Introduction to LaTeX

Liza Weisbrod
weisbel@auburn.edu

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Introduction to LaTeX

Class materials are at: https://libguides.auburn.edu/LaTeX/classmaterials

- Slides
- Practice examples handout
- LaTeX code for the examples worked in class. This document can be uploaded to Overleaf

Welcome to Introduction to LaTeX

Today we're going to talk about getting started with LaTeX. We'll set up a document and discuss the basics of LaTeX. You can't learn LaTeX in an hour, but after this class you should have the foundations of using LaTeX.

Have any of you used LaTeX before? For those of you who are not familiar with it, let's start by looking at a document produced in LaTeX.

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Asymptotic behavior of Iwasawa and Cholesky iterations

Randall R. Holmes, Huajun Huang, Tin-Yau Tam *

Department of Mathematics and Statistics, Auburn University, AL 36849-5310, USA

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ABSTRACT

We extend, in the context of a connected real semisimple Lie group, some results on the QR iteration and the Cholesky iteration of a nonsingular matrix. A group theoretic understanding of the abstract mechanisms of the iterations is obtained.

1. Introduction

The QR iteration [2,3,10,16] provides one of the most efficient methods for computing the eigenvalues of a nonsingular matrix $X \in \mathrm{GL}_n(\mathbb{C})$ with distinct eigenvalue moduli [13, p. 173–180]. The QR iteration of X is the sequence $\{X_i\}_{i\in\mathbb{N}}$ defined as follows:

$$X_1 := X,$$
$$X_i := R_{i-1}Q_{i-1}, \quad i = 2, 3, \ldots$$

where $X_i = Q_iR_i$ denotes the QR decomposition of the matrix X_i. Since $X_i = Q_{i-1}^{-1}X_{i-1}Q_{i-1}$, the eigenvalues of each X_i are identical with those of X. It is known [6, Theorems 2.1, 5.1], [16] that if the eigenvalue moduli of X are distinct, then the sequence obtained by taking the lower triangular parts of the matrices X_i ($i \in \mathbb{N}$) converges to a diagonal matrix with diagonal entries the eigenvalues of X.

* Corresponding author.
E-mail addresses: holmerr@auburn.edu (R.R. Holmes), huanghu@auburn.edu (H. Huang), tamtiny@auburn.edu (T.-Y. Tam).

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[First page of math paper]

This is a math paper written in LaTeX with several equations on the first page. Notice the beautiful mathematical formatting, which is one of the strong points of LaTeX.

Have any of you used Word to write equations before? If you have, you know why LaTeX exists. The spacing, the formatting, even making symbols outside of the basic numbers and letters are all difficult in Word. But with LaTeX, although it takes a bit more set up, writing equations like this is very straightforward.

[Introduction slide]

[What is LaTeX? slide]

Introduction

LaTeX *(LAY-tekh or LAH-tekh)*

- Developed in the 1980s by Leslie Lamport
- Originally used for mathematics, but now used in a wide variety of disciplines
- Operates with TeX, a typesetting program, created by Donald Knuth, an American computer scientist and mathematician

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LaTeX

- LaTeX is a document preparation system, not a word processing program
  - Users input content and LaTeX handles the formatting
  - Similar to CSS, formatting is handled by commands at the beginning of a document
- It's easy to change the style of your document with one line:
  - Article
  - Letter
  - CV
  - Poster
  - Slide presentation
  - Thesis

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Objectives

- LaTeX document structure and basics
  - How to set up a LaTeX document
  - How commands work
- Basic text commands
- Math mode
- How to go further with LaTeX

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[Objectives slide]

We will be talking about the basics of LaTeX.

After this class, you will have a document you can take with you and strategies for learning more about LaTeX.

We will be using the **Practice Examples** handout for the class.

LaTeX Editor

Overleaf

`https://www.overleaf.com`

- Cloud-based
- Free

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[LaTeX editor slide]

To use LaTeX, you'll need an editor or integrated development environment (IDE). There are many different editors; some free, some you pay for. Some academic departments may have a site license for a particular editor.

Today, we're going to use Overleaf, a cloud-based editor. It also has features you can pay for, but for our purposes, the free version will suffice. Once you set up the account, you can go back to review the document you've created and use Overleaf to create other LaTeX documents.

To set up an account on Overleaf, go to overleaf.com and register with one of the methods provided. Overleaf will send you an email to confirm your account.

Once you register:

Click on New Project
Choose Blank Project
Give it a name

As you can see, Overleaf has provided the beginnings of a new document.

On the left side is what is called the file tree. Go ahead and close it as we will not need to do anything with it today.

The beginning of a LaTeX document is now on the left side and on the right is how your document will look when the LaTeX code is compiled.

Preamble

Preamble

- The section at the beginning of the document
- Sets the formatting and records information about the document
  - Author, Date, Title
  - Type of document
  - Fonts, colors, themes
  - Packages

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[Preamble slide]

PREAMBLE [From this point on, everything will be done in Overleaf]

Everything before \begin{document} is called the **preamble.**

Let's look more closely at the preamble.

The preamble sets up the formatting and records information about the document, such as author, title, and date.

You can also see some basic commands. Commands tell the compiler to do something.

LaTeX commands are in green. They always begin with a backslash and are often followed by an argument or parameter in brackets.

Try changing the author, the title, or the date. Using \today in the brackets after \date will make today's date appear.

To get your changes to show up, you'll need to click the green **Recompile** button.

The **preamble** is also where you add packages.

Packages:

- Extend LaTeX by adding new functions to LaTeX
- Add features such as support for pictures, links, and bibliographies
- Must be included in the preamble

Let’s add \usepackage{amsmath} to the preamble, which will add some math features to our document.

Preamble

Try changing the name of the document class:

`article`	For articles in scientific journals, presentations, short reports, program documentation, invitations, ...
`IEEEtran`	For articles with the IEEE Transactions format.
`proc`	A class for proceedings based on the article class.
`report`	For longer reports containing several chapters, small books, thesis, ...
`book`	For real books.
`slides`	For slides. The class uses big sans serif letters.
`letter`	For writing letters.
`beamer`	For writing presentations.

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DOCUMENT CLASS

You can change the format of your document quite easily. The first line of contains the \documentclass command which sets the basic formatting of the document. In this document, the \documentclass is ‘article’.

[Document class slide]

There are hundreds of document class types. Many journals which accept LaTeX files have created one specifically to take care of any formatting quirks they may require. Here are a few examples of document classes.

Try changing the document class argument to **slides** and recompile. Do the same with **IEEEtran**. Note the change in font and document formatting. Change the argument back to **article** before proceeding.

CONTENT

Everything between \begin{document} and \end{document} is content. This is where your document text will be typed.

Try typing a line of text after \section{Introduction}

Hello world!

LaTeX allows users to ‘comment out’ lines by using a % at the beginning of the line. The % tells the compiler to ignore the sign and everything after it till the end of the line.

This is a great feature, as it allows users to write notes to themselves, debug documents, and change text easily (but not permanently).

TEXT COMMANDS

The first section of the handout demonstrates text commands.

1. Commands and how they act on bracketed material.
2. New paragraph and indents.

First, change the \section{Introduction} to \section{Text Commands}. We will be adding section and subsection headings to each different topic to organize our document.

Let’s use the practice examples and try out some commands.

Type the first example of LaTeX code. Recompile.

On the next line, try one of the practice examples. Recompile.

Note that a new paragraph is not created. To create a new paragraph, a blank line must be inserted.

Insert a blank line between the two sentences. Recompile.

Note that the first line is not indented, but the second line is indented. This is the \documentclass{article} formatting at work.

LaTeX is highly configurable, so to remove the indent, insert the following command in the preamble:

\parindent=0pt

MATH MODE

1. Math formatting
2. Spacing
3. $$

Although LaTeX has many different applications, usually it's used to write some sort of mathematics. Typesetting math well is a strength of LaTeX. It italicizes the equations, uses clear and readable characters, and adjusts spacing appropriately for math.

LaTeX needs to know when text is mathematical, so you will need to go to Math mode. Math mode tells the compiler to change the way it is typesetting. It is indicated with a back slash, followed by an open parenthesis \(. This tells the compiler to begin typesetting letters using italics, which is standard practice for typesetting math, and to start using appropriate spacing for mathematics.

Math mode closes by typing the close parenthesis command, that is, a backslash followed by):

\(a+b=c\)

You will sometimes see dollar signs instead of parentheses and backslashes:

$a + b =c$

Note that spacing in LaTeX code has no effect on the output. For example,

\(a + b = c\)
results in the same output as
\(a + b=c\)

SUBSCRIPTS and SUPERSCRIPTS

1. Use brackets { } for more than one element
2. Combine superscripts and subscripts when needed

Type the LaTeX code in this section.
Type the first practice example (combining superscripts and subscripts): \(a_n^2\)

Type the second practice example, being sure to put the superscript in brackets: \(a^{x+y}\)

ROOTS

1. Optional arguments [ ]

Type the LaTeX code in the example. Note that a cube root requires the '3' in square brackets: [3]

FRACTIONS

1. Fractions always have two inputs
2. \dfrac
3. \usepackage{amsmath}

Fractions always require two inputs—numerator and denominator.

The 'frac' command results in a small display. To increase the size the characters, use the 'dfrac' command. The 'dfrac' command is available through the 'amsmath' package we added in the preamble.

DISPLAY MODE

1. Centers and adds space above and below the expression.
2. Puts expression on new line.

To set off a mathematical expression use **display mode**.

Instead of parentheses, use square brackets [ ] or two dollar signs ($$):

\[x + y =z\] or $$x + y =z$$

Alignment

Unaligned equations

$$2x - 5y = 8$$

$$9y = 3a + c^2$$

Using the *align* environment

$$\begin{aligned} 2x - 5y &= 8 \\ 9y &= 3a + c^2 \end{aligned}$$

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[Align environment slide]

ALIGN ENVIRONMENT

1. Environments
2. \\
3. No math mode commands
4. Need amsmath package for the ‘align’ environment

Environments format a block of text. They are bracketed with a ‘begin’ and ‘end’ command.

The **align** environment allows users to align mathematical expressions at a particular point. Math mode is built into this environment, so the backslash/parenthesis combination is not needed.

To break the lines, a double backslash is needed.

The ‘align’ environment and commands are available with the ‘amsmath’ package.

ADVANCED PRACTICE EXAMPLES

These are examples built on the constructions learned during the class. See the source code for solutions.

PRACTICE AND HELP

See the LibGuide (https://libguides.auburn.edu/LaTeX/Guides) for tutorials, learning resources, and more.

Tutorials & Help

For more practice and help:

`https://libguides.auburn.edu/LaTeX/Guides`.

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