Math 233

In the following pages I have excerpted some pages from *The Not So Short Introduction to LATEX* 2ϵ , by Tobias Oetiker. The full text of this document is also posted on our class Blackboard page, under "Reference."

placement of \bar for a variable with subscript. The apostrophe mark 'gives a prime:

```
$f(x) = x^2 \qquad f'(x)
= 2x \qquad f''(x) = 2\\[5pt]
\hat{XY} \quad \widehat{XY}
\quad \bar{x_0} \quad \bar{x}_0$
```

$$f(x) = x^2$$
 $f'(x) = 2x$ $f''(x) = 2$
 \widehat{XY} \widehat{XY} $\overline{x_0}$ $\overline{x_0}$

Vectors are often specified by adding small arrow symbols on top of a variable. This is done with the \vec command. The two commands \vec voerrightarrow and \vec are useful to denote the vector from A to B:

$$ec{a}$$
 $ec{AB}$ $ec{AB}$

Names of log-like functions are often typeset in an upright font, and not in italics as variables are, so LATEX supplies the following commands to typeset the most important function names:

```
\arccos
         \cos
                 \csc
                        \exp
                               \ker
                                         \limsup
\arcsin
         \cosh
                 \deg
                        \gcd
                               \lg
                                         \ln
\arctan
                                         \log
        \cot
                 \det
                        \hom
                               \lim
         \coth
                 \dim
                       \inf
                               \liminf
                                         \max
\arg
\sinh
                 \tan
                      \tanh
                               \min
                                         \Pr
         \sup
\sec
         \sin
```

$$\lim_{x \to 0} \frac{\sin x}{x} = 1$$

For functions missing from the list, use the \DeclareMathOperator command. There is even a starred version for functions with limits. This command works only in the preamble so the commented lines in the example below must be put into the preamble.

%\DeclareMathOperator{\argh}{argh}
%\DeclareMathOperator*{\nut}{Nut}
\[3\argh = 2\nut_{x=1}\]

$$3 \operatorname{argh} = 2 \operatorname{Nut}_{x=1}$$

For the modulo function, there are two commands: \bmod for the binary operator " $a \mod b$ " and \pmod for expressions such as " $x \equiv a \pmod{b}$:"

$$a \bmod b$$
$$x \equiv a \pmod b$$

3.8 List of Mathematical Symbols

The following tables demonstrate all the symbols normally accessible from *math mode*.

To use the symbols listed in Tables 3.12–3.8,8 the package amssymb must be loaded in the preamble of the document and the $\mathcal{A}_{\mathcal{M}}\mathcal{S}$ math fonts must be installed on the system. If the $\mathcal{A}_{\mathcal{M}}\mathcal{S}$ package and fonts are not installed on your system, have a look at CTAN:macros/latex/required/amslatex. An even more comprehensive list of symbols can be found at CTAN:info/symbols/comprehensive.

Table 3.1: Math Mode Accents.

\hat{a}	\hat{a}	\check{a}	\check{a}	\tilde{a}	\tilde{a}
\grave{a}	\grave{a}	\dot{a}	$\det\{a\}$	\ddot{a}	\ddot{a}
\bar{a}	\bar{a}	\vec{a}	\vec{a}	\widehat{AAA}	\widehat{AAA}
\acute{a}	\acute{a}	$reve{a}$	\breve{a}	\widetilde{AAA}	\widetilde{AAA}
0	\ma+hminm[a]				

 \check{a} \mathring{a}

Table 3.2: Greek Letters.

There is no uppercase of some of the letters like \Alpha, \Beta and so on, because they look the same as normal roman letters: A, B...

α	\alpha	θ	\theta	o	0	v	\upsilon
β	\beta	ϑ	\vartheta	π	\pi	ϕ	\phi
γ	\gamma	ι	\iota	ϖ	\varpi	φ	\varphi
δ	\delta	κ	\kappa	ρ	\rho	χ	\chi
ϵ	\epsilon	λ	\lambda	ϱ	\varrho	ψ	\psi
ε	$\vert varepsilon$	μ	\mu	σ	\sigma	ω	\omega
ζ	\zeta	ν	\nu	ς	\varsigma		
η	\eta	ξ	\xi	au	\tau		
Γ	\Gamma	Λ	\Lambda	\sum	\Sigma	Ψ	\Psi
Δ	\Delta	Ξ	\Xi	Υ	Υ	Ω	\Omega
Θ	\Theta	Π	\Pi	Φ	\Phi		

 $^{^8{\}rm These}$ tables were derived from ${\tt symbols.tex}$ by David Carlisle and subsequently changed extensively as suggested by Josef Tkadlec.

Table 3.3: Binary Relations.

You can negate the following symbols by prefixing them with a \not command.

<	<	>	>	=	=
\leq	$\leq or \leq o$	\geq	\geq or \ge	\equiv	\equiv
\ll	\11	\gg	\gg	Ė	\doteq
\prec	\prec	\succ	\succ	\sim	\sim
\preceq	\preceq	\succeq	\succeq	\simeq	\simeq
\subset	\subset	\supset	\supset	\approx	\approx
\subseteq	\subseteq	\supseteq	\supseteq	\cong	\cong
	\sqsubset a		\sqsupset a	\bowtie	$\$ Join a
	\sqsubseteq	\supseteq	\sqsupseteq	\bowtie	\bowtie
\in	\in	\ni	\ni , \owns	\propto	\propto
\vdash	\vdash	\dashv	\dashv	F	\models
	\mid		\parallel	\perp	\perp
\smile	\smile	\frown	\frown	\asymp	\asymp
:	:	∉	\notin	\neq	\neq or \ne

 $[^]a\mathrm{Use}$ the latex sym package to access this symbol

Table 3.4: Binary Operators.

+	+	_	_		
\pm	\pm	干	\mp	◁	\triangleleft
•	\cdot	÷	\div	\triangleright	\triangleright
×	\times	\	\setminus	*	\star
\cup	\cup	\cap	\cap	*	\ast
Ц	\sqcup	П	\sqcap	0	\circ
\vee	\vee , \lor	\wedge	\wedge , \label{land}	•	\bullet
\oplus	\oplus	\ominus	\ominus	\Diamond	\diamond
\odot	\odot	\oslash	\oslash	\forall	\uplus
\otimes	\otimes	\bigcirc	\bigcirc	П	\aggreen amalg
\triangle	$\$ bigtriangleup	∇	$\$ bigtriangledown	†	\dagger
\triangleleft	\backslash lhd a	\triangleright	$\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $	‡	\ddagger
\leq	\unlhd a	\trianglerighteq	\unrhd a	}	\wr

Table 3.5: BIG Operators.

\sum	\sum	U	\bigcup	V	\bigvee
\prod	\prod	\cap	\bigcap	\wedge	\bigwedge
\coprod	\coprod	\sqcup	\bigsqcup	+	\biguplus
\int	\int	∮	\oint	\odot	\bigodot
\oplus	\bigoplus	\otimes	\bigotimes		

Table 3.6: Arrows.

\leftarrow	\leftarrow or \gets	\leftarrow	\longleftarrow
\rightarrow	\rightarrow or \to	\longrightarrow	$\label{longright} \$
\leftrightarrow	$\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $	\longleftrightarrow	\longleftrightarrow
\Leftarrow	\Leftarrow	$ \leftarrow $	\Longleftarrow
\Rightarrow	\Rightarrow	\Longrightarrow	\Longrightarrow
\Leftrightarrow	\Leftrightarrow	\iff	\Longleftrightarrow
\mapsto	\mapsto	\longmapsto	\longmapsto
\leftarrow	\h ookleftarrow	\hookrightarrow	\hookrightarrow
	$\label{leftharpoonup}$	\rightarrow	\rightharpoonup
$\overline{}$	\leftharpoondown	$\overline{}$	\rightharpoondown
\rightleftharpoons	\rightleftharpoons	\iff	\iff (bigger spaces)
\uparrow	\uparrow	\downarrow	\downarrow
\updownarrow	\updownarrow	\uparrow	\Uparrow
\Downarrow	\Downarrow	1	\Updownarrow
7	\nearrow	\searrow	\searrow
/	\swarrow	_	\nwarrow
\sim	$\$ leads to a		

 $[^]a\mathrm{Use}$ the latexsym package to access this symbol

Table 3.7: Arrows as Accents.

\overrightarrow{AB}	\overrightarrow{AB}	\xrightarrow{AB}	\underrightarrow{AB}
\overrightarrow{AB}	\overleftarrow{AB}	AB	\underleftarrow{AB}
\overrightarrow{AB}	\overleftrightarrow{AB}	<u>AB</u>	\underleftrightarrow{AB}

(())	\uparrow	\uparrow
[[or \lbrack]] or \rbrack	\downarrow	\downarrow
{	$\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $	}	\} or \rbrace	\updownarrow	\updownarrow
<	\langle	\rangle	\rangle	\uparrow	\Uparrow
	or \vert		\ or \Vert	\Downarrow	\Downarrow
/	/	\	\backslash	\updownarrow	\Updownarrow
L	\lfloor		\rfloor		
7	\rceil	Γ	\lceil		

Table 3.8: Delimiters.

Table 3.9: Large Delimiters.

(\lgroup)	\rgroup		\lmoustache
Ì	\arrowvert	ĺ	\Arrowvert	ĺ	\bracevert
	\rmoustache				

Table 3.10: Miscellaneous Symbols.

	\dots		\cdots	:	\vdots	٠	\ddots
\hbar	\hbar	\imath	\imath	J	\j math	ℓ	\ell
\Re	\Re	\Im	\Im	×	\aleph	Ø	\wp
\forall	\forall	\exists	\exists	Ω	\mho a	∂	∂
/	,	1	\prime	Ø	\emptyset	∞	∞
∇	\nabla	\triangle	$\$ triangle		\Box a	\Diamond	$\$ Diamond a
\perp	\bot	T	\top	_	\angle	$\sqrt{}$	\surd
\Diamond	\diamondsuit	\Diamond	\heartsuit	4	\clubsuit	\spadesuit	\spadesuit
\neg	\neg or \lnot	þ	\flat	þ	\natural	#	\sharp

 $^a\mathrm{Use}$ the $\mathsf{latexsym}$ package to access this symbol

 ${\bf Table~3.11:~Non-Mathematical~Symbols.}$

These symbols can also be used in text mode.

```
† \dag § \S © \copyright ® \textregistered 
‡ \ddag ¶ \P £ \pounds % \%
```

Table 3.12: $\mathcal{A}_{\mathcal{M}}\mathcal{S}$ Delimiters.

Γ	\ulcorner	٦	\urcorner	L	\llcorner	_	\lrcorner
	\lvert		\rvert		\1Vert		\rVert

Table 3.13: $\mathcal{A}\!\mathcal{M}\!\mathcal{S}$ Greek and Hebrew.

```
\digamma \digamma \varkappa \varkappa \beth \beth \gimel \gimel \daleth \daleth
```

Table 3.14: Math Alphabets.

See Table 6.4 on 111 for other math fonts.

Example	Command	Required package
${\bf ABCDEabcde 1234}$	\mathrm{ABCDE abcde 1234}	
ABCDEabcde1234	\mathit{ABCDE abcde 1234}	
ABCDEabcde1234	\mathnormal{ABCDE abcde 1234}	
ABCDE	\mathcal{ABCDE abcde 1234}	
A BC D E	\mathscr{ABCDE abcde 1234}	mathrsfs
ABCD Eabcde1234	\mathfrak{ABCDE abcde 1234}	${\sf amsfonts} {\rm or} {\sf amssymb}$
ABCDEƏ⊬⊭⊭₽	\mathbb{ABCDE abcde 1234}	${\sf amsfonts} {\rm or} {\sf amssymb}$

Table 3.15: $\mathcal{A}\!\mathcal{M}\!\mathcal{S}$ Binary Operators.

$\dot{+}$	\dotplus		\centerdot		
\bowtie	\ltimes	\rtimes	\rtimes	*	\divideontimes
$\displaystyle \bigcup$	\doublecup	\bigcap	\doublecap	\	\smallsetminus
$\underline{\vee}$	\veebar	$\overline{\wedge}$	\barwedge	\equiv	\doublebarwedge
\blacksquare	\boxplus	\Box	\boxminus	\ominus	\circleddash
\boxtimes	\boxtimes	•	\boxdot	0	\circledcirc
Т	\intercal	*	\circledast	\angle	\rightthreetimes
Υ	\curlyvee	人	\curlywedge	\rightarrow	\leftthreetimes

Table 3.16: $\mathcal{A}_{\mathcal{M}}\mathcal{S}$ Binary Relations.

<	\lessdot	>	\gtrdot	≑	\doteqdot
\leq	\leqslant	\geqslant	\geqslant	≓	\risingdotseq
<	\eqslantless	≽	\eqslantgtr	≒.	\fallingdotseq
\leq	\leqq	\geq	\geqq		\eqcirc
///	\lll or \llless	>>>	\ggg	<u>•</u>	\circeq
\lesssim	\lesssim	\gtrsim	\gtrsim	$\stackrel{\triangle}{=}$	\triangleq
\lessapprox	\lessapprox		\gtrapprox	<u></u>	\bumpeq
\leq	\lessgtr	\geq	\gtrless	≎	\Bumpeq
\leq	\lesseqgtr	\geq	\gtreqless	\sim	\thicksim
\\\ \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	\lesseqqgtr	\	\gtreqqless	\approx	$\$ thickapprox
$\stackrel{\frown}{\preccurlyeq}$	\preccurlyeq	≽	\succcurlyeq	\cong	\approxeq
\curlyeqprec	\curlyeqprec	\succcurlyeq	\curlyeqsucc	\sim	\backsim
\preceq	\precsim	\succeq	\succsim	\geq	\backsimeq
\lessapprox	\precapprox		\succapprox	F	\vDash
\subseteq	\subseteqq	∥U &Y	\supseteqq	\vdash	\Vdash
П	\shortparallel	\ni	\Supset	$\parallel \vdash$	\Vvdash
⋖	\blacktriangleleft	\Box	\sqsupset	€	\backepsilon
\triangleright	\vert vartriangleright	•.•	\because	\propto	\varpropto
•	\blacktriangleright	€	\Subset	Ŏ	\between
\trianglerighteq	\trianglerighteq	$\overline{}$	\smallfrown	ф	\pitchfork
\triangleleft	\vartriangleleft	1	\slashortmid	\smile	\smallsmile
\leq	\trianglelefteq	∴.	\therefore		\sqsubset

Table 3.17: $\mathcal{A}_{\mathcal{M}}\mathcal{S}$ Arrows.

←	\dashleftarrow	>	\dashrightarrow
otin	\leftleftarrows	\Rightarrow	\rightrightarrows
$\stackrel{\longleftarrow}{\longrightarrow}$	$\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $	\rightleftharpoons	\rightleftarrows
\Leftarrow	\Lleftarrow	\Rightarrow	\Rrightarrow
₩	\t twoheadleftarrow	\longrightarrow	\t twoheadrightarrow
\longleftrightarrow	\leftarrowtail	\rightarrowtail	\rightarrowtail
$\stackrel{\longleftarrow}{}$	$\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $	\rightleftharpoons	\rightleftharpoons
$ \uparrow $	\Lsh	ightharpoons	\Rsh
$\leftarrow\!$	\looparrowleft	\hookrightarrow	$\label{looparrowright}$
$ \leftarrow $	\curvearrowleft	\curvearrowright	\curvearrowright
Q	\circlearrowleft	\bigcirc	\circlearrowright
-	$\mbox{\mbox{\tt multimap}}$	$\uparrow\uparrow$	\upuparrows
$\downarrow \downarrow$	\downdownarrows	1	\upharpoonleft
1	\upharpoonright	ļ	\downharpoonright
~→	\rightsquigarrow	~~~	\leftrightsquigarrow

Table 3.18: $\mathcal{A}\!\mathcal{M}\!\mathcal{S}$ Negated Binary Relations and Arrows.

\$	\nless	\nearrow	\ngtr	\nsubseteq	\varsubsetneqq
≤	\lneq	\geq	\gneq	$ \supseteq $	\varsupsetneqq
≰	\nleq	≱	\ngeq	$\not\sqsubseteq$	\nsubseteqq
≰	\nleqslant	$\not\geq$	\ngeqslant	$ \not\equiv$	\nsupseteqq
≨	\lneqq	\geq	\gneqq	1	\nmid
$\stackrel{ ext{ ext{ ext{\left}}}}{=}$	\lvertneqq	\geqq	\gvertneqq	#	\nparallel
≰	\nleqq	$\not \geq$	\ngeqq	ł	\nshortmid
≢ ≤≈	\lnsim	<i>.</i> ≈	\gnsim	Ħ	\nshortparallel
≨	\lnapprox	≥	\gnapprox	~	\nsim
*	\nprec	7	\nsucc	\ncong	\ncong
\npreceq	\npreceq	$\not\succeq$	\nsucceq	$\not\vdash$	\nvdash
$\not\equiv$	\precneqq	$\not\succeq$	\succneqq	¥	\nvDash
$\not\gtrsim$	\precnsim	≿ ∻	\succnsim	\mathbb{H}	\nVdash
~ ≈	\precnapprox	∠æ	\succnapprox	$\not\Vdash$	\nVDash
Ç	\subsetneq	\supseteq	\supsetneq		\ntriangleleft
$\not\subseteq$	\varsubsetneq	\supseteq	\varsupsetneq	$\not\!$	\n
$\not\subseteq$	\nsubseteq	$\not\supseteq$	\nsupseteq	⊉	\ntrianglelefteq
\subseteq	\subsetneqq	\supseteq	\supsetneqq	$\not\trianglerighteq$	\ntrianglerighteq
\leftarrow	\nleftarrow	$\rightarrow \rightarrow$	\nrightarrow	$\leftrightarrow \rightarrow$	\nleftrightarrow
#	\nLeftarrow	\Rightarrow	\nRightarrow	\Leftrightarrow	\n

Table 3.19: $\mathcal{A}_{\mathcal{M}}\mathcal{S}$ Miscellaneous.

\hbar	\hbar	\hbar	\hslash	\Bbbk	\Bbbk
	\square		\blacksquare	\odot	\circledS
\triangle	\vert vartriangle	A	\blacktriangle	С	\complement
∇	\triangledown	▼	$\blue{location}$	G	\Game
\Diamond	\lozenge	♦	\blacklozenge	*	\bigstar
_	\angle	4	\measuredangle		
/	\diagup		\diagdown	1	\backprime
∄	\nexists	Ь	\Finv	Ø	\varnothing
\eth	\eth	∢	\sphericalangle	Ω	\mho