create a *size environment*. You do this by using one of the commands listed above, and this controls the size of all text until it is changed by another command. You would typically use this for sections of text that need to be made smaller, such as tables, block quotes, technical sections not germane to the main discussion, and similar.

This paragraph has a normalsize font size.

This paragraph has a tiny font size.

This paragraph has a scriptsize font size.

This paragraph has a footnotesize font size.

This paragraph has a small font size.

This paragraph has a normalsize font size.

This paragraph has a large font size.

This paragraph has a Large font size.

This paragraph has a LARGE font size.

This paragraph has a huge font size.

This paragraph has a Huge font size.

This paragraph has a normalsize font size.

```
\documentclass{article}
  \title{Font Sizes}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \section{Introduction}
  \label{Introduction}
  \section{Body}
```

```

\label{Body}
\normalsize{}\paragraph{}This paragraph has a normalsize font size.
\tiny{}\paragraph{}This paragraph has a tiny font size.
\scriptsize{}\paragraph{}This paragraph has a scriptsize font size.
\footnotesize{}\paragraph{}This paragraph has a footnotesize font size.
\small{}\paragraph{}This paragraph has a small font size.
\normalsize{}\paragraph{}This paragraph has a normalsize font size.
\large{}\paragraph{}This paragraph has a large font size.
\Large{}\paragraph{}This paragraph has a Large font size.
\LARGE{}\paragraph{}This paragraph has a LARGE font size.
\huge{}\paragraph{}This paragraph has a huge font size.
\Huge{}\paragraph{}This paragraph has a Huge font size.
\normalsize{}\paragraph{}This paragraph has a normalsize font size.
\section{Conclusion}
\label{Conclusion}
\end{document}

```

Exercise: The issues of font, font size, and font decoration, are difficult, complicated, and subject to internecine wars. You may want to postpone your exploration of these issues until you have created and compiled several hundred `.tex` documents. If you want, and have discretionary time available and nothing else to do, you may want to delve into the complex and divisive world of fonts, font sizes, and font decorations.

L^AT_EX 2_ε is *Professional*

L^AT_EX 2_ε is flexible to an extreme. You can customize every part of your document. However, its authors have spent much time and effort to ensure that it gives a professional appearance “out of the box.” This short tutorial does not cover customization. After you have created and compiled several dozen `.tex` files, you will begin to see the need for customization.⁴ Unless you have special requirements, such as page margins, paragraph spacing, and page numbers, and you are happy with the appearance of your document, you do not need to think about customization.

⁴The first thing you may want to do is to change the page margins. An easy way to change page margins is to use the `geometry` package.

3 Math and Symbols

Both \TeX and $\text{\LaTeX}_{2\epsilon}$ shine when it comes to math. In fact, Donald Knuth originally wrote \TeX just so he could typeset math. In this section, we will dip our toes into math and symbols. This will not be difficult. If you have need for more advanced mathematics, you will know how to find what you need to render your equations.

3.1 Special characters

Most characters are not special. An a is just an a , a Z is just a Z , and a 7 is just a 7 . Sometimes, this isn't the case — an $\&$ is not just an ampersand. $\text{\LaTeX}_{2\epsilon}$ has ten special characters. They are listed below.

\backslash , $\%$, $\{$, $\}$, $\$$, \wedge , \rightarrow , \sim , $\#$, $\&$

You already know four of them. “ \backslash ” indicates the beginning of a command, “ $\%$ ” indicates a comment, and the “ $\{$ - $\}$ ” pair (usually) indicates the argument to a command. You will learn about three more in this section, “ $\$$ ”, “ $_$ ”, and “ \wedge ”. It's worthwhile to stare at these characters long enough to become familiar with them. When you document misbehaves, often these characters are the culprit.

Sometimes you will find characters that wish they were special, but are not. These include the cedilla (\c), the degree ($^\circ$), and diphthongs (\ae). All these are represented by $\text{\LaTeX}_{2\epsilon}$ commands, you will use the command for the character.

Exercise: Scott Pakin has published the booklet *The Comprehensive \LaTeX Symbol List*. You can find this online in PDF format. Search for it and just look at it. It contains over 300 pages of symbols. You'll be amazed!

3.2 Inline math

- $\$$
 - plus or $+$
 - $-$ (dash or subtraction)
 - times or \ast
 - frac or div
 - sqrt
 - \wedge (caret or circumflex)
 - $_$ (underscore)

This is an example of inline math. Use the dollar symbol ($\$$) to set the math. Here is how it works. Addition: $4 + 5 = 9$. Subtraction: $4 - 5 = -1$. Multiplication:

$4 \times 5 = 20$. Multiplication: $4 * 5 = 20$. Division: $\frac{4}{5} = 0.8$. Division: $4 \div 5 = 0.8$.
 Square root: $\sqrt{2} = 1.41421$. Exponents: $2^8 = 256$. Subscripts: x_0, x_1, x_2 .

```
\documentclass{article}
  \title{Inline Math}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
This is an example of inline math. Use the dollar symbol (\$) to set the math.
Here is how it works.
  Addition: $4 + 5 = 9$.
  Subtraction: $4 - 5 = -1$.
  Multiplication: $4 \times 5 = 20$.
  Multiplication: $4 \ast 5 = 20$.
  Division: $\frac{4}{5} = 0.8$.
  Division: $4 \div 5 = 0.8$.
  Square root: $\sqrt{2} = 1.41421$.
  Exponents: $2^8 = 256$.
Subscripts: $x_0, x_1, x_2$
\end{document}
```

Exercise: You can find the *User's Guide for the amsmath Package* in PDF format online. Search for it and start reading through it.

3.3 Equations

- amsmath
- equation
- equation*

L^AT_EX 2_ε provides the *equation* environment for writing block equations with the *amsmath* package. First, import the package with `\usepackage{amsmath}`. Equations are numbered and can be referenced by means of their labels. The starred version omits the equation from the numbered equations. Here are some examples. Equation 1 is the formula for a straight line. Equation 2 is the formula for the slope of a straight line. The third, unnumbered equation is the formula for a straight line with multiple parameters.

$$y = \beta_0 + \beta_1 x_1 \tag{1}$$

$$m = \frac{y_1 - y_0}{x_1 - x_0} \tag{2}$$

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3$$

```
\documentclass{article}
\usepackage{amsmath}
```

```

\title{Equations}
\author{Charles Carter}
\date{\today{}}
\begin{document}
\maketitle{}
This is an example of equations.
\begin{equation}
\label{line}
y = \beta_0 + \beta_1 x_1
\end{equation}
\begin{equation}
\label{slope}
m = \frac{y_1 - y_0}{x_1 - x_0}
\end{equation}
\begin{equation*}
y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3
\end{equation*}
\end{document}

```

Exercise: Continue reading through the *User's Guide for the amsmath Package*.

3.4 Multiline equations

- align
- gather
- multiline

How do I place several equations together in one equation environment, aligned on a particular character, such as an equal sign (=)? Use the *align* environment, with the ampersand (&) as the tab character, and end each line with two backslashes (\\).

$$y = \beta_0 + \beta_1 x_1 \tag{3}$$

$$slope = \frac{y_1 - y_0}{x_1 - x_0} \tag{4}$$

$$predictedvalue = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 \tag{5}$$

How do I center the equations? Use the *gather* environment, with no tab character but ending each line with two backslashes (\\).

$$y = \beta_0 + \beta_1 x_1 \tag{6}$$

$$slope = \frac{y_1 - y_0}{x_1 - x_0} \tag{7}$$

$$predictedvalue = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 \tag{8}$$

What if I have a very long equation that won't fit on one line? Use the *multline* environment, breaking with two backslashes (\\)

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 \quad (9)$$

```
\documentclass{article}
\usepackage{amsmath}
\title{Multiline Equations}
\author{Charles Carter}
\date{\today{}}
\begin{document}
\maketitle{}
This is an example of align.
\begin{align}
y&= \backslash\beta\_0 + \backslash\beta\_1 x\_1\\
\text{slope}&= \backslash\frac{y\_1 - y\_0}{x\_1 - x\_0}\\
\text{predictedvalue}&= \backslash\beta\_0 + \backslash\beta\_1 x\_1 + \backslash\beta\_2 x\_2 + \backslash\beta\_3 x\_3
\end{align}
This is an example of gather.
\begin{gather}
y = \backslash\beta\_0 + \backslash\beta\_1 x\_1\\
\text{slope} = \backslash\frac{y\_1 - y\_0}{x\_1 - x\_0}\\
\text{predictedvalue} = \backslash\beta\_0 + \backslash\beta\_1 x\_1 + \backslash\beta\_2 x\_2 + \backslash\beta\_3 x\_3
\end{gather}
This is an example of multiline.
\begin{multline}
y = \backslash\beta\_0 + \backslash\beta\_1 x\_1 + \backslash\beta\_2 x\_2 + \backslash\beta\_3 x\_3 +\\
\backslash\beta\_4 x\_4 + \backslash\beta\_5 x\_5 + \backslash\beta\_6 x\_6 +\\
\backslash\beta\_7 x\_7 + \backslash\beta\_8 x\_8 + \backslash\beta\_9 x\_9
\end{multline}
\end{document}
```

3.5 Higher math

- sums
- products
- limits
- derivatives
- integrals

Equation 10 states the shorthand for the sum of a series of integers 1 through n . Equation 11 states the shorthand for the product of a series of integers 1 through

n . Equation 12 demonstrates the notation for limits. Equation 13 demonstrates the notation for derivatives. Equation 14 demonstrates the notation for integrals.

$$\sum_{i=1}^{i=n} i = 1 + 2 + 3 + \cdots + n \quad (10)$$

$$\prod_{i=1}^{i=n} i = 1 \times 2 \times 3 \times \cdots \times n \quad (11)$$

$$\lim_{x \rightarrow \infty} f(x) \quad (12)$$

$$\frac{d}{dx} [e^{\frac{x}{2}} \sin(ax)] \quad (13)$$

$$\int_a^b x^2 dx \quad (14)$$

```
\documentclass{article}
  \title{Higher Math}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
\begin{gather}
\sum_{i=1}^{i=n} i = 1 + 2 + 3 + \dots{} + n \\
\prod_{i=1}^{i=n} i = 1 \times 2 \times 3 \times \dots{} \times n \\
\lim_{x \to \infty} f(x) \label{higher:lim} \\
\frac{d}{dx} \left[ e^{\frac{x}{2}} \sin(ax) \right] \\
\int_a^b x^2 dx
\end{gather}
\end{document}
```

Exercise: Continue reading through the *User's Guide for the amsmath Package*.

3.6 Matrices

- `vmatrix`
- `pmatrix`
- `bmatrix`
- `Bmatrix`
- `Vmatrix`

Matrices are contained within a math environment, either an equation block or inline math pairs (\dots). They are entered by row. Each row ends with two backslash symbols ($\backslash\backslash$). Each element on a row is separated by an ampersand ($\&$).

The different variations create different surrounding brackets. `\vmatrix` uses vertical bars ($|\dots|$). `\pmatrix` uses parentheses ((\dots)). `\bmatrix` uses square brackets ($[\dots]$). `\Bmatrix` uses curly braces ($\{\dots\}$). `\Vmatrix` uses double vertical bars ($||\dots||$).

$$\begin{vmatrix} 1 & 3 & 3 \\ 1 & 4 & 3 \\ 1 & 3 & 4 \end{vmatrix} \times \begin{vmatrix} 7 & -3 & -3 \\ -1 & 1 & 0 \\ -1 & 0 & 1 \end{vmatrix} = \begin{vmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{vmatrix}$$

```
\documentclass{article}
\title{Matrices}
\author{Charles Carter}
\date{\today{}}
\begin{document}
\maketitle{}
$ \begin{vmatrix}
1 & 3 & 3 \\
1 & 4 & 3 \\
1 & 3 & 4
\end{vmatrix}
\times
\begin{vmatrix}
7 & -3 & -3 \\
-1 & 1 & 0 \\
-1 & 0 & 1
\end{vmatrix}
=
\begin{vmatrix}
1 & 0 & 0 \\
0 & 1 & 0 \\
0 & 0 & 1
\end{vmatrix} $
\end{document}
```

Exercise: Continue reading through the *User's Guide for the amsmath Package*.

3.7 Greek letters

Here are the Greek letters commonly used in mathematical and scientific applications. The $\text{\LaTeX} 2_{\epsilon}$ commands for the Greek letters are in inline math mode, so you *must* surround the command by a pair of dollar signs (\dots). You must also use the `amsmath` package.

Alpha	Alpha	A	alpha	α
Beta	B	B	beta	β
Gamma	Gamma	Γ	gamma	γ
Delta	Delta	Δ	delta	δ
Epsilon	E	E	epsilon	ϵ
Zeta	Z	Z	zeta	ζ
Eta	H	H	eta	η
Theta	Theta	Θ	theta	θ
Iota	I	I	iota	ι
Kappa	K	K	kappa	κ
Lamba	Lambda	Λ	lambda	λ
Mu	M	M	mu	μ
Nu	N	N	nu	ν
Xi	Xi	Ξ	xi	ξ
Omicron	O	O	o	o
Pi	Pi	Π	pi	π
Rho	R	R	rho	ρ
Sigma	S	S	sigma	σ
Tau	T	T	tau	τ
Upsilon	Y	Y	upsilon	υ
Phi	Phi	Φ	phi	ϕ
Chi	X	X	chi	χ
Psi	Psi	Ψ	psi	ψ
Omega	Omega	Ω	omega	ω

```

\documentclass{article}
\usepackage{amsmath}
\title{Greek Letters}
\author{Charles Carter}
\date{\today{}}
\begin{document}
\maketitle
\begin{tabular}{|| 1 || 1 | 1 || 1 | 1 ||}
\hline
Alpha & Alpha &  $A$  & & alpha &  $\alpha$  \\
\hline
Beta & B &  $B$  & & beta &  $\beta$  \\
\hline
Gamma & Gamma &  $\Gamma$  & & gamma &  $\gamma$  \\
\hline
Delta & Delta &  $\Delta$  & & delta &  $\delta$  \\
\hline
Epsilon & E &  $E$  & & epsilon &  $\epsilon$  \\
\hline
Zeta & Z &  $Z$  & & zeta &  $\zeta$  \\
\hline
Eta & H &  $H$  & & eta &  $\eta$  \\
\hline
Theta & Theta &  $\Theta$  & & theta &  $\theta$  \\
\hline
Iota & I &  $I$  & & iota &  $\iota$ 

```

```

\hline
Kappa & K & $K$      & kappa & $\kappa$ \\
\hline
Lamba & Lambda & $\Lambda$      & lambda & $\lambda$ \\
\hline
Mu & M & $M$      & mu & $\mu$ \\
\hline
Nu & N & $N$      & nu & $\nu$ \\
\hline
Xi & Xi & $\Xi$      & xi & $\xi$ \\
\hline
Omicron & O & $O$      & o & $o$ \\
\hline
Pi & Pi & $\Pi$      & pi & $\pi$ \\
\hline
Rho & R & $R$      & rho & $\rho$ \\
\hline
Sigma & S & $S$      & sigma & $\sigma$ \\
\hline
Tau & T & $T$      & tau & $\tau$ \\
\hline
Upsilon & Y & $Y$      & upsilon & $\upsilon$ \\
\hline
Phi & Phi & $\Phi$      & phi & $\phi$ \\
\hline
Chi & X & $X$      & chi & $\chi$ \\
\hline
Psi & Psi & $\Psi$      & psi & $\psi$ \\
\hline
Omega & Omega & $\Omega$      & omega & $\omega$ \\
\hline
\end{tabular}
\end{document}

```

Exercise: Mathematics uses a large number of non-Latin characters. For example, search for the Hebrew character Aleph (\aleph) and the symbol for infinity (∞).

\LaTeX 2 $_{\epsilon}$ is *Well Documented*

4 References

In scientific and research writing, one of the most critical aspects is references. Think about it: can you imagine a research paper without a single reference? These include footnotes, endnotes, marginal notes, and especially citations to sources. References have two components, a target and a source, or a label and a reference to that label. We have used labels before, but now we will explicitly consider them.

4.1 Footnotes

- footnote
- label
- ref
- pageref

To insert a footnote, just use the command `footnote`.⁵ If you label the footnote, you can refer to the footnote by number and page in the text of the document. Please be sure to read footnote 5 on page 23.

```
\documentclass{article}
  \title{Footnotes and References}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  To insert a footnote, just use the command \text{footnote}.\footnote{\label{references:fn}
  Don't forget to put the \textbackslash{} before the \texttt{footnote} command.} If you
  label the footnote, you can refer to the footnote by number and page in the text of the
  document. Please be sure to read footnote \ref{references:fn} on page
  \pageref{references:fn}.
\end{document}
```

Exercise: Read the L^AT_EX 2_ε documentation on footnotes.

4.2 Endnotes

- package endnotes
- endnote
- theendnotes
- addcontentsline

⁵Don't forget to put the `\` before the `footnote` command.

Endnotes are a little more complicated than footnotes, but not much.¹ Here is an endnote.² In order to actually print the endnotes, use the `\theendnotes` command. In order to create an entry for the endnotes in the table of contents, you must use the `\addcontentsline`.³ Please see endnote 3 on page 43 for the details.

```
\documentclass{article}
  \usepackage{endnotes}
  \title{Endnotes}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \tableofcontents{}
  \section{Text}
  Endnotes are a little more complicated than footnotes, but not much.\endnote{The
  difference between footnotes and endnotes is that footnotes go at the foot of
  the page where they appear, while endnotes appear at the end of the document.}
  Here is an endnote.\endnote{This is an endnote.} In order to actually print
  the endnotes, use the \texttt{\theendnotes} command. In order to create an
  entry for the endnotes in the table of contents, you must use the \texttt{\addcontentsline}
  \endnote{\label{references:en}The addcontentsline takes three parameters,
  where the line should be written, usually \textit{toc}, the formatting to be
  used, usually \textit{section}, and the name to be given to the entry, perhaps
  \textit{Endnotes}.} Please see endnote \ref{references:en} on page
  \pageref{references:en} for the details.
  \theendnotes{}
  \addcontentsline{toc}{section}{Endnotes}
\end{document}
```

Exercise: Find and read through the documentation of the Endnotes package.

4.3 Margin notes

- `\marginpar`
- `\reversemarginpar`
- `\normalmarginpar`
- `\raggedright`

Marginal notes are really useful to call attention to very important points. They can also be useful in drafting documents to note future edits, insertions, or deletions. Use `\marginpar` to create a marginal note. To delete marginal notes during the drafting process, just comment them out. The text remains as a reminder of the modifications in the document.

Important
point!

This is re-
versed text

To permanently reverse the page sides, use `reversemarginpar`. To reverse the reverse page margins, use `normalmarginpar`. To change the paragraph alignment from the default justified text, use the command `raggedright` in a block.

This is in
the correct
margin

```
\documentclass{article}
  \title{Margin Notes}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \marginpar{Important point!}
  Marginal notes are really useful to call attention to very important
  points. They can also be useful in drafting documents to note
  future edits, insertions, or deletions. Use \texttt{marginpar}
  to create a marginal note. To delete marginal notes during the
  drafting process, just comment them out. The text remains as a
  reminder of the modifications in the document.
  {\raggedright\reversemarginpar{\marginpar{This is reversed text}}}
  To permanently reverse the page sides, use \texttt{reversemarginpar}.
  To reverse the reverse page margins, use \texttt{normalmarginpar}.
  {\raggedright\normalmarginpar\marginpar{This is in the correct margin}}
\end{document}
```

Exercise: If you really need to create sophisticated marginal notes, you will need both the `geometry` and `marginnote` packages. The former is very useful, and you may need to use it in every paper. The latter is useful for marginal notes when you need something more than the default $\text{\LaTeX 2}_{\epsilon}$ commands.

4.4 Bibliography

- creating an external Bib \TeX database

Needless to say, every research paper requires a bibliography. $\text{\LaTeX 2}_{\epsilon}$ has multiple ways to include bibliographies. I have chosen to use a method called Bib \TeX . There are three reasons for this choice. First, it's simple enough to include in a simple tutorial. Second, it gives good results using its default settings. Third, it's complex enough to be configured for almost any application (given an author's time and patience).

Bib \TeX uses an external file as a bibliographical database. This means that management of the sources is separate from writing and editing the original document. The data from the external database is merged into the original document with a series of commands. We will cover the basics of the external database in this lesson. In the following lesson, we will see how to merge the two files.

The external Bib \TeX database is merely a plain text file with entries in a prescribed format. It *must* have the `.bib` extension for the filename. The following file includes four books and three online sources. The Bib \TeX format file contains

specifications for a large number of types of sources, and you should become familiar with the various types of documents and the format for each.

Create a document with the following content. Name it `tut.bib` and place it in the same directory with your original source document, where you compile your PDF output. Each entry has a type identifier preceded by the at symbol (`@`) and followed by a curly brace pair (`{...}`), within which are contained various fields separated by commas. The first field is the identifier you will use to access the entry. The subsequent fields are “key”=“value” pairs, giving the title, author, date etc.

```

\\tut.bib
@book{
  goossens04,
  author   = "Frank Mittelbach and Michel Goossens and Johannes Braams and David Carlisle",
  title    = "The \LaTeX{} Companion (Tools and Techniques for Computer Typesetting)",
  year     = "2004",
  edition  = "2nd",
  publisher = "Addison-Wesley",
  address  = "Reading, MA",
  ISBN     = "978-0201362992"
}
@book{
  kottwitz11,
  author   = "Stefan Kottwitz ",
  title    = "\LaTeX{} Beginner's Guide",
  year     = "2011",
  publisher = "Packt Publishing",
  address  = "Birmingham, UK",
  ISBN     = "978-1847199867"
}
@book{
  kottwitz15,
  author   = "Stefan Kottwitz ",
  title    = "\LaTeX{} Cookbook",
  year     = "2015",
  publisher = "Packt Publishing",
  address  = "Birmingham, UK",
  ISBN     = " 978-1784395148"
}
@book{
  gratzer14,
  author   = "George Gratzer",
  title    = "Practical \LaTeX{}",
  year     = "2014",
  publisher = "Springer",
  address  = "New York, NY",
  ISBN     = "978-1847199867"
}
@electronic{
  oetiker15,
  author   = "Tobias Oetiker and Hubert Partl and Irene Hyna and Elisabeth Schlegl",

```

```

    title = "The Not So Short Introduction to {LaTeX2e}",
    url    = "http://tug.ctan.org/info/lshort/english/lshort.pdf",
    year = "2015",
    note = "accessed August 2, 2016"
}
@electronic{
    pakin15,
    author = "Scott Pakin",
    title = "The Comprehensive {LATEX} Symbol List",
    url = "http://tug.ctan.org/info/symbols/comprehensive/symbols-letter.pdf",
    year = "2015",
    note = "accessed August 2, 2016"
}
@electronic{
    carter16,
    author = "Charles Carter",
    title = "Another Short Tutorial to {LaTeX2e}",
    url = "https://github.com/ccc31807/latex-short-intro",
    year = "2016",
    note = "accessed August 2, 2016"
}

```

Exercise: Search for the Bib_T_EX format specification. Name four different kinds of source documents and identifies the required elements for each.

4.5 Citations

- cite
- nocite
- bibliographystyle
- bibliography
- addcontentsline

Preparing the bibliographic database is fairly straightforward and easy. Unfortunately, the details of including the citations in your document is not as straightforward.⁶ To cite to a reference, use the `cite` command, passing the citation reference as an argument. By default, the printed bibliography includes only cited references — to include a particular uncited reference, use the `mnocite` command, passing the citation reference as an argument. To include all uncited references, use the command `nocite{*}`. (The asterisk is a typeglob that means “everything”).

To specify a citation style, use the command `bibliographystyle`. As you will see when you study the different styles, there are many of them. Adding to the

⁶Again, you must pay attention to the reference types and required fields. This is probably the most onerous part of including a bibliography.

amount of effort of work potentially involved, you can write your own style specification if you don't want to use any that are available. In the example below, I have used the *IEEEtranS* style. This will probably not meet your needs. You will have to find an appropriate style for your requirements.

To include the bibliography itself, use the command `bibliography`. To add your references to the table of contents, use the command `addcontentsline`. To compile your bibliography using the command line interface, see appendix C on page 42.

```
\documentclass{article}
  \title{Bibliography}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \tableofcontents{}
  \section{Introduction}
  \label{inTroduction}
  This section cites \cite{goossens04} and \cite{oetiker15}.
  \section{Body}
  \label{Body}
  This section cites \cite{kottwitz15} and \cite{pakin15}.
  \section{Conclusion}
  This section contains no citations.
  \label{Conclusion}
  \bibliographystyle{IEEEtranS}
  \bibliography{tut}
  \addcontentsline{toc}{section}{References}
  \nocite{*}
\end{document}\le
```

Exercise: BibTeX provides many different kinds of styles. Research three of them.

Exercise: Every style has required fields and optional fields. For the three styles you researched, list the required fields and the optional fields.

4.6 Indices

$\text{\LaTeX } 2_{\varepsilon}$ is *Stable*

5 Lists

5.1 Verbatim

- verbatim environment

Perhaps the simplest and easiest way to make a list is by using the `verbatim` environment. Everything in the environment is printed as is, that is, $\text{\LaTeX 2}\epsilon$ commands are not evaluated.

```
\documentclass{article}
  \title{Verbtim Environment}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \section{Verbatim Environment}
  \begin{verbatim}
    \texttt{one}
    \textit{two}
    \textsf{three}
    \huge{aye}
    \tiny{bee}
    \section{see}
  \end{verbatim}
\end{document}
```

Exercise: The only command not permitted in the `verbatim` environment is the `\end{verbatim}` command. The reason is that this command ends the verbatim environment. If you examine the source of this tutorial, you will see that I resorted to a trick to include this command. As an exercise, can you figure out the trick?

5.2 Unordered Lists

5.3 Ordered Lists

5.4 Dictionary Lists

5.5 Listings Package

5.6 Listings Version 1

5.7 Listings Version 2

\LaTeX 2 $_{\epsilon}$ is *Easy*

6 Tables

6.1 Simple table

•

```
\documentclass{article}
  \title{This is My Title}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \section{Introduction}
  \label{Introduction}
  \section{Body}
  \label{Body}
  \section{Conclusion}
  \label{Conclusion}
\end{document}
```

Exercise:

Exercise:

6.2 Row and column lines

•

```
\documentclass{article}
  \title{This is My Title}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \section{Introduction}
  \label{Introduction}
  \section{Body}
  \label{Body}
  \section{Conclusion}
  \label{Conclusion}
\end{document}
```

Exercise:

Exercise:

6.3 Column spacing

•

```
\documentclass{article}
  \title{This is My Title}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \section{Introduction}
  \label{Introduction}
  \section{Body}
  \label{Body}
  \section{Conclusion}
  \label{Conclusion}
\end{document}
```

Exercise:

Exercise:

6.4 Table placement

•

```
\documentclass{article}
  \title{This is My Title}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \section{Introduction}
  \label{Introduction}
  \section{Body}
  \label{Body}
  \section{Conclusion}
  \label{Conclusion}
\end{document}
```

Exercise:

Exercise:

6.5 Long tables

•

```
\documentclass{article}
  \title{This is My Title}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \section{Introduction}
  \label{Introduction}
  \section{Body}
  \label{Body}
  \section{Conclusion}
  \label{Conclusion}
\end{document}
```

Exercise:

Exercise:

6.6 Nested tables

•

```
\documentclass{article}
  \title{This is My Title}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \section{Introduction}
  \label{Introduction}
  \section{Body}
  \label{Body}
  \section{Conclusion}
  \label{Conclusion}
\end{document}
```

Exercise:

Exercise:

$\text{\LaTeX 2}_{\epsilon}$ is *Free*

7 Images

7.1

•

```
\documentclass{article}
  \title{This is My Title}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \section{Introduction}
  \label{Introduction}
  \section{Body}
  \label{Body}
  \section{Conclusion}
  \label{Conclusion}
\end{document}
```

Exercise:

Exercise:

7.2

•

```
\documentclass{article}
  \title{This is My Title}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \section{Introduction}
  \label{Introduction}
  \section{Body}
  \label{Body}
  \section{Conclusion}
  \label{Conclusion}
\end{document}
```

Exercise:

Exercise:

7.3

-

```
\documentclass{article}
  \title{This is My Title}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \section{Introduction}
  \label{Introduction}
  \section{Body}
  \label{Body}
  \section{Conclusion}
  \label{Conclusion}
\end{document}
```

Exercise:

Exercise:

7.4

-

```
\documentclass{article}
  \title{This is My Title}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \section{Introduction}
  \label{Introduction}
  \section{Body}
  \label{Body}
  \section{Conclusion}
  \label{Conclusion}
\end{document}
```

Exercise:

Exercise:

7.5

-

```
\documentclass{article}
  \title{This is My Title}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \section{Introduction}
  \label{Introduction}
  \section{Body}
  \label{Body}
  \section{Conclusion}
  \label{Conclusion}
\end{document}
```

Exercise:

Exercise:

7.6

-

```
\documentclass{article}
  \title{This is My Title}
  \author{Charles Carter}
  \date{\today{}}
\begin{document}
  \maketitle{}
  \section{Introduction}
  \label{Introduction}
  \section{Body}
  \label{Body}
  \section{Conclusion}
  \label{Conclusion}
\end{document}
```

Exercise:

Exercise:

8 Conclusion

- A Installing \LaTeX 2 ϵ
- B Development Environments
- C Command Line Execution

Notes

¹The difference between footnotes and endnotes is that footnotes go at the foot of the page where they appear, while endnotes appear at the end of the document.

²This is an endnote.

³The `addcontentsline` takes three parameters, where the line should be written, usually *toc*, the formatting to be used, usually *section*, and the name to be given to the entry, perhaps *Endnotes*.

References

- [1] C. Carter. (2016) Another short tutorial to LaTeX2e. Accessed August 2, 2016. [Online]. Available: <https://github.com/cc31807/latex-short-intro>
- [2] G. Gratzner, *Practical L^AT_EX*. New York, NY: Springer, 2014.
- [3] S. Kottwitz, *L^AT_EX Beginner's Guide*. Birmingham, UK: Packt Publishing, 2011.
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- [5] F. Mittelbach, M. Goossens, J. Braams, D. Carlisle, and C. Rowley, *The L^AT_EX Companion (Tools and Techniques for Computer Typesetting)*, 2nd ed. Reading, MA: Addison-Wesley, 2004.
- [6] T. Oetiker, H. Partl, I. Hyna, and E. Schlegl. (2015) The not so short introduction to LaTeX2e. Accessed August 2, 2016. [Online]. Available: <http://tug.ctan.org/info/lshort/english/lshort.pdf>
- [7] S. Pakin. (2015) The comprehensive L^AT_EX symbol list. Accessed August 2, 2016. [Online]. Available: <http://tug.ctan.org/info/symbols/comprehensive/symbols-letter.pdf>