A $\LaTeX$ Cheat Sheet for Discrete Math

1 Extending $\LaTeX$

```
\newcommand{\mycmd}[1]{#1}}
\operatorname*{myop}(x)
```

2 Basics

$a, \mathbf{a}$	`a, \mathbf{a}`
$\Phi, \boldsymbol{\Phi}$	`\Phi, \boldsymbol{\Phi}`
a^{ij}	`a^{ij}`
a_{ij}	`a_{ij}`
a_{i}^{j}	`a_{i}^{j}`
${}_{k}^{l}a_{i}^{j}$	`{}_{k}^{l}a_{i}^{j}`
$\bar x$	`\bar x`
$\vec x$	`\vec x`
$\dot x$	`\dot x`
$\tilde{a}$	`\tilde{a}`
$\lvert a \rvert$ (Sec. 16.2)	`\lvert a \rvert`
$\lceil a \rceil$ (Sec. 16.2)	`\lceil a \rceil`
$\lfloor a \rfloor$ (Sec. 16.2)	`\lfloor a \rfloor`
$\overline{ab}$	`\overline{ab}`
$\underline{ab}$	`\underline{ab}`
$\overrightarrow{AB}$	`\overrightarrow{AB}`
$\overleftarrow{AB}$	`\overleftarrow{AB}`
$\widetilde{ab}$	`\widetilde{ab}`
$\overbrace{a_{1} \cdots a_{k}}^{k}$	`\overbrace{a_{1} \cdots a_{k}}^{k}`
$\underbrace{a_{1} \cdots a_{k}}_{k}$	`\underbrace{a_{1} \cdots a_{k}}_{k}`
$M^{\top}$ = transpose	`M^{\top}`
$\ell_{\bot}$	`\ell_{\bot}`
$\ell_{\parallel}$	`\ell_{\parallel}`

3 Cancellation

```
\usepackage{cancel}
```

$a \neq b$	`a \neq b`
$a \not\subseteq b$	`a \not\subseteq b`
$\not aa$	`\not aa`
$\not{aa}$	`\not{aa}`
$\cancel{a b c \beta}$	`\cancel{a b c \beta}`
$\bcancel{a b c \beta}$	`\bcancel{a b c \beta}`
$\xcancel{a b c \beta}$	`\xcancel{a b c \beta}`
$\cancelto{\infty}{a b c \beta}$	`\cancelto{\infty}{a b c \beta}`

4 Meta

$x \implies y$	`x \implies y`
$x \impliedby y$	`x \impliedby y`
$x \iff y$	`x \iff y`
$x \Longrightarrow y$	`x \Longrightarrow y`
$x \Longleftarrow y$	`x \Longleftarrow y`
$a \triangleq b$	`a \triangleq b`
$a \overset{\triangle}{\equiv} b$	`a \overset{\triangle}{\equiv} b`
$a \overset{\triangle}{\iff} b$	`a \overset{\triangle}{\iff} b`
$a \overset{\triangle}{\longleftrightarrow} b$	`a \overset{\triangle}{\longleftrightarrow} b`

5 More

$\sideset{_{a}^{b}}{_{c}^{d}} \sum$	`\sideset{_{a}^{b}}{_{c}^{d}} \sum`
$\overset{ab}{xyz}$	`\overset{ab}{xyz}`
$\underset{i}{\arg \, \min} \, \{ a_{i} \}$	`\underset{i}{\arg \, \min} \, \{ a_{i} \}`
$\underset{a}{\arg \, \max} \, f(a)$	`\underset{a}{\arg \, \max} \, f(a)`
$\frac{a}{b}$	`\frac{a}{b}`
$\tfrac{a}{b}$	`\tfrac{a}{b}`
$\sum_{i = 0}^{5} i$	`\sum_{i = 0}^{5} i`
$\prod_{i = 0}^{5} i$	`\prod_{i = 0}^{5} i`
$\lim_{a \to \infty} x$	`\lim_{a \to \infty} x`
$\frac{\mathrm{d} f(x)}{\mathrm{d} x}$	`\frac{\mathrm{d} f(x)}{\mathrm{d} x}`
$a + \mathrm{i}\, b$	`a + \mathrm{i}\, b`
$\int_{a}^{b} \! f(x) \, \mathrm{d} x$	`\int_{a}^{b} \! f(x) \, \mathrm{d} x`
$\left[\frac{\infty}{\infty}\right]$	`\left[\frac{\infty}{\infty}\right]`

6 Format Patterns

a $\begin{array}{|l|} \text{bb} \\ \text{cc} \end{array}$ d.

```
a
\begin{tabular}{|l|}
  bb \\
  cc
\end{tabular}
d.
```

$\genfrac(]{0pt}{2}{a+b}{c+d+e}$

```
{\genfrac(]{0pt}{2}
  {a+b}
  {c+d+e}
}
```

$a = \begin{cases} 1, & n \text{ is odd}, \\ 0, & \text{otherwise}. \end{cases}$

```
a =
\begin{cases}
  1, & n \text{ is odd}, \\
  0, & \text{otherwise}.
\end{cases}
```

$$\sum_{\substack{k \in \mathbb{Z} \\ 7 < k \\ k \leq 4}} a_{k}.$$

```
\sum_{
  \substack{
    k \in \hSoZ\\
    7 < k \\
    k \leq 4
  }
}
a_{k}.
```

$$n! = \underbrace{1 \cdot 2 \cdot \dotso \cdot n}_{n}$$

```
n! =
\underbrace{
  1
  \cdot 2
  \cdot
  \dotso
  \cdot n
}_{n}
```

$$\begin{align*} aaa &= b+b+b && // ccc\\ d &= e+e && // fff \end{align*}$$

```
\begin{align*}
aaa &= b+b+b &// ccc\\
d &= e+e &// fff
\end{align*}
```

7 Equations

$$\begin{align*} 1 + (2 + 3) & = 1 + 5\\ & = 6\\ & = 12/2. \end{align*}$$

```
\begin{align*}
  1 + (2 + 3)
  & = 1 + 5\\
  & = 6\\
  & = 12/2.
\end{align*}
```

$$\left. \frac{x^{2}}{3} \right|_{0}^{1}$$

```
\left.
  \frac{x^{2}}{3}
\right|_{0}^{1}
```

8 Spaces in Math mode

$a\!a$	`a\!a` negative
$a\,a$	`a\,a` thin
$a\:a$	`a\:a` medium
$a\;a$	`a\;a` thick
$a\ a$	`a\ a` ?
$a\quad a$	`a\quad a`
$a\qquad a$	`a\qquad a`

9 Dots

$1 \cdot 2 \cdot 3$ (multiplication)	`$1 \cdot 2 \cdot 3$`
$1, 2, \dotsc, 9$ (comma)	`$1, 2, \dotsc, 9$`
$1 + 2 + \dotso + 9$ (operator)	`$1 + 2 + \dotso + 9$`

10 Matrices

$$\begin{pmatrix} a_{1,1} & \cdots & a_{1,n}\\ \vdots & \ddots & \vdots\\ a_{m,1} & \cdots & a_{m,n} \end{pmatrix}$$

```
\begin{pmatrix}
  a_{1,1} & \cdots & a_{1,n}\\
  \vdots  & \ddots & \vdots\\
  a_{m,1} & \cdots & a_{m,n}
\end{pmatrix}
```

$$\begin{array}{cc} & \begin{array}{cc} x & y \end{array} \\ \begin{array}{c} A \\ B \end{array} & \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} \end{array}$$

```
\bordermatrix{
  ~ & x & y \cr
  A & 1 & 2 \cr
  B & 3 & 4 \cr
}
```

11 Logic

$p \implies q$	`p \implies  q`
$p \impliedby q$	`p \impliedby  q`
$p \iff q$	`p \iff  q`
$\overline{p}$	`\overline{p}`
$\neg p$	`\neg p`
$p \land q$	`p \land q`
$p \lor q$	`p \lor q`
$p \oplus q$	`p \oplus q`
$p \rightarrow q$	`p \rightarrow q`
$p \leftrightarrow q$	`p \leftrightarrow q`
$p \equiv q$	`p \equiv q`
$p \longrightarrow q$	`p \longrightarrow q`
$p \longleftrightarrow q$	`p \longleftrightarrow q`
$\forall x \in A \ P(x)$	`\forall x \in A \ P(x)`
$\not\forall x \in A \ P(x)$	`\not \forall x \in A \ P(x)`
$\exists x \in A \ P(x)$	`\exists x \in A \ P(x)`
$\not\exists x \in A \ P(x)$	`\not \exists x \in A \ P(x)`

12 Set Theory

$\emptyset$	`\emptyset`
$x \in A$	`x \in A`
$x \notin A$	`x \notin A`
$\{x, y\}$	`\{ x, y \}`
$\{x \mid P(x)\}$	`\{ x \mid P(x) \}`
$A \subset B$	`A \subset B`
$A \not\subset B$	`A \not\subset B`
$A \subseteq B$	`A \subseteq B`
$A \not\subseteq B$	`A \not\subseteq B`
2^A = power set of A	`2^{A}`
$\mathcal{P}(A)$ = power set of A	`\mathcal{P}(A)`
$\lvert A \rvert$ = cardinality of A (Sec. 16.2)	`\lvert A \rvert`
$A \cup B$	`A \cup B`
$A \cap B$	`A \cap B`
$A \smallsetminus B$ = set difference	`A \smallsetminus B`
$A \times B$ = Cartesian product	`A \times B`
(a, b) = ordered pair	`(a, b)`
$\overline{A}$ = complement of A	`\overline{A}`
f^{-1} = inverse	`f^{-1}`
$f \circ g$ = composition	`f \circ g`
$a \, \beta \, b$ = relation	`a \, \beta \, b`
$a \, \cancel{\beta} \, b$	`a \,\cancel{\beta} \,b`
M_β = matrix of β	`aaa`
$f \colon A \to B$ = function	`f \colon A \to B`
$a \mapsto f(a)$ = mapped to	`a \mapsto f(a)`
$f \upharpoonright C$ = restriction of f to C	`f \upharpoonright C`
i_A = identity function of A	`i_{A}`
B^A = set of all functions	`B^{A}`
$\mathbb{A}$	`\mathbb{A}`
$\mathcal{A}$	`\mathcal{A}`

13 Algebraic Structures

$[A, \oplus]$	`[A, \oplus]`
$[A, \oplus, \otimes]$	`[A, \oplus, \otimes]`

14 Number Theory

$\lceil x \rceil$	`\hCeil{x}`
$\lfloor x \rfloor$	`\hPairingFloor{x}`
$\lvert x \rvert$	`\hAbs{x}`
$x \mid y$	`x \mid y`
$x \nmid y$	`x \nmid y`
$x \bot y$	`x \bot y`
$x \perp y$	`x \perp y`
$x \ \mathrm{div} \ y$	`x \ \mathrm{div} \ y`
$x \ \mathrm{rem} \ y$	`x \ \mathrm{rem} \ y`
$\log_{2} x$	`\log_{2} x`
$\sum_{i=1}^{n} a_{i}$	`\sum_{i=1}^{n} a_{I}`
$\prod_{i=1}^{n} a_{i}$	`\prod_{i=1}^{n} a_{I}`
$\frac{x}{y}$	`\frac{x}{y}`
$\sqrt[n]{x}$	`\sqrt[n]{x}`
$a \bmod b$	`a \bmod b`
$0 \equiv 3 \pmod{3}$	`0 \equiv 3 \pmod{3}`
$0 \equiv 3 \mod{3}$	`0 \equiv 3 \mod{3}`
$0 \equiv 3 \pod{3}$	`0 \equiv 3 \pod{3}`

15 Combinatorics

$n! = n$ factorial	`n!`
$n^{\overline{r}} = n$ to the r rising	`n^{\overline{r}}`
$n^{\underline{r}} = n$ to the r falling	`n^{\underline{r}}`
$\binom{n}{r} = n$ choose r	`\binom{n}{r}`
${n \choose r} = n$ choose r	`{n \choose r}`
${n \brack r}$ = Stirling cycle number	`{n \brack r}`
${n \brace r}$ = Stirling subset number	`{n \brace r}`
$S(n, k)$ = Stirling number	`S(n, k)`
B_n = The nth Bell number	`B_{n}`

16 *h* extensions

`See the source of this document.`

16.1 *h*Tags

aa *dd* bb.	`aa \hDed{dd} bb.`
$x \overset{\Delta}{\iff} y$	`x \hDiff y`
$x \triangleq y$	`x \hDeq y`
$x \overset{\Delta}{\equiv} y$	`x \hDev y`

16.2 *h*Pairs

$\lvert x \rvert$	`\hAbs{x}`
$\lceil x \rceil$	`\hCeil{x}`
$\lfloor x \rfloor$	`\hFloor{x}`
$\lVert x \rVert$	`| x |`

16.3 *h*Sets

$\mathbb{N}$= The natural numbers	`\hSoN`
$\mathbb{N}^+$= Counting numbers	`\hSoNp`
$\mathbb{Z}$= The integers	`\hSoZ`
$\mathbb{Z}^+$= positive integers	`\hSoZp`
$\mathbb{Z}^-$= negative integers	`\hSoZn`
$\mathbb{Z}_{\geq 0}$= nonnegative integers	`\hSoZnn`
$\mathbb{Z}_{\neq 0}$= nonzero integers	`\hSoZnz`
$\mathbb{Z}_{\leq 0}$= nonpositive integers	`\hSoZnp`
$\mathbb{Q}$= The rational numbers	`\hSoQ`
$\mathbb{Q}^+$= positive rational numbers	`\hSoQp`
$\mathbb{Q}^-$= negative rational numbers	`\hSoQn`
$\mathbb{Q}_{\geq 0}$= nonnegative rationals	`\hSoQnn`
$\mathbb{Q}_{\neq 0}$= nonzero rationals	`\hSoQnz`
$\mathbb{Q}_{\leq 0}$= nonpositive rationals	`\hSoQnp`
$\mathbb{R}$= The real numbers	`\hSoR`
$\mathbb{R}^+$= positive real numbers	`\hSoRp`
$\mathbb{R}^-$= negative real numbers	`\hSoRn`
$\mathbb{R}_{\geq 0}$= nonnegative reals	`\hSoRnn`
$\mathbb{R}_{\neq 0}$= nonzero reals	`\hSoRnz`
$\mathbb{R}_{\leq 0}$= nonpositive reals	`\hSoRnp`
$\mathbb{C}$= The complex numbers	`\hSoC`
$\mathbb{C}_{\neq 0}$= nonzero complex numbers	`\hSoCnz`
$\mathbb{P}$= The set of Prime Numbers	`\hSoPrimes`
$\{T, F\}$	`\hSoTruth`
$\mathbb{B} = \{0, 1\}$	`\hSoBits`
2^A	`\hSoSubsets{A}`
$\mathcal{P}(A) = 2^A$= The set of all subsets	`\hSoPowerSet{A}`
B^A=The set of all functions	`\hSoFunctions{A}{B}`

16.4 Labels References

Definition 18.1	`\refdef{def:aa}`
Theorem 18.1	`\refthm{thm:gauss}`
Lemma 18.2	`\reflem{lem:fermat}`
Sec. 18	`\refsec{sec:templates}`

17 Math Environments

Axiom	`ax`
Corollary	`cor`
Definition	`defn`
Example	`exmp`
Exercise	`exercise`
Equation	`align*`
Lemma	`lem`
Notation	`notation`
Proof	`proof`
Proposition	`prop`
Remark	`rem`
Theorem	`thm`

18 Environment Usage

Axiom 1. *aaa*	\begin{ax}
	  aaa
	  \label{ax:one}
	\end{ax}

Definition 18.1. aaa *ddd* bbb.	\begin{defn}
	  aaa \hDed{ddd} bbb.
	  \label{def:aa}
	\end{defn}

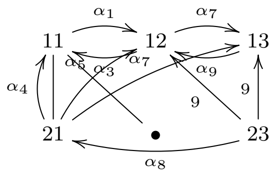
Theorem 18.1 (Gauss). *aaa*	\begin{thm}[Gauss]
	  aaa
	  \label{thm:gauss}
	\end{thm}

Proof. aaa □	\begin{proof} aaa \end{proof}

Lemma 18.2 (Fermat). *aaa*	\begin{lem}[Fermat]
	  aaa
	  \label{lem:fermat}
	\end{lem}

Corollary 18.3. *aaa*	\begin{cor} aaa \end{cor}
Proposition 18.4. *aaa*	\begin{prop} aaa \end{prop}
Remark 18.1. aaa	\begin{rem} aaa \end{rem}
Notation. aaa	\begin{notation} aaa \end{notation}

19 xymatrix




```
\xymatrix{
%
11
\POS[];
[d]**\dir{-};
[];[dr]**\dir{-};
\ar@/^/[r]^{\alpha_{1}}
%
& 12
\ar@/^/[r]^{\alpha_{7}}
\ar@/^/[l]^{\alpha_{3}}
%
& 13
\ar@/^/[l]^{\alpha_{9}}
\\
%
21
\ar@/^/[ur]^{\alpha_{5}}
\ar@/^/[u]^{\alpha_{4}}
\ar@/^/[urr]^{\alpha_{7}}
%
& \bullet
%
& 23
\ar@/^/[ll]^{\alpha_{8}}
\ar[u]^{9}
\ar[ul]^{9}
}
```

20 Lists

```
\usepackage{enumerate}
```

• aa
• bb
	\begin{itemize}
	  \item aa
	  \item bb
	\end{itemize}

1. aa
2. bb
	\begin{enumerate}
	  \item aa
	  \item bb
	\end{enumerate}

i) aa
ii) bb
	\begin{enumerate}[i)]
	  \item aa
	  \item bb
	\end{enumerate}

a) aa
b) bb
	\begin{enumerate}[a)]
	  \item aa
	  \item bb
	\end{enumerate}

21 Math mode

inline: aaa or aaa bbb	inline:
	\$
	  aaa
	\$
	or
	\(
	  aaa
	\)
	bbb

display: $$aaa$$ bbb	display: \[aaa \] bbb