CS109 LaTeX Cheat Sheet

Created by Derek Chong for CS109 during Spring 2020.

This cheat sheet assumes you have done an introductory tutorial and have a basic level of general knowledge. It focuses on giving you a quick reference for language features you will encounter in CS109, in order to make your life easier when working on problem sets.

Frequently-Used Markup

Building Blocks			
$\geq$	`\geq`	$\leq$	`\leq`
$\neq$	`\neq`	$\approx$	`\approx`
$\sim$	`\sim`	$\Rightarrow$	`\Rightarrow`
$\sqrt{42}$	`\sqrt{42}`	∞	`\infty`
λ	`\lambda`	μ, σ	`\mu, \sigma`
$\Phi(0)$	`\Phi(0)`	Σ	`\Sigma`
θ	`\theta`	$\bar{X}, \hat{X}$	`\bar{X}, \hat{X}`
$A, B, \ldots, Z$	`A,B,\dots,Z`	$1, 2, \cdots, n$	`1,2,\cdots,n`
`my_function()`	`\verb|my_function()|`	$\frac{42 \text{ units} \times 42 \text{ units}}{42 \text{ units} \times 42 \text{ units}}$	`\frac{42 \textrm{ units} \times 42 \textrm{ units}}{42 \textrm{ units} \times 42 \textrm{ units}}`
$\sum_{i=0}^{n} \frac{a}{b}$	`\sum_{i=0}^{n} \frac{a}{b}`	$\prod_{i=0}^{n} \frac{a}{b}$	`\prod_{i=0}^{n} \frac{a}{b}`
Probability			
$P(A \cap B)$	`P(A \cap B)`	$P(A \cup B)$	`P(A \cup B)`
$\binom{n}{k}$	`\binom{n}{k}`	$P(A_1 \| B^C)$	`P(A_1|B^C)`

$P(\text{text} \mid \text{text})$	`P(\textrm{text } \mid \textrm{ text})`	$P(\text{cond} \leq 5.0)$	`P(\textrm{cond} \leq 5.0)`
$\frac{P(\text{a} \mid \text{b}) \times P(\text{b})}{P(\text{a})}$	`\frac{P(\textrm{a } \mid \textrm{ b}) \times P(\textrm{b})}{P(\textrm{a})}`	$\frac{P(\text{a} \mid \text{b}) \times P(\text{b})}{P(\text{a} \mid \text{b})P(\text{b}) + P(\text{a} \mid \text{b}^C)P(\text{b}^C)}$	`\frac{P(\textrm{a } \mid \textrm{ b}) \times P(\textrm{b})}{P(\textrm{a } \mid \textrm{ b})P(\textrm{b}) + P(\textrm{a } \mid \textrm{ b}^C)P(\textrm{b}^C)}`
Random Variables			
$X \sim \text{Ber}(p)$	`X \sim \textrm{Ber}(p)`	$X \sim \text{Bin}(n, p)$	`X \sim \textrm{Bin}(n,p)`
$X \sim \text{Poi}(\lambda = 0)$	`X \sim \textrm{Poi}(\lambda=0)`	$X \sim \text{Exp}(\lambda = 0)$	`X \sim \textrm{Exp}(\lambda=0)`
$X \sim \mathcal{N}(\mu = 0, \sigma^2 = 1)$	`X \sim \mathcal{N}(\mu = 0, \sigma^2 = 1)`	$\theta \sim \text{Beta}(a, b)$	`\theta \sim \textrm{Beta}(a,b)`
Calculus			
$\int_{-1}^{1} x^2 - 2x + 1 dx$	`\int_{-1}^{1} x^2 - 2x + 1 dx`	$\left[x - \frac{1}{2}x^2 \right]_{-1}^{1}$	`\left[ x - \frac{1}{2}x^2 \right]_{-1}^1`
$\iint_{0<y<x<1} \frac{x}{y} dy dx$	`\iint_{0<y<x<1} \frac{x}{y} dy dx`	$\frac{2}{3}y - \frac{3}{4}y^2 \Big\vert_{-1}^{x}$	`\left. \frac{2}{3}y - \frac{3}{4}y^2 \right\vert_{-1}^{x}`
Variance and Covariance			
$\text{Var}(X)$	`\textrm{Var}(X)`	$\text{Cov}(X, Y)$	`\textrm{Cov}(X,Y)`
$\begin{bmatrix} a & b \\ c & d \end{bmatrix}$	`\begin{bmatrix} a & b \\ c & d \end{bmatrix}`	ρ	`\rho`

Useful Structures

Groups of Equations

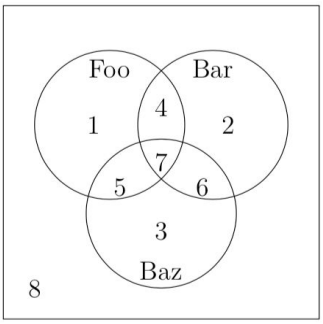
`\begin{align*}` chunks can be used to organise multiple lines of equations.

$$
\begin{aligned}
P(X=x|Y=1,W=P_1) &= \frac{P(X=x,Y=1|W=P_1)}{P(Y=1|W=P_1)} \\
&= P(X=x|W=P_1) \\
&= \binom{5}{x}(0.1)^x(0.9)^{5-x} \\
P(X=x|Y=1,W=P_2) &= \frac{P(X=x,Y=1|W=P_2)}{P(Y=1|W=P_2)} \\
&= P(X=x|W=P_2) \\
&= \binom{5}{x}(0.1)^x(0.9)^{5-x}
\end{aligned}
$$

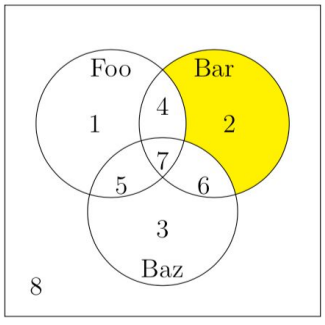
```
\begin{align*}
P(X=x|Y=1,W=P_1)
&= \frac{P(X=x,Y=1 |
W=P_1)}{P(Y=1|W=P_1)} \\
&= P(X=x|W=P_1) \\
&= \binom{5}{x}(0.1)^x(0.9)^{5-x} \\
P(X=x|Y=1,W=P_2)
&= \frac{P(X=x,Y=1 |
W=P_2)}{P(Y=1|W=P_2)} \\
&= P(X=x|W=P_2) \\
&= \binom{5}{x}(0.1)^x(0.9)^{5-x}
\end{align*}
```

Venn Diagrams

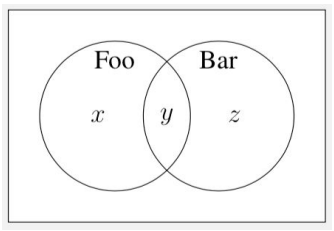
You may have to install the venndiagram package (and include `\usepackage{venndiagram}`)




```
\begin{venndiagram3sets}[labelA={Foo},labelB={Bar},labelC
={Baz},
labelOnlyA={1},labelOnlyB={2},labelOnlyC={3},
labelOnlyAB={4},labelOnlyAC={5},labelOnlyBC={6},labelABC=
{7},
labelNotABC={8}]
```



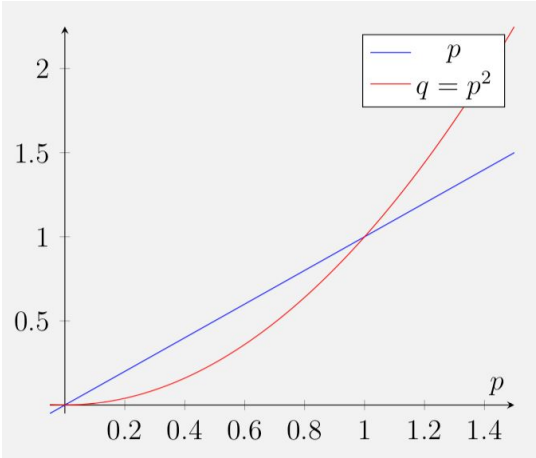

```
\begin{center}
\begin{venndiagram3sets}[labelA={Foo},labelB={Bar},labelC
={Baz},
labelOnlyA={1},labelOnlyB={2},labelOnlyC={3},
labelOnlyAB={4},labelOnlyAC={5},labelOnlyBC={6},labelABC=
{7},labelNotABC={8},shade={yellow}]
\fillOnlyB\end{venndiagram3sets}
\end{center}
```




```
\begin{center}
\begin{venndiagram2sets}[labelA={Foo},labelB={Bar},
labelOnlyA={$x$},labelOnlyB={$z$}, labelAB={$y$},
shade={white}]
\fillAll
\end{venndiagram2sets}
\end{center}
```

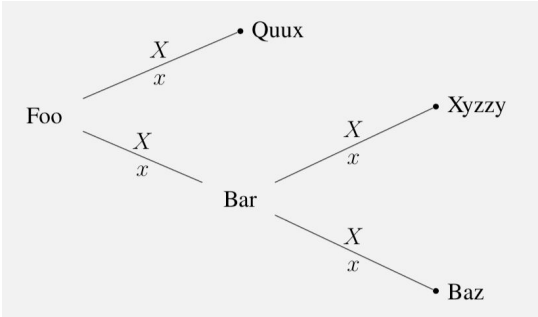
Full package documentation is available here:
https://ctan.math.illinois.edu/macros/latex/contrib/venndiagram/venndiagram.pdf

Plotting Graphs




```
\begin{tikzpicture}
    \begin{axis}[
       axis lines = center,
       xlabel = {$p$},
    ]
    \addplot [domain=-0.05:1.5, samples=100,
color=blue]{x};
    \addlegendentry{$p$}
    \addplot [domain=-0.05:1.5, samples=100,
color=red]{x*x};
    \addlegendentry{$q = p^2$}
    \end{axis}
\end{tikzpicture}
```

Probability Trees




```
\tikzstyle{level 1}=[level distance=3.5cm, sibling
distance=3cm]
\tikzstyle{level 2}=[level distance=3.5cm, sibling
distance=3.3cm]
\tikzstyle{bag} = [text width=4em, text centered]
\tikzstyle{end} = [circle, minimum width=3pt,fill, inner
sep=0pt]
\begin{tikzpicture}[grow=right]
\node[bag] {Foo}
    child {
        node[bag] {Bar}
            child {
                node[end, label=right:{Baz}] {}
                edge from parent
                node[above] {$X$}
                node[below]  {$x$}
            }
            child {
                node[end, label=right:{Xyzzy}] {}
                edge from parent
                node[above] {$X$}
                node[below]  {$x$}
            }
```

```
            edge from parent
            node[above] {$X$}
            node[below]  {$x$}
    }
    child {
        node[end, label=right:{Quux}] {}
        edge from parent
            node[above] {$X$}
            node[below]  {$x$}
    };
\end{tikzpicture}
```

Tables

Foo	0	1	2	3	4
Bar	0.0000	0.0000	0.0000	0.0000	0.0000
Baz	0.0000	0.0000	0.0000	0.0000	0.0000
Quux	0.0000	0.0000	0.0000	0.0000	1.9921
Xyzzy	0.00%	0.00%	0.00%	0.00%	0.00%

```
\setlength{\tabcolsep}{0.75em} % horizontal padding
\def\arraystretch{1.25} % vertical padding
\begin{tabular}{ |c|c|c|c|c|c| }
 \hline
 Foo & $0$ & $1$ & $2$ & $3$ & $4$ \\
 \hline
 Bar & $0.0000$ & $0.0000$ & $0.0000$ & $0.0000$ & $0.0000$ \\
 \hline
 Baz & $0.0000$ & $0.0000$ & $0.0000$ & $0.0000$ & $0.0000$ \\
 \hline
 Quux & $0.0000$ & $0.0000$ & $0.0000$ & $0.0000$ & $0.0000$ \\
 \hline
 Xyzzy & $0.00\%$ & $0.00\%$ & $0.00\%$ & $0.00\%$ & $0.00\%$ \\
 \hline
\end{tabular}
```

Python Code

This code requires you to install the `pythonhiglight` package and include `\usepackage{pythonhighlight}` in your header.
https://github.com/olivierverdier/python-latex-highlighting

```python
some_var = 42 # example comment
for n in range(5):
    print("Hello world!")
```

```
\begin{python}
some_var = 42 # example comment
for n in range(5):
    print("Hello world!")
\end{python}
```

General Tips

- **Local LaTeX**: Running LaTeX locally can help you learn faster than Overleaf - a shorter feedback loop is really helpful!

- **Wolfram Alpha**: You can paste LaTeX snippets directly into Wolfram Alpha and most of the time it'll understand them correctly and do something useful.
    - You can even add Wolfram Alpha as a custom search engine in Chrome. This lets you type "w [your LaTeX equation]" into your location bar, and it'll take you straight to the answer in Wolfram. Just go to this link, and add this as an entry.

- **Half-LaTeX environments**: Using a half-LaTeX environment like MS Word, Powerpoint, or Google Docs with the Auto-LaTeX Equations Addon is super useful while you're doing your rough work.
    - Save up snippets for typesetting and test them in Wolfram Alpha as you go!
    - Auto-LaTeX may throw an error if you're signed into >1 Google Account at once
    - MS Office LaTeX support was added in 2016, is not yet available on macOS

- **Keyboard shortcuts**:
    - On TeXShop, you can type \bali and press Esc twice, and it'll set up a \begin{align*} block. Or \b[xyz] for any \begin{xyz} block.
    - It can be nice to define custom shortcuts for things you find yourself typing frequently, such as `\textrm{}` or Bayes' Theorem.

- **Expectations**: You don't have to use any of the above structures if you don't want to! The teaching team will accept and grade PSets in any format you submit.

- **Motivation**: Strong LaTeX skills will make you more effective in all future courses. Goals