Cheat Sheet for LaTeX

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1 LaTeX Symbols

1.1 package

```
\usepackage{amssymb,amsmath,amsthm,amsfonts}
\usepackage{multicol,multirow,calc,ifthen}
\usepackage{tikz,graphicx,color}
\usepackage[]{algorithm,algpseudocode}
\usepackage[landscape]{geometry}
```

1.2 The basics

description	command	output
plus or minus	\pm	$\pm$
multiplication (times)	\times	$\times$
multiplication (dot)	\cdot	$\cdot$
division symbol	\div	$\div$
backslash	\backslash	$\backslash$
division (slash)	/	$/$
circle plus	\oplus	$\oplus$
circle times	\otimes	$\otimes$
equal	\equiv	$\equiv$
not equal	\neq	$\neq$
less than or equal to	\leq	$\leq$
greater than or equal to	\geq	$\geq$
approximately equal to	\approx	$\approx$
infinity	\infty	∞
fraction	\frac{a}{b}	$\frac{a}{b}$
square root	\sqrt{x}	$\sqrt{x}$
nth root	\sqrt[n]{x}	$\sqrt[n]{x}$
exponentiation	a^b	a^b
subscript	a_b	a_b
absolute value	|x|	$\|x\|$
natural log	\ln(x)	$\ln(x)$
logarithms	\log_{a}b	$\log_a b$
exponential function	e^x	e^x
pi	\pi	π
degree	90^\circ	90°
dim	\dim(x)	$\dim(x)$
det	\det(x)	$\det(x)$
sin	\sin(x)	$\sin(x)$
arcsin	\arcsin(x)	$\arcsin(x)$
liminf	\liminf(x)	$\liminf(x)$
dots	\ldots	$\ldots$
dots	\cdots	$\cdots$
diagonal dots	\ddots	$\ddots$
underset	\overset{x}{\to}	$\overset{x}{\to}$
overset	\underset{f}{\to}	$\underset{f}{\to}$

1.3 Define your own function

```
\newcommand{\norm}[1]{\left\|#1\right\|} % norm
\newcommand{\abs}[1]{\left|#1\right|}    %abs
\newcommand{\lap}{\Delta } % laplace
\newcommand{\tr}[1]{\operatorname{tr}(#1)}%trace
\newcommand{\tribint}[2]
{\left<#1\right>_{\mathcal{E}^{#2}_{h}}}
```

description	command	output
norm	\norm{u}	$\|u\|$
absolute value	\abs{u}	$\|u\|$
laplace	\lap u	Δu
trace	\tr{u}	$\operatorname{tr}(u)$
edge integral	\tribint{f,\psi}{I}	$\langle f,\psi\rangle_{\mathcal{E}_h^I}$

1.4 Greek and Hebrew letters

command	output	command	output
\alpha	α	\tau	τ
\beta	β	\theta	θ
\chi	χ	\upsilon	υ
\delta	δ	\xi	ξ
\epsilon	ϵ	\zeta	ζ
\varepsilon	ε	\Delta	Δ
\eta	η	\Gamma	Γ
\gamma	γ	\Lambda	Λ
\iota	ι	\Omega	Ω
\kappa	κ	\Phi	Φ
\lambda	λ	\Pi	Π
\mu	μ	\Psi	Ψ
\nu	ν	\Sigma	Σ
\omega	ω	\Theta	Θ
\phi	ϕ	\Upsilon	Υ
\varphi	φ	\Xi	Ξ
\pi	π	\aleph	$\aleph$

1.5 Geometry and trigonometry

description	command	output
angle	\angle ABC	$\angle ABC$
degree	90^{\circ}	90°
triangle	\triangle ABC	$\triangle ABC$
segment	\overline{AB}	$\overline{AB}$
sine	\sin	sin
cosine	\cos	cos
tangent	\tan	tan
cotangent	\cot	cot
secant	\sec	sec
cosecant	\csc	csc
inverse sine	\arcsin	arcsin
inverse cosine	\arccos	arccos
inverse tangent	\arctan	arctan

1.6 Calculus

description	command	output
derivative	\frac{df}{dx}	$\frac{df}{dx}$
derivative	\f'	f'
partial derivative	\frac{\partial f}{\partial x}	$\frac{\partial f}{\partial x}$
integral	\int	$\int$
double integral	\iint	$\iint$
triple integral	\iiint	$\iiint$
limits	\lim_{x\to \infty}	$\lim_{x\to\infty}$
summation	\sum_{n=1}^{\infty}a_n	$\sum_{n=1}^{\infty} a_n$

1.7 Linear algebra

description	command	output
vector	\vec{v}	$\vec{v}$
vector	\mathbf{v}	$\mathbf{v}$
norm	\norm{\vec{v}}	$\|\vec{v}\|$
matrix	\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6\\ 7 & 8 & 0 \end{bmatrix}	$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{bmatrix}$
matrix	\begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6\\ 7 & 8 & 0 \end{pmatrix}	$\begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{pmatrix}$
border matrix	\bordermatrix {~ & x & r \cr A & 1 & 0 \cr B & 0 & 1\cr	$\bordermatrix{~ & x & r \cr A & 1 & 0 \cr B & 0 & 1\cr}$
determinant	\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{vmatrix}	$\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{vmatrix}$
determinant	\det(A)	$\det(A)$
trace	\tr{A}	$\operatorname{tr}(A)$
inverse	\inv{A}	A^{-1}
transpose	\trsp{A}	A^T
dimension	\dim(V)	$\dim(V)$

1.8 Logic

description	command	output
not	\sim	$\sim$
and	\land	$\land$
or	\lor	$\lor$
if...then	\to	$\to$
if and only if	\leftrightarrow	$\leftrightarrow$
logical equivalence	\equiv	$\equiv$
therefore	\therefore	$\therefore$
there exists	\exists	$\exists$
for all	\forall	$\forall$
implies	\Rightarrow	$\Rightarrow$
equivalent	\Leftrightarrow	$\Leftrightarrow$

1.9 Set theory

description	command	output
element of	\in	$\in$
not an element of	\not\in	$\notin$
subset of	\subset	$\subset$
subset of	\subseteq	$\subseteq$
not a subset of	\not\subset	$\not\subset$
contains	\supset	$\supset$
contains	\supseteq	$\supseteq$
union	\cup	$\cup$
intersection	\cap	$\cap$
big union	\bigcup_{n=1}^{10}A_n	$\bigcup_{n=1}^{10} A_n$
big intersection	\bigcap_{n=1}^{10}A_n	$\bigcap_{n=1}^{10} A_n$
empty set	\emptyset	$\emptyset$
power set	\mathcal{P}	$\mathcal{P}$

2 Figure

2.1 Insert figure

```
\begin{figure}[H]
\begin{center}
\includegraphics[width=0.2\textwidth]{fig.eps}
\caption{simulation result }\label{fig:pro2}
\end{center}
\end{figure}
```

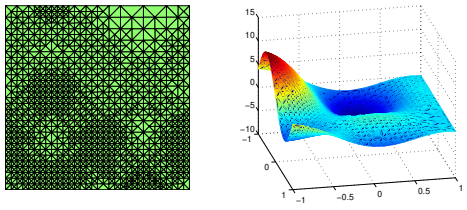

Figure 1: simulation result

2.2 draw figure with TikZ

```
\begin{figure}[H]
\begin{center}
\begin{tikzpicture}[scale=0.5,>=latex]
\shade[ball color=gray,opacity=0.50] (0,0) circle (2cm);
\draw[->] (0,0,0) -- (3,0,0) node (xaxis) [right] {$x$};
\draw[->] (0,0,0) -- (0,3,0) node (zaxis) [right] {$z$};
\draw[->] (0,0,0) -- (0,0,5) node (yaxis) [left] {$y$};
\draw [->] (0,0,0)-- (2,0,2)node[right] {$_{r\sin\phi}$};
\draw [blue,->] (0,0,0)-- (2,2,2)node[right] {$r$};
\draw [blue,->] (0.5,0.5,0.5)to[bend right](0,0.5,0);
\node[] at (0.3,0.6,0)   {$_\phi$};
\draw[blue,densely dashed] (2,0,2)-- (2,2,2)--(0,1.8,0);
\draw[blue,densely dashed](2,0,2)--(1.7,0,0)node[above]{$x$};
\draw[blue,densely dashed](2,0,2)--(0,0,1.9)node[left]{$y$};
\coordinate (x0) at (2,0,2);
\draw [blue,->] (0,0,0.5)to[bend right](0.4,0,0.4);
\node[] at (0.3,0,1)   {$_\theta$};
\end{tikzpicture}
\caption{Spherical coordinate in $\mathbb{R}^3$}
\end{center}
\end{figure}
```

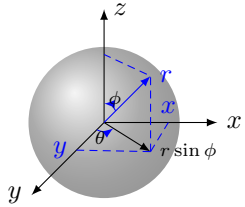

Figure 2: Spherical coordinate in $\mathbb{R}^3$

3 Table

```
\begin{table}[H]
\caption{Errors of FEM for Poisson Equation}\label{tab:p2}
\begin{center}
\begin{tabular}{ccc}
\hline $h$&$\norm{u-u_h}_{L^2}$ & $\abs{u-u_h}_{H^1}$\\
\hline $1/4$& $7.62\times 10^{-3}$ &$1.02\times10^{-1}$
\\$1/8$& $2.02\times 10^{-3}$ &$5.58\times10^{-2}$
\\ $1/16$ & $5.32\times 10^{-4}$ &$3.01\times10^{-2}$
\\ $1/32$& $1.37\times 10^{-4}$ &$1.60\times10^{-2}$
\\ $1/64$& $3.52\times 10^{-5}$ &$8.51\times10^{-3}$
\\ $1/128$& $ 8.87\times 10^{-6}$ &$4.48\times10^{-3}$
\\ $1/256$& $2.20\times 10^{-6}$ &$2.35\times10^{-3}$
\\\hline
\end{tabular}
\end{center}
\end{table}
```

Table 1: Errors of FEM for Poisson Equation

h	$\|u-u_h\|_{L^2}$	$\|u-u_h\|_{H^1}$
$1/4$	7.62×10^{-3}	1.02×10^{-1}
$1/8$	2.02×10^{-3}	5.58×10^{-2}
$1/16$	5.32×10^{-4}	3.01×10^{-2}
$1/32$	1.37×10^{-4}	1.60×10^{-2}
$1/64$	3.52×10^{-5}	8.51×10^{-3}
$1/128$	8.87×10^{-6}	4.48×10^{-3}
$1/256$	2.20×10^{-6}	2.35×10^{-3}

4 Algorithm

```
\begin{algorithm} [H]
\caption{Bisection method}
\begin{algorithmic}[1]
\State $a_0\gets a, b_0\gets b$
\While{$k >0$}
   \State $c_k\gets \frac{a_{k-1}+b_{k-1}}{2}$
\If {$f(a_k)f(c_k)<0$}
    \State $a_k \gets a_{k-1}$
    \State $b_k\gets c_k$
 \EndIf
\If {$f(b_k)f(c_k)<0$}
    \State $a_k \gets c_k$
    \State $b_k\gets b_{k-1}$
 \EndIf
\State $x^k\gets c^k\gets \frac{a_{k}+b_{k}}{2}$
\EndWhile
\end{algorithmic}
\end{algorithm}
```

Algorithm 1 Bisection method

1: $a_0 \leftarrow a, b_0 \leftarrow b$
2: **while** $k > 0$ **do**
3: $\quad c_k \leftarrow \frac{a_{k-1}+b_{k-1}}{2}$
4: $\quad$ **if** $f(a_k)f(c_k) < 0$ **then**
5: $\quad\quad a_k \leftarrow a_{k-1}$
6: $\quad\quad b_k \leftarrow c_k$
7: $\quad$ **end if**
8: $\quad$ **if** $f(b_k)f(c_k) < 0$ **then**
9: $\quad\quad a_k \leftarrow c_k$
10: $\quad\quad b_k \leftarrow b_{k-1}$
11: $\quad$ **end if**
12: $\quad x^k \leftarrow c^k \leftarrow \frac{a_k+b_k}{2}$
13: **end while**