

# Making publication quality documents

## LaTeX

# LaTeX

- Traditional word processors like Word and google docs aren't enough to do everything you need to make a paper for an academic journal
  - Writing equations, references, programmatic sizing of figures, etc.
- LaTeX
  - A “programming language” for making documents

# Why use LaTeX?

- It's FREE
- It's (arguably) the best way to typeset equations
- It's journal-quality
  - You submit LaTeX files directly to journals
  - Journals have their own LaTeX templates! (eg. AASTeX for AJ/ApJ, more on this next class)
- Outputs directly to PDF
- Define your own formatting rules and implement everywhere at once

# Using LaTeX

- You can download a LaTeX distribution and an editor onto your computer
  - If this interests you, check out [MiKTeX](#)
- Or, you can just use [Overleaf](#)!

# Overleaf

- Online LaTeX editor and compiler - similar to Google Drive/Docs
- Many astronomers use it
- ~~Allows you to collaborate on a document with multiple authors/editors~~

Overleaf recently got rid of some free stuff like this :(

- You can add one collaborator, and I think view others to view as read-only
- Everything is saved to the cloud, so you can access it anywhere

# Getting started with Overleaf

- Go to Overleaf
  - <https://www.overleaf.com/>
- Make an account and sign in
- Select New Project → Blank Project
  - Name it whatever you want
  - Delete all of the text in the left-hand window — we're starting from scratch!

Menu

Upgrade

AstroComm - LaTeX I

Review

Share

Submit

History

Layout

Chat

main.tex

Source

Rich Text

Ω

1

Editor

Recompile

PDF

File outline

We can't find any sections or subsections in this file.  
[Find out more about the file outline](#)

# Starting a document

```
\documentclass{article}
```

```
\begin{document}
```

```
[YOUR TEXT HERE]
```

```
\end{document}
```

- Other document classes exist (report, book, etc.) but **article** is most common\*
- All content goes between `\begin{document}` and `\end{document}`
  - **Preamble** goes before `\begin`
  - ***No text allowed*** after `\end`

\* If you're not using AASTeX




# Starting a document

```
\documentclass{article}
```

```
\begin{document}
```

```
[YOUR TEXT HERE]
```

```
\end{document}
```

Click  to update the PDF preview on the right!

# Exercise

- Add in the basics for a Latex document
- Add in some text
- Compile!

# The Preamble

Everything before `\begin{document}`

- Import Packages: `\usepackage{packagename}`
  - Lets you use fancy LaTeX add-on packages that do things that base LaTeX can't
- Title your document: `\title{My Document Name}`
  - Combine with `\author{My Name}`, `\date{\today}`
  - Initiate with `\maketitle` (this comes after `\begin{document}`)
- Define custom commands (we'll come back to this later)

# Common Packages

- `graphicx` – required to insert figures
- `geometry` – controls margin sizes (`\usepackage[margin=1in]{geometry}`)
- `natbib` – used for in-text citations
- `xcolor` – helps with changing text color
- `amsmath`, `amssymb`, `amsfonts` – useful equation stuff
- `hyperref` – add hyperlinks
- `enumerate` – make bulleted and numbered lists

# Document content

General command format:

```
\somecommand[optionalthing]{argument1}{argument2}
```

- Whitespace
  - LaTeX ignores most whitespace
  - An empty line starts a new paragraph
- % Comments start with “%”
- Text formatting:
  - Bold: `\textbf{Bold}`
  - Italics: `\textit{Italics}`
  - Underlined: `\underline{Underlined}`

# Sections all the way down

- LaTeX makes it easy to divide your document into sections
- Automatic indexing and numbering
- Section - `\section{}`
  - Subsection - `\subsection{}`
    - Subsubsection - `\subsubsection{}`
      - Paragraph - `paragraph{}`
- Add an asterisk (`\section*{}`) to add an unnumbered section

# Exercise

- Make a document!
- Include the required
  - `\documentclass{article}`
  - `\begin{document}`
    - ....
  - `\end{document}`
- Add in commands to make 2 sections each with its own subsection

Menu

Upgrade

AstroComm - LaTeX I

Review

Share

Submit

History

Layout

Chat

main.tex

Source

Rich Text

Ω

```
1 \documentclass{article}
2
3 \begin{document}
4
5 \section{First Section}
6
7 \subsection{A Subsection}
8
9 \subsection{Another Subsection}
10
11 \section*{Unnumbered Section}
12
13 \section{Third Section}
14
15 \end{document}
16
```

Recompile

→

←

→

←

File outline

First Section

- A Subsection
- Another Subsection

Unnumbered Section

Third Section

1 First Section

1.1 A Subsection

1.2 Another Subsection

Unnumbered Section

2 Third Section

Sections are filled in automatically in the outline as they are created

16



# Equations in LaTeX

- Math modes
  - Inline math mode:  $x+y$
  - Display math mode: 
$$x+y$$
  - equation environment (display numbered equation)

```
\begin{equation}
```

```
x+y
```

```
\end{equation}
```

# Equations in LaTeX - Important commands

**Exponential**

`x{exp}`

**Subscript**

`x{sub}`

**Fraction**

`\frac{numerator}{denominator}`

**Multiplication**

`\times` or `\cdot`

**Square root (or cube root, etc)**

`\sqrt[root]{argument}`

**Sum, product, integral**

`\sum`, `\prod`, `\int_{lowerlim}^{upperlim}`

**Greek letters**

`\alpha`, `\beta`, `\gamma`, etc.

**Greek letters (upper case)**

`\Gamma`, `\Delta`, `\Theta`, etc.

# More math mode commands to know

- Parentheses don't scale to the content in them, i.e.  $\left(\frac{x}{y}\right) \rightarrow$ 
  - Solution 1:  $\left(\frac{x}{y}\right)$
  - **Solution 2:**  $\left(\frac{x}{y}\right)$  with `\usepackage{physics}`
- $\propto$ ,  $\pm$ ,  $\approx$ ,  $\leq$ ,  $\geq$
- $\bar{x}$  for bar over a variable (average),  $\dot{x}$  or  $\dot{\phantom{x}}$  for a dot over a variable (time derivative)
- Use  $\text{text}$  or  $\text{text}$  or  $\text{rm text}$  to add normal text within math mode

# Finding More LaTeX symbols

- Just Google “LaTeX Math Symbols” or “LaTeX [symbol you’re looking for]” to find a ton of resources and cheat sheets!
- DeTeXify: <http://detexify.kirelabs.org/classify.html>
  - Draw a symbol into the box and DeTeXify will tell you the LaTeX command

## Activity: Equation Practice!

1)  $E = mc^2$

2)  $z = \frac{y^{2+x} + 2}{54}$

3)  $z = \int_{-\infty}^{\infty} x^2 - e^x$

# Activity: Equation Practice!

```
11 ▾ \begin{equation}
12     E = mc^2
13 \end{equation}
14
15 ▾ \begin{equation}
16     z = \frac{y^{2+x} + 2}{54}
17 \end{equation}
18
19 ▾ \begin{equation}
20     z = \int_{-\infty}^{\infty} x^2 - e^x dx
21 \end{equation}
22
```

# figure Environment

- `\begin{figure}`, `\end{figure}`
- `\includegraphics[size]{filename}`
  - Requires `\usepackage{graphicx}` in preamble
  - To change size of the image relative to the width of the page use e.g.

`\includegraphics[width = 0.5 \textwidth]{filename}`

```
\begin{figure}
  \centering Centers the table
  \includegraphics{filename.png}
  \caption{Caption} Adds a caption
  \label{fig:my_label}
\end{figure}
```

Tags the figure so it can be referenced in text (more later)

Upload figures to Overleaf file

The screenshot shows the Overleaf web editor interface. At the top, there's a navigation bar with 'Menu', 'Upgrade', and 'AstroComm - LaTeX I'. Below this, a toolbar contains icons for file management, editing, and compilation. An orange arrow points to the 'Upload' icon. On the left, a 'File list' box highlights the file browser, showing 'example.png' and 'main.tex'. The main editor area displays LaTeX source code for a document with sections and subsections. The right sidebar shows the compiled PDF output with a table of contents.

File list

```
1 \documentclass{article}
2
3 \begin{document}
4
5 \section{First section}
6
7 \subsection{A Subsection}
8
9 \subsection{Another Subsection}
10
11 \section*{Unnumbered Section}
12
13 \section{Third Section}
14
15 \end{document}
16
```

1 First section  
1.1 A Subsection  
1.2 Another Subsection  
Unnumbered Section  
2 Third Section





Code Editor

Visual Editor



Normal text

**B** *I*

Recompile



1 / 1



64%

equations.tex

example.png

main.tex

File outline

Section

A Subsection

Another Subsection

An Unnumbered Section

Third Section

```
1 \documentclass{article}
2 \usepackage{graphicx} % Required for inserting images
3 \usepackage[margin = 1in]{geometry}
4 \usepackage{amsmath, amssymb, amsfonts}
5 \usepackage{physics}
6
7 \begin{document}
8
9 \section{Section}
10
11 \begin{figure}
12   \centering
13   \includegraphics[width=0.5\textwidth]{example.png}
14   \caption{A little guy}
15   \label{fig:ex}
16 \end{figure}
17
18 \subsection{A Subsection}
19
20 \subsection{Another Subsection}
21
22 \section*{An Unnumbered Section}
23
24 \section{Third Section}
25
26 \end{document}
27
```

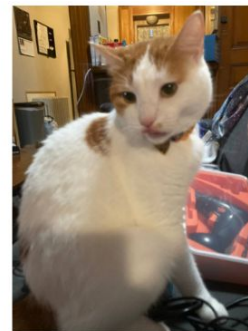


Figure 1: A little guy

## 1 Section

### 1.1 A Subsection

### 1.2 Another Subsection

## An Unnumbered Section

## 2 Third Section

# How do I get figures to go where I want them??

It's hard to fully control where a “float” (like a figure or table) ends up on the page.

```
\begin{figure}[!h]  
  \centering  
  \includegraphics{example.png}  
  \caption{A little guy}  
  \label{fig:ex}  
\end{figure}
```

Tells LaTeX where to put the table

- h = “here”
- t = top
- b = bottom
- p = separate page
- Can be combined in order of priority → [ht]
- Add ! to override what LaTeX thinks is a “good” placement

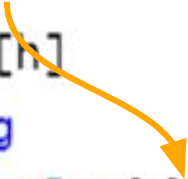
# table Environment

```
\begin{table}[h]
  \centering
  \begin{tabular}{c|c}
    1 & 0 \\
    0 & 1
  \end{tabular}
  \caption{Caption}
  \label{tab:my_label}
\end{table}
```

# tabular Environments

- `\begin{tabular}{table format}`
  - `{table format}` can be made up of any combination of
    - `r`: right-aligned column
    - `l`: left-aligned column
    - `c`: center-aligned column
    - `|`: vertical line between columns
  - To fill in the table, make rows with the following symbols:
    - `&`: column break
    - `\\`: line break
    - `\hline`: horizontal line

One letter = one column




```
\begin{table}[h]
\centering
\begin{tabular}{c|c}
1 & 0 \\
0 & 1
\end{tabular}
\caption{Caption}
\label{tab:my_label}
\end{table}
```

# tabular Environments

- `\begin{tabular}{table format}`
  - `{table format}` can be made up of any combination of
    - `r`: right-aligned column
    - `l`: left-aligned column
    - `c`: center-aligned column
    - `|`: vertical line between columns
  - To fill in the table, make rows with the following symbols:
    - `&`: column break
    - `\\`: line break
    - `\hline`: horizontal line

```
\begin{table}[h]
\centering
\begin{tabular}{l|c r}
one & two & three \\
\hline
1 & 2 & 3 \\
I & II & III
\end{tabular}
\caption{Caption}
\label{tab:my_label}
\end{table}
```



one	two	three
1	2	3
I	II	III

Table 1: Caption

# Writing Latex Tables

- It can be cumbersome to manually enter large data tables
- Astropy is able to write tables in LaTeX format

```
data = Table()
```

```
data['x'] = [1, 2, 3]
```

```
data['y'] = [4, 5, 6]
```

```
data.write('data.tex', format='latex') # writes it to a file named data.tex
```

# Labelling and referencing

- `\label{labelname}` can be used to label...
  - Sections
  - Tables
  - Figures
  - Equations

- Once a label exists, you can use `\ref{labelname}` to refer to it:

As we show in Figure `\ref{fig:labelname}`... ---> As we show in Figure 2...

- Figures, Tables, Sections, and Equations are all automatically numbered in order and `\ref{labelname}` will be replaced in text with a number

# Making lists with itemize and enumerate

- Use **itemize** for **bulleted lists** and **enumerate** for **numbered lists**

```
\begin{itemize}  
  \item Item one  
  \item Item two  
  \item Item three  
\end{itemize}
```



- Item one
- Item two
- Item three

```
\begin{enumerate}  
  \item Item one  
  \item Item two  
  \item Item three  
\end{enumerate}
```



1. Item one
2. Item two
3. Item three



# Escape Characters

# \$ % ^ & \_ { } ~ \

- Escape characters have a specific purpose so you can't use them in your text normally
  - LaTeX will break and yell at you
- In general, if you want to use have these characters in the text just put a backslash in front of them:

70\% --> 70%, Jack \& Jill --> Jack & Jill

# Defining your own commands

```
\newcommand{\name}[number_of_parameters]{definition_of_command}
```

- Use to save yourself time by creating shortcuts for things you use a lot
- Be careful when defining things with names that could already exist in LaTeX

# Defining your own commands

`\newcommand{\name}[number_of_parameters]{definition_of_command}`

- Use to save yourself time by creating shortcuts for things you use a lot
- Be careful when defining things with names that could already exist in LaTeX

Ex 1.) Boltzmann constant: `\newcommand{\kb}{k_\mathrm{B}}`

`\kb`  $\rightarrow k_{\text{B}}$

# Defining your own commands

`\newcommand{\name}[number_of_parameters]{definition_of_command}`

- Use to save yourself time by creating shortcuts for things you use a lot
- Be careful when defining things with names that could already exist in LaTeX

Ex 1.) Boltzmann constant: `\newcommand{\kb}{k_\mathrm{B}}`

`\kb`  $\rightarrow k_{\text{B}}$

Default is zero  
parameters

# Defining your own commands

`\newcommand{\name}[number_of_parameters]{definition_of_command}`

- Use to save yourself time by creating shortcuts for things you use a lot
- Be careful when defining things with names that could already exist in LaTeX

Ex 1.) Boltzmann constant: `\newcommand{\kb}{k_\mathrm{B}}`

`\kb` →  $k_B$

Takes one  
parameter

Parameter  
replaces #1

Ex 2.) Color text red (requires xcolor package): `\newcommand{\red}[1]{\color{red} #1}`

`\red{text}` → **text**

# Defining your own commands

`\newcommand{\name}[number_of_parameters]{definition_of_command}`

- Use to save yourself time by creating shortcuts for things you use a lot
- Be careful when defining things with names that could already exist in LaTeX

Ex 1.) Boltzmann constant: `\newcommand{\kb}{k_\mathrm{B}}`

`\kb`  $\rightarrow k_B$

Ex 2.) Color text red (requires xcolor package): `\newcommand{\red}[1]{\color{red} #1}`

`\red{text}`  $\rightarrow$  **text**

Ex 3.) Make vector with components from 1 to n:

`\newcommand{\aDEFvector}[2][a]{(#1_1, #1_2, \ldots, #1_{#2})}`

`\aDEFvector{10}`  $\rightarrow (a_1, a_2, \dots, a_{10})$  OR `\aDEFvector[b]{10}`  $\rightarrow (b_1, b_2, \dots, b_{10})$

# Defining your own commands

`\newcommand{\name}[number_of_parameters]{definition_of_command}`

- Use to save yourself time by creating shortcuts for things you use a lot
- Be careful when defining things with names that could already exist in LaTeX

Ex 1.) Boltzmann constant: `\newcommand{\kb}{k_\mathrm{B}}`

`\kb` →  $k_B$

Ex 2.) Color text red (requires xcolor package): `\newcommand{\red}[1]{\color{red}#1}`

`\red{text}` →  $\text{red text}$

Default value  
for optional  
param #1

Ex 3.) Make vector with components from 1 to n:

2 parameters

`\newcommand{\aDEFvector}[2][a]{(#1_1, #1_2, \ldots, #1_{#2})}`

`\aDEFvector{10}` →  $(a_1, a_2, \dots, a_{10})$  OR `\aDEFvector[b]{10}` →  $(b_1, b_2, \dots, b_{10})$

# When you're stuck, look it up

- Google your issue
- Check out guides/tutorials
  - [https://www.overleaf.com/learn/latex/Learn\\_LaTeX\\_in\\_30\\_minutes](https://www.overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes)
  - <https://www.overleaf.com/learn>
  - <https://guides.nyu.edu/LaTeX/resources>
  - <https://latex-tutorial.com/tutorials/>
- Other resources
  - <https://detexify.kirelabs.org/classify.html>
  - <https://tex.stackexchange.com/>
  - <https://en.wikibooks.org/wiki/LaTeX/Mathematics>
  - ChatGPT etc.
    - Only for Latex commands