APPENDIX

A

Math symbol tables

A.1 Hebrew and Greek letters

Hebrew letters

Type	Typeset
`\aleph`	א
`\beth`	ב
`\daleth`	ד
`\gimel`	ג

G. Grätzer, *More Math Into* LaTeX, DOI 10.1007/978-3-319-23796-1

Greek letters

Lowercase

Type	Typeset	Type	Typeset	Type	Typeset
`\alpha`	α	`\iota`	ι	`\sigma`	σ
`\beta`	β	`\kappa`	κ	`\tau`	τ
`\gamma`	γ	`\lambda`	λ	`\upsilon`	υ
`\delta`	δ	`\mu`	μ	`\phi`	ϕ
`\epsilon`	ϵ	`\nu`	ν	`\chi`	χ
`\zeta`	ζ	`\xi`	ξ	`\psi`	ψ
`\eta`	η	`\pi`	π	`\omega`	ω
`\theta`	θ	`\rho`	ρ		
`\varepsilon`	ε	`\varpi`	ϖ	`\varsigma`	ς
`\vartheta`	ϑ	`\varrho`	ϱ	`\varphi`	φ
	`\digamma`	$\digamma$	`\varkappa`	$\varkappa$	

Uppercase

Type	Typeset	Type	Typeset	Type	Typeset
`\Gamma`	Γ	`\Xi`	Ξ	`\Phi`	Φ
`\Delta`	Δ	`\Pi`	Π	`\Psi`	Ψ
`\Theta`	Θ	`\Sigma`	Σ	`\Omega`	Ω
`\Lambda`	Λ	`\Upsilon`	Υ		
`\varGamma`	$\varGamma$	`\varXi`	$\varXi$	`\varPhi`	$\varPhi$
`\varDelta`	$\varDelta$	`\varPi`	$\varPi$	`\varPsi`	$\varPsi$
`\varTheta`	$\varTheta$	`\varSigma`	$\varSigma$	`\varOmega`	$\varOmega$
`\varLambda`	$\varLambda$	`\varUpsilon`	$\varUpsilon$		

A.2 Binary relations

Type	Typeset	Type	Typeset
`<`	$<$	`>`	$>$
`=`	$=$	`:`	$:$
`\in`	$\in$	`\ni` or `\owns`	$\ni$
`\leq` or `\le`	$\leq$	`\geq` or `\ge`	$\geq$
`\ll`	$\ll$	`\gg`	$\gg$
`\prec`	$\prec$	`\succ`	$\succ$
`\preceq`	$\preceq$	`\succeq`	$\succeq$
`\sim`	$\sim$	`\approx`	$\approx$
`\simeq`	$\simeq$	`\cong`	$\cong$
`\equiv`	$\equiv$	`\doteq`	$\doteq$
`\subset`	$\subset$	`\supset`	$\supset$
`\subseteq`	$\subseteq$	`\supseteq`	$\supseteq$
`\sqsubseteq`	$\sqsubseteq$	`\sqsupseteq`	$\sqsupseteq$
`\smile`	$\smile$	`\frown`	$\frown$
`\perp`	$\perp$	`\models`	$\models$
`\mid`	$\mid$	`\parallel`	$\parallel$
`\vdash`	$\vdash$	`\dashv`	$\dashv$
`\propto`	$\propto$	`\asymp`	$\asymp$
`\bowtie`	$\bowtie$		
`\sqsubset`	$\sqsubset$	`\sqsupset`	$\sqsupset$
`\Join`	$\Join$		

Note the `\colon` command used in $f : x \to x^2$, typed as

```
f \colon x \to x^2
```

More binary relations

Type	Typeset	Type	Typeset
\leqq	$\leqq$	\geqq	$\geqq$
\leqslant	$\leqslant$	\geqslant	$\geqslant$
\eqslantless	$\eqslantless$	\eqslantgtr	$\eqslantgtr$
\lesssim	$\lesssim$	\gtrsim	$\gtrsim$
\lessapprox	$\lessapprox$	\gtrapprox	$\gtrapprox$
\approxeq	$\approxeq$		
\lessdot	$\lessdot$	\gtrdot	$\gtrdot$
\lll	$\lll$	\ggg	$\ggg$
\lessgtr	$\lessgtr$	\gtrless	$\gtrless$
\lesseqgtr	$\lesseqgtr$	\gtreqless	$\gtreqless$
\lesseqqgtr	$\lesseqqgtr$	\gtreqqless	$\gtreqqless$
\doteqdot	$\doteqdot$	\eqcirc	$\eqcirc$
\circeq	$\circeq$	\triangleq	$\triangleq$
\risingdotseq	$\risingdotseq$	\fallingdotseq	$\fallingdotseq$
\backsim	$\backsim$	\thicksim	$\thicksim$
\backsimeq	$\backsimeq$	\thickapprox	$\thickapprox$
\preccurlyeq	$\preccurlyeq$	\succcurlyeq	$\succcurlyeq$
\curlyeqprec	$\curlyeqprec$	\curlyeqsucc	$\curlyeqsucc$
\precsim	$\precsim$	\succsim	$\succsim$
\precapprox	$\precapprox$	\succapprox	$\succapprox$
\subseteqq	$\subseteqq$	\supseteqq	$\supseteqq$
\Subset	$\Subset$	\Supset	$\Supset$
\vartriangleleft	$\vartriangleleft$	\vartriangleright	$\vartriangleright$
\trianglelefteq	$\trianglelefteq$	\trianglerighteq	$\trianglerighteq$
\vDash	$\vDash$	\Vdash	$\Vdash$
\Vvdash	$\Vvdash$		
\smallsmile	$\smallsmile$	\smallfrown	$\smallfrown$
\shortmid	$\shortmid$	\shortparallel	$\shortparallel$
\bumpeq	$\bumpeq$	\Bumpeq	$\Bumpeq$
\between	$\between$	\pitchfork	$\pitchfork$
\varpropto	$\varpropto$	\backepsilon	$\backepsilon$
\blacktriangleleft	$\blacktriangleleft$	\blacktriangleright	$\blacktriangleright$
\therefore	$\therefore$	\because	$\because$

Negated binary relations

Type	Typeset	Type	Typeset
\neq or \ne	$\neq$	\notin	$\notin$
\nless	$\nless$	\ngtr	$\ngtr$
\nleq	$\nleq$	\ngeq	$\ngeq$
\nleqslant	$\nleqslant$	\ngeqslant	$\ngeqslant$
\nleqq	$\nleqq$	\ngeqq	$\ngeqq$
\lneq	$\lneq$	\gneq	$\gneq$
\lneqq	$\lneqq$	\gneqq	$\gneqq$
\lvertneqq	$\lvertneqq$	\gvertneqq	$\gvertneqq$
\lnsim	$\lnsim$	\gnsim	$\gnsim$
\lnapprox	$\lnapprox$	\gnapprox	$\gnapprox$
\nprec	$\nprec$	\nsucc	$\nsucc$
\npreceq	$\npreceq$	\nsucceq	$\nsucceq$
\precneqq	$\precneqq$	\succneqq	$\succneqq$
\precnsim	$\precnsim$	\succnsim	$\succnsim$
\precnapprox	$\precnapprox$	\succnapprox	$\succnapprox$
\nsim	$\nsim$	\ncong	$\ncong$
\nshortmid	$\nshortmid$	\nshortparallel	$\nshortparallel$
\nmid	$\nmid$	\nparallel	$\nparallel$
\nvdash	$\nvdash$	\nvDash	$\nvDash$
\nVdash	$\nVdash$	\nVDash	$\nVDash$
\ntriangleleft	$\ntriangleleft$	\ntriangleright	$\ntriangleright$
\ntrianglelefteq	$\ntrianglelefteq$	\ntrianglerighteq	$\ntrianglerighteq$
\nsubseteq	$\nsubseteq$	\nsupseteq	$\nsupseteq$
\nsubseteqq	$\nsubseteqq$	\nsupseteqq	$\nsupseteqq$
\subsetneq	$\subsetneq$	\supsetneq	$\supsetneq$
\varsubsetneq	$\varsubsetneq$	\varsupsetneq	$\varsupsetneq$
\subsetneqq	$\subsetneqq$	\supsetneqq	$\supsetneqq$
\varsubsetneqq	$\varsubsetneqq$	\varsupsetneqq	$\varsupsetneqq$

A.3 Binary operations

Type	Typeset	Type	Typeset
`+`	$+$	`-`	$-$
`\pm`	$\pm$	`\mp`	$\mp$
`\times`	$\times$	`\cdot`	$\cdot$
`\circ`	$\circ$	`\bigcirc`	$\bigcirc$
`\div`	$\div$	`\bmod`	$\bmod$
`\cap`	$\cap$	`\cup`	$\cup$
`\sqcap`	$\sqcap$	`\sqcup`	$\sqcup$
`\wedge` or `\land`	$\wedge$	`\vee` or `\lor`	$\vee$
`\triangleleft`	$\triangleleft$	`\triangleright`	$\triangleright$
`\bigtriangleup`	$\bigtriangleup$	`\bigtriangledown`	$\bigtriangledown$
`\oplus`	$\oplus$	`\ominus`	$\ominus$
`\otimes`	$\otimes$	`\oslash`	$\oslash$
`\odot`	$\odot$	`\bullet`	$\bullet$
`\dagger`	$\dagger$	`\ddagger`	$\ddagger$
`\setminus`	$\setminus$	`\smallsetminus`	$\smallsetminus$
`\wr`	$\wr$	`\amalg`	$\amalg$
`\ast`	$\ast$	`\star`	$\star$
`\diamond`	$\diamond$		
`\lhd`	$\lhd$	`\rhd`	$\rhd$
`\unlhd`	$\unlhd$	`\unrhd`	$\unrhd$
`\dotplus`	$\dotplus$	`\centerdot`	$\centerdot$
`\ltimes`	$\ltimes$	`\rtimes`	$\rtimes$
`\leftthreetimes`	$\leftthreetimes$	`\rightthreetimes`	$\rightthreetimes$
`\circleddash`	$\circleddash$	`\uplus`	$\uplus$
`\barwedge`	$\barwedge$	`\doublebarwedge`	$\doublebarwedge$
`\curlywedge`	$\curlywedge$	`\curlyvee`	$\curlyvee$
`\veebar`	$\veebar$	`\intercal`	$\intercal$
`\doublecap` or `\Cap`	$\Cap$	`\doublecup` or `\Cup`	$\Cup$
`\circledast`	$\circledast$	`\circledcirc`	$\circledcirc$
`\boxminus`	$\boxminus$	`\boxtimes`	$\boxtimes$
`\boxdot`	$\boxdot$	`\boxplus`	$\boxplus$
`\divideontimes`	$\divideontimes$	`\vartriangle`	$\vartriangle$
`\And`	$\And$		

A.4 Arrows

Type	Typeset	Type	Typeset
\leftarrow	←	\rightarrow or \to	→
\longleftarrow	⟵	\longrightarrow	⟶
\Leftarrow	⇐	\Rightarrow	⇒
\Longleftarrow	⟸	\Longrightarrow	⟹
\leftrightarrow	↔	\longleftrightarrow	⟷
\Leftrightarrow	⇔	\Longleftrightarrow	⟺
\uparrow	↑	\downarrow	↓
\Uparrow	⇑	\Downarrow	⇓
\updownarrow	↕	\Updownarrow	⇕
\nearrow	↗	\searrow	↘
\swarrow	↙	\nwarrow	↖
\iff	⟺	\mapstochar	↦
\mapsto	↦	\longmapsto	⟼
\hookleftarrow	↩	\hookrightarrow	↪
\leftharpoonup	↼	\rightharpoonup	⇀
\leftharpoondown	↽	\rightharpoondown	⇁
\leadsto	⇝		
\leftleftarrows	⇇	\rightrightarrows	⇉
\leftrightarrows	⇆	\rightleftarrows	⇄
\Lleftarrow	⇚	\Rrightarrow	⇛
\twoheadleftarrow	↞	\twoheadrightarrow	↠
\leftarrowtail	↢	\rightarrowtail	↣
\looparrowleft	↫	\looparrowright	↬
\upuparrows	⇈	\downdownarrows	⇊
\upharpoonleft	↿	\upharpoonright	↾
\downharpoonleft	⇃	\downharpoonright	⇂
\leftrightsquigarrow	↭	\rightsquigarrow	⇝
\multimap	⊸		
\nleftarrow	↚	\nrightarrow	↛
\nLeftarrow	⇍	\nRightarrow	⇏
\nleftrightarrow	↮	\nLeftrightarrow	⇎
\dashleftarrow	⇠	\dashrightarrow	⇢
\curvearrowleft	↶	\curvearrowright	↷
\circlearrowleft	↺	\circlearrowright	↻
\leftrightharpoons	⇋	\rightleftharpoons	⇌
\Lsh	↰	\Rsh	↱

A.5 Miscellaneous symbols

Type	Typeset	Type	Typeset
\hbar	$\hbar$	\ell	ℓ
\imath	$\imath$	\jmath	$\jmath$
\wp	$\wp$	\partial	∂
\Im	$\Im$	\Re	$\Re$
\infty	∞	\prime	$\prime$
\emptyset	$\emptyset$	\varnothing	$\varnothing$
\forall	$\forall$	\exists	$\exists$
\smallint	$\smallint$	\triangle	$\triangle$
\top	$\top$	\bot	$\bot$
\P	$\P$	\S	$\S$
\dag	$\dag$	\ddag	$\ddag$
\flat	$\flat$	\natural	$\natural$
\sharp	$\sharp$	\angle	$\angle$
\clubsuit	$\clubsuit$	\diamondsuit	$\diamondsuit$
\heartsuit	$\heartsuit$	\spadesuit	$\spadesuit$
\surd	$\surd$	\nabla	∇
\pounds	$\pounds$	\neg or \lnot	$\neg$
\Box	$\Box$	\Diamond	$\Diamond$
\mho	$\mho$		
\hslash	$\hslash$	\complement	$\complement$
\backprime	$\backprime$	\nexists	$\nexists$
\Bbbk	$\Bbbk$		
\diagup	$\diagup$	\diagdown	$\diagdown$
\blacktriangle	$\blacktriangle$	\blacktriangledown	$\blacktriangledown$
\triangledown	$\triangledown$	\eth	$\eth$
\square	$\square$	\blacksquare	$\blacksquare$
\lozenge	$\lozenge$	\blacklozenge	$\blacklozenge$
\measuredangle	$\measuredangle$	\sphericalangle	$\sphericalangle$
\circledS	$\circledS$	\bigstar	$\bigstar$
\Finv	$\Finv$	\Game	$\Game$

A.6 Delimiters

Name	Type	Typeset
left parenthesis	`(`	(
right parenthesis	`)`	)
left bracket	`[` or `\lbrack`	[
right bracket	`]` or `\rbrack`	]
left brace	`\{` or `\lbrace`	{
right brace	`\}` or `\rbrace`	}
backslash	`\backslash`	\
forward slash	`/`	/
left angle bracket	`\langle`	⟨
right angle bracket	`\rangle`	⟩
vertical line	`|` or `\vert`	|
double vertical line	`\\|` or `\Vert`	‖
left floor	`\lfloor`	⌊
right floor	`\rfloor`	⌋
left ceiling	`\lceil`	⌈
right ceiling	`\rceil`	⌉
upward	`\uparrow`	↑
double upward	`\Uparrow`	⇑
downward	`\downarrow`	↓
double downward	`\Downarrow`	⇓
up-and-down	`\updownarrow`	↕
double up-and-down	`\Updownarrow`	⇕
upper-left corner	`\ulcorner`	⌜
upper-right corner	`\urcorner`	⌝
lower-left corner	`\llcorner`	⌞
lower-right corner	`\lrcorner`	⌟

A.7 Operators

"Pure" operators, with no limits

Type	Typeset	Type	Typeset	Type	Typeset	Type	Typeset
`\arccos`	arccos	`\cot`	cot	`\hom`	hom	`\sin`	sin
`\arcsin`	arcsin	`\coth`	coth	`\ker`	ker	`\sinh`	sinh
`\arctan`	arctan	`\csc`	csc	`\lg`	lg	`\tan`	tan
`\arg`	arg	`\deg`	deg	`\ln`	ln	`\tanh`	tanh
`\cos`	cos	`\dim`	dim	`\log`	log		
`\cosh`	cosh	`\exp`	exp	`\sec`	sec		

Operators with limits

Type	Typeset	Type	Typeset
`\det`	det	`\limsup`	lim sup
`\gcd`	gcd	`\max`	max
`\inf`	inf	`\min`	min
`\lim`	lim	`\Pr`	Pr
`\liminf`	lim inf	`\sup`	sup
`\injlim`	inj lim	`\projlim`	proj lim
`\varliminf`	$\underline{\lim}$	`\varlimsup`	$\overline{\lim}$
`\varinjlim`	$\varinjlim$	`\varprojlim`	$\varprojlim$

A.7.1 Large operators

Type	Inline	Displayed
`\int_{a}^{b}`	$\int_a^b$	$\displaystyle\int_a^b$
`\oint_{a}^{b}`	$\oint_a^b$	$\displaystyle\oint_a^b$
`\iint_{a}^{b}`	$\iint_a^b$	$\displaystyle\iint_a^b$
`\iiint_{a}^{b}`	$\iiint_a^b$	$\displaystyle\iiint_a^b$
`\iiiint_{a}^{b}`	$\iiiint_a^b$	$\displaystyle\iiiint_a^b$
`\idotsint_{a}^{b}`	$\int\cdots\int_a^b$	$\displaystyle\int\cdots\int_a^b$
`\prod_{i=1}^{n}`	$\prod_{i=1}^{n}$	$\displaystyle\prod_{i=1}^{n}$
`\coprod_{i=1}^{n}`	$\coprod_{i=1}^{n}$	$\displaystyle\coprod_{i=1}^{n}$
`\bigcap_{i=1}^{n}`	$\bigcap_{i=1}^{n}$	$\displaystyle\bigcap_{i=1}^{n}$
`\bigcup_{i=1}^{n}`	$\bigcup_{i=1}^{n}$	$\displaystyle\bigcup_{i=1}^{n}$
`\bigwedge_{i=1}^{n}`	$\bigwedge_{i=1}^{n}$	$\displaystyle\bigwedge_{i=1}^{n}$
`\bigvee_{i=1}^{n}`	$\bigvee_{i=1}^{n}$	$\displaystyle\bigvee_{i=1}^{n}$
`\bigsqcup_{i=1}^{n}`	$\bigsqcup_{i=1}^{n}$	$\displaystyle\bigsqcup_{i=1}^{n}$
`\biguplus_{i=1}^{n}`	$\biguplus_{i=1}^{n}$	$\displaystyle\biguplus_{i=1}^{n}$
`\bigotimes_{i=1}^{n}`	$\bigotimes_{i=1}^{n}$	$\displaystyle\bigotimes_{i=1}^{n}$
`\bigoplus_{i=1}^{n}`	$\bigoplus_{i=1}^{n}$	$\displaystyle\bigoplus_{i=1}^{n}$
`\bigodot_{i=1}^{n}`	$\bigodot_{i=1}^{n}$	$\displaystyle\bigodot_{i=1}^{n}$
`\sum_{i=1}^{n}`	$\sum_{i=1}^{n}$	$\displaystyle\sum_{i=1}^{n}$

A.8 Math accents and fonts

Math accents

		amsxtra	
Type	Typeset	Type	Typeset
\acute{a}	$\acute{a}$		
\bar{a}	$\bar{a}$		
\breve{a}	$\breve{a}$	\spbreve	$\spbreve$
\check{a}	$\check{a}$	\spcheck	$\spcheck$
\dot{a}	$\dot{a}$	\spdot	$\spdot$
\ddot{a}	$\ddot{a}$	\spddot	$\spddot$
\dddot{a}	$\dddot{a}$	\spdddot	$\spdddot$
\ddddot{a}	$\ddddot{a}$		
\grave{a}	$\grave{a}$		
\hat{a}	$\hat{a}$		
\widehat{a}	$\widehat{a}$	\sphat	$\sphat$
\mathring{a}	$\mathring{a}$		
\tilde{a}	$\tilde{a}$		
\widetilde{a}	$\widetilde{a}$	\sptilde	$\sptilde$
\vec{a}	$\vec{a}$		

Math fonts

Type	Typeset
LaTeX	
\mathbf{A}	$\mathbf{A}$
\mathcal{A}	$\mathcal{A}$
\mathit{A}	A
\mathnormal{A}	$\mathnormal{A}$
\mathrm{A}	A
\mathsf{A}	A
\mathtt{A}	$\mathtt{A}$
\boldsymbol{\alpha}	$\boldsymbol{\alpha}$
\mathbb{A}	$\mathbb{A}$
\mathfrak{A}	$\mathfrak{A}$
\mathscr{a}	$\mathscr{a}$

And thousand more from STIX (see Section 6.2)!
\mathscr requires the eucal package with the mathscr option

A.9 Math spacing commands

Name	Width	Short	Long
1 mu (math unit)		`\mspace{1mu}`	
thinspace		`\,`	`\thinspace`
medspace		`\:`	`\medspace`
thickspace		`\;`	`\thickspace`
interword space		`\␣`	
1 em			`\quad`
2 em			`\qquad`
Negative space			
1 mu			`\mspace{-1mu}`
thinspace		`\!`	`\negthinspace`
medspace			`\negmedspace`
thickspace			`\negthickspace`

APPENDIX

B

Text symbol tables

B.1 Some European characters

Name	Type	Typeset	Type	Typeset
a-ring	`\aa`	å	`\AA`	Å
aesc	`\ae`	æ	`\AE`	Æ
ethel	`\oe`	œ	`\OE`	Œ
eszett	`\ss`	ß	`\SS`	SS
inverted question mark	`?‘`	¿		
inverted exclamation mark	`!‘`	¡		
slashed L	`\l`	ł	`\L`	Ł
slashed O	`\o`	ø	`\O`	Ø

G. Grätzer, *More Math Into* LaTeX, DOI 10.1007/978-3-319-23796-1

B.2 Text accents

Name	Type	Typeset	Name	Type	Typeset
acute	`\'{o}`	ó	macron	`\={o}`	ō
breve	`\u{o}`	ŏ	overdot	`\.{g}`	ġ
caron/haček	`\v{o}`	ǒ	ring	`\r{u}`	ů
cedilla	`\c{c}`	ç	tie	`\t{oo}`	o͡o
circumflex	`\^{o}`	ô	tilde	`\~{n}`	ñ
dieresis/umlaut	`\"{u}`	ü	underdot	`\d{m}`	ṃ
double acute	`\H{o}`	ő	underbar	`\b{o}`	o̲
grave	`\`{o}`	ò			
dotless i	`\i`	ı	dotless j	`\j`	ȷ
	`\'{\i}`	í		`\v{\j}`	ǰ

B.3 Text font commands

B.3.1 Text font family commands

Command with Argument	Command Declaration	Switches to the font family
`\textnormal{...}`	`{\normalfont ...}`	document
`\emph{...}`	`{\em ...}`	*emphasis*
`\textrm{...}`	`{\rmfamily ...}`	roman
`\textsf{...}`	`{\sffamily ...}`	sans serif
`\texttt{...}`	`{\ttfamily ...}`	`typewriter style`
`\textup{...}`	`{\upshape ...}`	upright shape
`\textit{...}`	`{\itshape ...}`	*italic shape*
`\textsl{...}`	`{\slshape ...}`	*slanted shape*
`\textsc{...}`	`{\scshape ...}`	SMALL CAPITALS
`\textbf{...}`	`{\bfseries ...}`	**bold**
`\textmd{...}`	`{\mdseries ...}`	normal weight and width

B.3.2 Text font size changes

Command	LaTeX sample text	AMS sample text
`\Tiny`	[not available]	sample text
`\tiny`	sample text	sample text
`\SMALL` or `\scriptsize`	sample text	sample text
`\Small` or `\footnotesize`	sample text	sample text
`\small`	sample text	sample text
`\normalsize`	sample text	sample text
`\large`	sample text	sample text
`\Large`	sample text	sample text
`\LARGE`	sample text	sample text
`\huge`	sample text	sample text
`\Huge`	sample text	sample text

B.4 Additional text symbols

Name	Type	Typeset
ampersand	`\&`	&
asterisk bullet	`\textasteriskcentered`	*
backslash	`\textbackslash`	\
bar (caesura)	`\textbar`	|
brace left	`\{`	{
brace right	`\}`	}
bullet	`\textbullet`	•
circled a	`\textcircled{a}`	ⓐ
circumflex	`\textasciicircum`	^
copyright	`\copyright`	©
dagger	`\dag`	†
double dagger (diesis)	`\ddag`	‡
dollar	`\$`	$
double quotation left	`\textquotedblleft` or ‘‘	“
double quotation right	`\textquotedblright` or ’’	”
em dash	`\textemdash` or `---`	—
en dash	`\textendash` or `--`	–
exclamation down	`\textexclamdown` or `!‘`	¡
greater than	`\textgreater`	>
less than	`\textless`	<
lowline	`\_`	_
midpoint	`\textperiodcentered`	·
octothorp	`\#`	#
percent	`\%`	%
pilcrow (paragraph)	`\P`	¶
question down	`\textquestiondown` or `?‘`	¿
registered trademark	`\textregistered`	®
section	`\S`	§

Additional text symbols, *continued*

Name	Type	Typeset
single quote left	`\textquoteleft` or ‘	‘
single quote right	`\textquoteright` or ’	’
sterling	`\pounds`	£
superscript	`\textsuperscript{a}`	ª
tilde	`\textasciitilde`	~
trademark	`\texttrademark`	™
visible space	`\textvisiblespace`	␣

For the `\textsubscript` command, see Section 10.3.

B.5 Additional text symbols with T1 encoding

An accent

Name	Type	Typeset
Ogonek	`\k{e}`	ę

European characters

Name	Type	Typeset	Type	Typeset
Eth	`\dh`	ð	`\DH`	Ð
Dyet	`\dj`	đ	`\DJ`	Đ
Eng	`\ng`	ŋ	`\NG`	Ŋ
Thorn	`\th`	þ	`\TH`	Þ

Quotation marks

Name	Type	Typeset	Type	Typeset
Single Guillemet	`\guilsinglleft`	‹	`\guilsinglright`	›
Double Guillemet	`\guillemotleft`	«	`\guillemotright`	»
Single Quotation	`\quotesinglbase`	‚	`\textquoteright`	’
Double Quotation	`\quotedblbase`	„	`\textquotedbl`	"

B.6 Text spacing commands

Name	Width	Short command	Long command
Positive Space			
Normal	varies	␣	
Intersentence	varies	\@.␣	
Interword	varies	\␣	
Italic Corr.	varies	\/␣	
Tie	varies	~	
Thinspace	▯	\,	\thinspace
Medspace	▯	\:	\medspace
Thickspace	▯	\;	\thickspace
1 em	⌊⌋		\quad
2 em	⌊——⌋		\qquad
Negative Space			
Thinspace	▯	\!	\negthinspace
Medspace	▯		\negmedspace
Thickspace	▯		\negthickspace

APPENDIX

C

Some background

In this book we define LaTeX as the foundation TeX, the work platform LaTeX, and the superstructure AMS packages rolled into one. While you do not need to know anything about LaTeX's detailed structure and history to use it, such knowledge may help you understand how and why LaTeX works the way it does.

In Section C.1, we present a short history of LaTeX, where it has come from and where it is going. Section C.2 provides a description of how LaTeX works. In Section C.3 the various prompts are defined and Section C.4 discusses the separation of visual and logical design elements.

C.1 A short history

C.1.1 TeX

Donald E. Knuth's multivolume work, *The Art of Computer Programming* [47], caused its author a great deal of frustration because it was very difficult to keep the volumes typographically uniform. To solve this problem, Knuth decided to create his own typesetting language. The result is described in *The* TeX*book* [48].

G. Grätzer, *More Math Into* LaTeX, DOI 10.1007/978-3-319-23796-1

A mathematical typesetting language takes care of the multitude of details that are so important in mathematical typesetting, including

- Spacing formulas properly
- Breaking text into pleasingly typeset lines and paragraphs
- Hyphenating words where necessary
- Providing hundreds of symbols for typesetting mathematics

LaTeX does all this and more on almost any computer: Windows computer, Mac, UNIX, workstation, or mainframe. You can write your document on a Windows computer and e-mail it to a coworker who makes corrections on a Mac. The final manuscript might be sent to a publisher who uses a UNIX computer to prepare the document for printing.

Knuth realized that typesetting is only half the solution to the manuscript production problem. You also need a style designer—a specialist who determines what fonts to use, how large a vertical space to put before and after a theorem, and numerous other design issues.

C.1.2 LaTeX 2.09 *and* AMS-TeX

Knuth also realized that typesetting a complex document in TeX requires a very knowledgeable user. So TeX was designed as a platform on which *convenient work environments*—macro packages—could be built, more suitable for the average user to work with. It is somewhat unfortunate that *two* such platforms were made available to the mathematical community in the early 1980s, AMS-TeX and LaTeX.

AMS-TeX was written by Michael D. Spivak for the American Mathematical Society, whereas LaTeX was developed by Leslie Lamport. The strengths of the two systems were somewhat complementary. AMS-TeX provided many features needed by mathematical articles, including

- Sophisticated math typesetting capabilities
- Extensive options for formatting multiline formulas
- Flexible bibliographic references

LaTeX also provided many features, including

- The use of logical units to separate the logical and the visual design of an article
- Automatic numbering and cross-referencing
- Bibliographic databases

Both AMS-TeX and LaTeX became very popular, causing a split in the mathematical community as some chose one system over the other.

C.1.3 LaTeX 3

When Lamport decided not to develop LaTeX any further, the LaTeX 3 *team*[1] took over with the aim of actively supporting, maintaining, and updating LaTeX.

The goals for LaTeX 3 are very ambitious. LaTeX 3 will

- Provide high-quality typesetting for a wide variety of document types and typographic requirements
- Support direct formatting commands for editors and designers, which are essential to the fine-tuning of document layout and page design
- Process complex structured documents and support a document syntax that allows automatic translation of documents conforming to the international document-type definition standard SGML (Standard Generalized Markup Language, ISO 8879)
- Provide a common foundation for a number of incompatible LaTeX variants that have been developed, including the old LaTeX 2.09, LaTeX with the New Font Selection Scheme, and AMS-LaTeX

See two articles by Frank Mittelbach and Chris Rowley, LaTeX *2.09* → LaTeX *3* [57], 1992, and *The* LaTeX *3 Project* [59], 1994, for a statement of goals. Go to `The LaTeX3 project` at
http://www.latex-project.org/latex3.html
for more up-to-date articles and reports.

A number of LaTeX 3 projects have already been completed and are part of LaTeX, including:

The New Font Selection Scheme LaTeX uses Knuth's Computer Modern fonts. The New Font Selection Scheme, NFSS, of Frank Mittelbach and Rainer Schöpf, written in 1989, allows the *independent changing* of font attributes and the integration of new font families into LaTeX. With the proliferation of PostScript fonts and printers, more and more users want to use PostScript fonts in their LaTeX documents.

New and improved environments Frank Mittelbach wrote a new multicolumn environment and Rainer Schöpf improved the `verbatim` and `comment` environments. There have also been several improvements made to the `tabular` and `array` environments. The extremely important `graphicx` package by David Carlisle and Sebastian Rahtz was released.

[1] A talented group of mathematicians and programmers, Frank Mittelbach, Chris Rowley, and Rainer Schöpf. The group has since expanded with the addition of Johannes Braams, David Carlisle, Michael Downes, Denys Duchier, Robin Fairbairns, Alan Jeffrey, and Martin Schröder; many volunteers have also contributed to the project. The current LaTeX 3 project team personnel are: Frank Mittelbach, Rainer Schöpf, Chris Rowley, David Carlisle, Johannes Braams, Robin Fairbairns, Morten Høgholm, Thomas Lotze, Javier Bezos, Will Robertson, Joseph Wright, and Bruno Le Floch.

The first interim solution

In 1990, the AMS released AMS-LaTeX , version 1.0—see Rainer Schöpf's *Foreword* to this book for a personal account. This release contained

- AMS-TeX recoded to work with LaTeX
- The NFSS styles for proclamations
- The new `verbatim` environment

AMS-LaTeX , version 1.0, is a LaTeX *dialect*. It was incompatible with the then current LaTeX—version 2.09.

While the LaTeX 3 team wanted to unify the mathematical community, this first attempt by the AMS split it even further apart. Many AMS-TeX users simply refused to switch. Even today, 17 years later, many mathematicians cling to AMS-TeX. Even the LaTeX community was split into users of the old LaTeX, those whose LaTeX incorporated the NFSS, and AMS-LaTeX users.

The second interim solution

When it became obvious that the goals of LaTeX 3 could not be fulfilled any time soon, the LaTeX 3 team decided to issue a new version of LaTeX, version 2e (also called LaTeXe) in June of 1994. This version replaced LaTeX 2.09, see the two Mittelbach and Rowley articles cited above. This interim release accomplished some of LaTeX 3's goals, including the projects listed previously. Since then, LaTeXe (called LaTeX today) has become accepted as the standard LaTeX.

In February of 1995, the AMS released version 1.2 of AMS-LaTeX (which I call the AMS packages in this book) built on top of the new LaTeX. Michael Downes was the project leader.

The changes in AMS-LaTeX were substantial. The `align` environment, for example, was completely rewritten by David M. Jones. The recoded AMS-TeX had now become a LaTeX package, `amsmath`.

It is extremely important to note that while AMS-LaTeX 1.0 and 1.1 were monolithic structures, versions 1.2 and 2.0 (see Section C.1.4) are just collections of packages that fit nicely into the LaTeX model. You can use one AMS package or all, by themselves or mixed with other LaTeX packages. This book was typeset using the LaTeX document class (`book`) and the AMS packages, version 2.13, along with a number of other LaTeX (non-AMS) packages.

C.1.4 More recent developments

Since 1996, changes to LaTeX have been minor. A few new symbols have been added. Much work has been done on character encoding and LM (Latin Modern) fonts by Bogusław Jackowski and Janusz M. Nowacki to extend LaTeX to languages other than American English (see Appendixes E and F).

In 1999, the American Mathematical Society released version 2.0 of the AMS packages and in 2004, version 2.2. About the same time, a consortium (made up of the AMS, Blue Sky Research, and Y&Y) released free PostScript versions of the CM and AMS fonts. These PostScript fonts are now part of any LaTeX distribution.

Interestingly, there are still those who argue that the AMS packages are not part and parcel of LaTeX and typesetting math. In life, almost everything is a compromise, in software design, even more so. Using the AMS packages to typeset math is an exception. It costs you nothing—if you do not need their features for a document, then you don't have to use them. You need not sacrifice anything in order to have the power of the AMS packages available when you need them. This is why, in this book, by LaTeX we mean LaTeX with the AMS packages.

C.2 How LaTeX works

In this section, I present a very simplified overview of the inner workings of LaTeX.

C.2.1 The layers

TeX and LaTeX consist of many layers. These include:

`virtex` TeX's core, containing about 350 primitive commands such as

```
input   accent   hsize
```

`virtex` can also read *format files,* which are precompiled sets of commands. LaTeX is nothing more than `virtex` reading in a large set of commands, built layer upon layer.

`plain.tex` The most basic layer built on `virtex`. It adds about 600 commands to `virtex`. When you invoke the `TeX` command, `virtex` loads the `plain` format, which is the default. The core TeX commands combined with the commands defined by the `plain` format are called Plain TeX.

Plain TeX is described in detail in Appendix B of Knuth's *The* TeX*book* [48]. You can also read `plain.tex`, a text file in the LaTeX distribution. Plain TeX is powerful enough that you could do all your work in it. This approach is advocated by many, including Michael Doob in his book, TeX *Starting from* 1 [12].

`virtex` cannot build (compile) format files. For that you need another version of TeX called `initex`, which loads the most basic information a format needs, such as the hyphenation tables and `plain.tex`, and creates a format file.

LaTeX

LaTeX is a format file containing a compiled set of commands written by Leslie Lamport and others. It provides tools for logical document design, automatic numbering and

cross-referencing, tables of contents, and many other features. The new LaTeX we are using is under the control of the LaTeX3 group.

Document classes

The document class forms the next layer. You may choose

- `amsart`, `amsbook`, or `amsproc`, provided by the AMS
- `article`, `book`, `letter`, `proc`, `report`, or `slides`, the legacy classes
- or any one of a large (and growing) number of other document classes provided by publishers of books and journals, universities, and other interested parties

Packages

The next layer is made up of the packages loaded by the document. You can use standard LaTeX packages, AMS packages, or any of hundreds of other packages in the LaTeX universe, mixed together as necessary. Any package may require other packages, or may automatically load other packages.

Documents

At the top of this hierarchy sit your documents, with their custom commands and environments, utilizing all the power derived from the layers below.

C.2.2 Typesetting

When typesetting, LaTeX uses two basic types of files, the source files and the font metric files.

A font metric file is designed to hold the information for a font of a given size and style. Each LaTeX font metric file, called a `tfm` file, contains the size of each character, the kerning (the space placed between two adjacent characters), the length of the italic correction, the size of the interword space, and so on. A typical `tfm` file is `cmr10.tfm`, which is the LaTeX font metric file for the font `cmr` (CM roman) at 10-point size.

LaTeX reads the source file one line at a time. It converts the characters of each line into a *token sequence*. A token is either a character—together with an indication of what role the character plays—or a command. The argument of a command is the token following it unless a group enclosed in braces follows it, in which case the contents of the group becomes the argument.[2] An example of this behavior can be seen when you specify an exponent. LaTeX looks for the next token as the exponent unless a group enclosed in braces follows the `^` symbol. This explains why `$2^3$` and `$2^\alpha$`

[2] Delimited commands work somewhat differently (see Section 14.1.9).

work, but `$2^\mathfrak{m}$` does not. Indeed, `3` and `\alpha` each become a single token but `\mathfrak{m}` becomes more than one, four, in fact. Of course, if you *always* use braces, as in

```
$2^{3}$, $2^{\alpha}$, $2^{\mathfrak{m}}$
```

then you never have to think about tokens to type such expressions.

After tokenizing the text, LaTeX hyphenates it and attempts to split the paragraph into lines of the required width. The measurements of the characters—also called glyphs—are absolute, as are the distances between characters—called kerning. The spaces, interword space, intersentence space, and so on, are made of *glue* or rubber length (see Section 14.5.2). Glue has three parameters:

- the length of the space
- stretchability, the amount by which it can be made longer
- shrinkability, the amount by which it can be made shorter

LaTeX stretches and shrinks glue to form lines of equal length.

LaTeX employs a formula to measure how much stretching and shrinking is necessary in a line. The result is called badness. A badness of 0 is perfect, while a badness of 10,000 is very bad. Lines that are too wide are reported with messages such as

```
Overfull \hbox (5.61168pt too wide) in paragraph
                at lines 49--57
```

The badness of a line that is stretched too much is reported as follows:

```
Underfull \hbox (badness 1189) in paragraph
                at lines 93--93
```

Once enough paragraphs are put together, LaTeX composes a page from the typeset paragraphs using vertical glue. A short page generates a warning message such as

```
Underfull \vbox (badness 10000) has
occurred while \output is active
```

The typeset file is stored as a `dvi` (Device Independent) file or a PDF file.

C.2.3 Viewing and printing

Viewing and printing LaTeX's typeset output are not really part of LaTeX proper, but they are obviously an important part of your work environment. The printer driver prints the `dvi` and PDF files, and the video driver lets you view them on your monitor.

C.2.4 LaTeX's files

Auxiliary files

LaTeX is a *one-pass compiler,* that is, it reads the source file once only for typesetting. As a result, LaTeX must use auxiliary files to store information it generates during a run. For each typesetting run, LaTeX uses the auxiliary files compiled during the *previous* typesetting run. This mechanism explains why you have to typeset twice or more (see Section 17.2) to make sure that changes you have made to the source files are reflected in the typeset document. Such an auxiliary file has the same base name as the source file, the extension indicates its type.

The most important auxiliary file, the `aux` file, contains a great deal of information about the document, most importantly, the data needed for symbolic referencing. Here are two typical entries:

```
\newlabel{struct}{{5}{2}}
\bibcite{eM57a}{4}
```

The first entry indicates that a new symbolic reference was introduced on page 2 of the typeset document in Section 5 using the command

```
\label{struct}
```

The command `\ref{struct}` produces 5, while `\pageref{struct}` yields 2.

The second entry indicates that the bibliographic entry with label `eM57a` has been assigned the number 4, so `\cite{eM57a}` produces [4].

There is an `aux` file for the source file being processed, and another one for each file included in the main file by an `\include` command.

No auxiliary file is written if the `\nofiles` command is given. The message

```
No auxiliary output files.
```

in the `log` file reminds you that `\nofiles` is in effect.

The `log` file contains all the information shown in the `log` window during the typesetting. The `dvi` file contains the typeset version of the source file.

There are five auxiliary files that store information for special tasks. They are written only if that special task is invoked by a command and there is no `\nofiles` command. The additional auxiliary files are

`glo` Contains the glossary entries produced by `\glossary` commands. A new file is written only if there is a

```
\makeglossary
```

command in the source file (see Section 16.6).

`lof` Contains the entries used to compile a list of figures. A new file is written only if there is a

```
\listoffigures
```

command in the source file (see Section 8.4.3).

`lot` Contains the entries used to compile a list of tables. A new file is written only if there is a

```
\listoftables
```

command in the source file (see Section 8.4.3).

`toc` Contains the entries used to compile a table of contents. A new file is written only if there is a

```
\tableofcontents
```

command in the source file (see Section 17.2).

For information about the auxiliary files created by BibTeX and *MakeIndex,* see Sections 15.2.3 and 16.3, respectively. Some classes and packages create additional auxiliary files (see Section 11.2.3 for an example).

Versions

A complete LaTeX distribution consists of hundreds of files, all of which interact in some way. Since most of these files have had many revisions, you should make sure that they are all up-to-date and compatible with each other. You can check the version numbers and dates by reading the first few lines of each file in a text editor or by checking the dates and version numbers that are shown on the list created by the command `\listfiles`, which I discuss later in this section.

LaTeX has been updated every year. While writing this book, I used the version of LaTeX that was issued on May 5, 2014.

When you typeset a LaTeX document, LaTeX prints its release date in the `log` file with a line such as

```
LaTeX2e <2014/05/01>
```

If you use a LaTeX feature that was introduced recently, you can put a command such as the following into the preamble of your source file:

```
\NeedsTeXFormat{LaTeX2e}[2008/12/01]
```

This command specifies the date of the oldest version of LaTeX that may be used to typeset your file. If someone attempts to typeset your file with an older version, LaTeX generates a warning.

The AMS math package `amsmath` is at version 2.13, the document classes at version 2.26, and the AMSFonts set is at version 2.2d. See Section D.1 for more information on obtaining updated versions.

If you include the `\listfiles` command in the preamble of your document, then the `log` file contains a detailed listing of all the files used in the typesetting of your document. Here are the first few (truncated) lines from such a listing:

```
*File List*
   book.cls    1999/01/07 v1.4a Standard LaTeX document class
  leqno.clo    1998/08/17 v1.1c Standard LaTeX option
                  (left equation numbers)
   bk10.clo    2007/10/19 v1.4h Standard LaTeX file (size option)
   MiL5.sty    2014/12/15 Commands for MiL5
amsmath.sty    2013/01/14 v2.14 AMS math features
amstext.sty    2000/06/29 v2.01
 amsgen.sty    1999/11/30 v2.0
 amsbsy.sty    1999/11/29 v1.2d
 amsopn.sty    1999/12/14 v2.01 operator names
 amsthm.sty    2004/08/06 v2.20
verbatim.sty   2003/08/22 v1.5q LaTeX2e package for
                  verbatim enhancements
amsxtra.sty    1999/11/15 v1.2c
  eucal.sty    2009/06/22 v3.00 Euler Script fonts
amssymb.sty    2013/01/14 v3.01 AMS font symbols
amsfonts.sty   2013/01/14 v3.01 Basic AMSFonts support
omxcmex.fd    1999/05/25 v2.5h Standard LaTeX
                   font definitions
latexsym.sty   1998/08/17 v2.2e Standard LaTeX package
                   (lasy symbols)
  amscd.sty    1999/11/29 v1.2d
  alltt.sty    1997/06/16 v2.0g defines alltt environment
 xspace.sty    2009/10/20 v1.13 Space after command
                   names (DPC,MH)
graphicx.sty   2014/04/25 v1.0g Enhanced LaTeX Graphics
                   (DPC,SPQR)
 keyval.sty    2014/05/08 v1.15 key=value parser (DPC)
graphics.sty   2009/02/05 v1.0o Standard LaTeX Graphics
                   (DPC,SPQR)
   trig.sty    1999/03/16 v1.09 sin cos tan (DPC)
```

This list looks quite up-to-date (in fact, it is completely up-to-date). To confirm this, open the file `alltt.sty` in the latest LaTeX distribution. You find the lines

```
\ProvidesPackage{alltt}
          [1997/06/16 v2.0g defines alltt environment]
```

that explain the date found in the listing.

C.3 Interactive LaTeX

If LaTeX cannot carry out your instructions, it displays a *prompt* and possibly an error message in the `log` window.

- The `**` prompt means that LaTeX needs to know the name of a source file to typeset. This usually means that you misspelled a file name, you are trying to typeset a document that is not located in LaTeX's current folder, or that there is a space in the name of your source file.
- The `?` prompt indicates that LaTeX has found an error in your source file, and wants you to decide what to do next. You can try to continue typesetting the file by pressing
  - Return
  - `q` to typeset in quiet mode, not stopping for errors. Depending on the nature of the error, LaTeX may either recover or generate more error messages
  - `x` to stop typesetting your file
  - `h` to get advice on how to correct the error
- If you have misspelled the name of a package in a `\usepackage` command, or if LaTeX cannot find a file, it displays a message similar to the following:

  ```
  ! LaTeX Error: File 'misspelled.sty' not found.
  Type X to quit or <RETURN> to proceed,
  or enter new name. (Default extension: sty)

  Enter file name:
  ```

  You can either type the correct name of the file at the prompt, or type `x` to quit LaTeX.
- The `*` prompt signifies that LaTeX is in *interactive mode* and is waiting for instructions. To get such a prompt, comment out the line

  ```
  \end{document}
  ```

  in a source file, then typeset the file. Interactive instructions, such as `\show` and `\showthe` (see Section 14.1.8) may be given at the `*` prompt. To exit, type

  ```
  \end{document}
  ```

  at the `*` prompt, and press Return.
- If you get the `*` prompt and no error message, type `\stop` and press Return.

C.4 Separating form and content

In Section 2.3, we discuss logical and visual design and how LaTeX allows you to concentrate on the logical design and takes care of the visual design.

LaTeX uses four tools to separate the logical and visual design of a document:

1. **Commands** Information is given to LaTeX in the arguments of commands. For instance, title page information is given in this form. The final organization and appearance of the title page is completely up to the document class and its options.

   A more subtle example is the use of a command for distinguishing a term or notation. For instance, you may want to use an `\env` command for environment names. You may define `\env` as follows:

   ```
   \newcommand{\env}[1]{\texttt{#1}}
   ```

   This gives you a command that typesets all environment names in typewriter style (see Section 3.6.2). Logically, you have decided that an environment name should be marked up. Visually, you may change your decision any time. By changing the definition to

   ```
   \newcommand{\env}[1]{\textbf{#1}}
   ```

   all environment names are typeset in bold (see Section 3.6.5).

   The following example is taken from `secondarticleccom.tex` (see Section 9.3 and the `samples` folder). This article defines the construct $D^{\langle 2 \rangle}$ with the command

   ```
   \newcommand{\Dsq}{D^{\langle 2 \rangle}}
   ```

   If a referee or coauthor suggests a different notation, editing this *one line* changes the notation throughout the entire article.

2. **Environments** Important logical structures are placed within environments. For example, list items are typed within a list environment (see Section 4.2) and formatted accordingly. If you later decide to change the type of the list, you can do so by simply changing the name of the environment.

3. **Proclamations** You can change the style or numbering scheme of any proclamation at any time by changing that proclamation's definition in the preamble. See the typeset `secondarticle` article on pages 272–275 for examples of proclamations typeset with different styles.

4. **Numbering and cross-referencing** Theorems, lemmas, definitions, sections, and equations are logical units that can be freely moved around. LaTeX automatically recalculates the numbers and cross-references.

You write articles to communicate your ideas. The closer you get to a separation of logical and visual design, the more you are able to concentrate on that goal. Of course, you can never quite reach this ideal. For instance, a `line too wide` warning (see Sections 1.4 and 3.7.1) is a problem of visual design. When a journal changes the document class in an article you submitted, unless the new document class retains the same fonts and line width of the document class you used, new `line too wide` problems arise. LaTeX is successful in automatically solving visual design problems well over 95% of the time. That is getting fairly close to the ideal.

APPENDIX

D

LaTeX and the Internet

While LaTeX is pretty stable, the rest of the world around us is changing very fast and the Internet plays an ever larger role in our lives. This appendix deals with the Internet as a useful source of LaTeX information.

The Internet is clearly the main repository of all matters LaTeX, and the Comprehensive TeX Archive Network (CTAN) is the preeminent collection of TeX-related material. Section D.1 discusses how and where to find the LaTeX distribution, AMS and LaTeX packages, and the sample files for this book on CTAN.

Various international TeX user groups (especially TUG, the TeX Users Group) and the American Mathematical Society play a significant role in supporting LaTeX. I discuss some of the major user groups in Section D.2.

Finally, you find a great deal of useful information on the Internet concerning LaTeX. I provide some pointers in Section D.3.

D.1 Obtaining files from the Internet

Say you are interested in using Piet van Oostrum's `fancyhdr` package mentioned in Section 8.6. Chances are you can go ahead and use it, your LaTeX installation already has it. In this age of gigantic hard disks, your LaTeX installation places pretty much

G. Grätzer, *More Math Into* LaTeX, DOI 10.1007/978-3-319-23796-1

everything on your computer. But what if your version of `fancyhdr` needs updating or you need a new package. How you go about getting it?

We discuss below the proper way of doing this, with an FTP client or a Web browser. But maybe the simplest approach is to google `fancyhdr`. The first line of the first entry of the complete list of 82,100 responses is

`The TeX Catalogue OnLine, Entry for fancyhdr, Ctan Edition`

Clicking on it takes you to a page describing the package. You can get the package by clicking on `Download`. It is this simple.

In general, there are two types of Internet sites from which you can download files:

- FTP sites (using the file transfer protocol)
- Web sites (using the HTTP protocol)

To access them, use a *client* application on your computer to connect to a *server* on another machine. Most *Web browsers*, which are designed to connect to Web sites, also handle FTP transfers.

All operating systems include a browser and an FTP client as part of the system.

The Comprehensive TeX Archive Network

The Comprehensive TeX Archive Network (CTAN) is the preeminent collection of TeX-related material on the Internet. There are three main CTAN hosts:

- U.S.
  - FTP address: `ftp://tug.ctan.org/`
  - Web address: `http://www.ctan.org/`
- U.K.
  - FTP address: `ftp://ftp.tex.ac.uk/`
  - Web address: `http://www.tex.ac.uk/`
- Germany
  - FTP address: `ftp://ftp.dante.de/`
  - Web address: `http://www.dante.de/`

If you go to a CTAN site, at the very root you find `README.structure`, a very important file. It describes the bottom of the archive tree.

- `biblio` Systems for maintaining and presenting bibliographies within documents typeset using LaTeX

- `digests` Collections of TEX mailing list digests, TEX-related 'electronic magazines', and indexes, etc., of printed publications
- `dviware` Printer drivers and previewers, etc., for DVI files
- `fonts` Fonts written in Metafont, and support for using fonts from other sources (e.g., those in Adobe Type 1 format)
- `graphics` Systems and TEX macros for producing graphics
- `help` FAQs and similar direct assistance, the catalogue
- `indexing` Systems for maintaining and presenting indexes of documents typeset using TEX.
- `info` Manuals and extended how-to information, errata for TEX-related publications, collections of project (e.g., LATEX and NTS) documents, etc.
- `language` Support for various languages
- `macros` TEX macros. Several directories have significant sub-trees.
- `obsolete` Material which is now obsolete, including all of LATEX 2.09
- `support` TEX support environments and the like
- `systems` TEX systems. Organized by operating environment
- `tds` The TEX Directory Structure standard
- `usergrps` Information supplied by TEX User Groups
- `web` Literate Programming tools and systems

All of these have many subdirectories, for instance, `info` has the `examples` subdirectory that contains the sample files for this book. This is a rather new subdirectory, older sample files are in `info` proper.

So if you are interested in BIBTEX, you go to `biblio/`, and so on. The explanations are clear. All matters LATEX are in `macros/latex/`, which has a number of subdirectories, including

- `contrib`—Contributed LATEX macros
- `unpacked`—Unpacked copy of the LATEX sources
- `required`—Packages "required" of a LATEX distribution

There are many *full mirrors*, exact duplicates, of CTAN and many *partial mirrors*. At the root of CTAN you find the `README.mirrors` file listing them all. To reduce network load, you should try to use a mirror located near you.

Many CTAN sites now have easy search access with Web browsers. For instance, point your browser to

`http://tug.ctan.org/search.html`

In the search field, type `fancyhdr`, and you get a long list of links. Click on

`macros/latex/contrib/fancyhdr.zip`

and you are done. If you type `gratzer`, you get the links to the help files of my various books—in `info/` and `info/examples/`.

The AMS *packages*

Chances are that you received the AMS packages with your LaTeX distribution. If you did not, or if you want to update them, go to a CTAN site:

- `/tex-archive/fonts/amsfonts/latex/`
- `/tex-archive/macros/latex/required/amslatex/`

or to the AMS site:

`http://www.ams.org/tex/amslatex.html`

The sample files

The sample files for this book, introduced in Section 1.1.2 on page 5, live on CTAN in the directory

`/info/examples/Math_into_LaTeX-5`

You can go to `/info/examples/` and download it, or you can search for the directory name `Math_into_LaTeX-5`. If you forget these, just search for `gratzer`.

You can also find the *Mission Impossible* (Part I) on CTAN:

`/info/Math_into_LaTeX-4/Mission_Impossible.pdf`

D.2 The TeX *Users Group*

The TeX Users Group (TUG) does a tremendous job of supporting and promoting TeX, by publishing a journal, *TUGboat*, three times a year and organizing an annual international conference. TUG also helps support the LaTeX 3 team in maintaining LaTeX and developing LaTeX 3.

Consider joining TUG if you have an interest in LaTeX. TUG's contact information is:

PO Box 2311
Portland, OR 97208–23110

Telephone: (503) 223-9994
E-mail: office@tug.org
Web page: `http://www.tug.org/`

If you are a member, you receive every year a brand new TeX Live DVD, which contains everything you need to install LaTeX.

The American Mathematical Society

The AMS provides excellent technical advice for using the AMS packages and AMS-Fonts. You can reach the AMS technical staff by e-mail at `tech-support@ams.org`, or by telephone at (800) 321-4267 or (401) 455-4080. You can also find a great deal of helpful TeX information on the AMS Web site in the `Author Resource Center`.

D.3 Some useful sources of LaTeX information

You may find useful the Frequently Asked Questions (FAQ) documents maintained on CTAN; search `FAQ`. The U.K. TeX Users Group maintains its own FAQ list at

`http://www.tex.ac.uk/cgi-bin/texfaq2html?introduction=yes`

The AMS FAQ is at

`http://www.ams.org/authors/author-faq.html`

You can also ask most TeX-related questions in the Usenet newsgroup `comp.text.tex`.

APPENDIX

E

PostScript fonts

In the late 1990s, as we mentioned in Section C.1.4, a consortium (the AMS, Blue Sky Research, and Y&Y) released a free PostScript version of the CM and AMS fonts, so everyone could switch to PostScript fonts, a tremendous advance for LaTeX users.

The Computer Modern fonts were originally "hardwired" into LaTeX. Many users liked LaTeX but disliked the Computer Modern font, and with the spread of personal computers and PostScript laser printers, it was imperative that more PostScript fonts be integrated into LaTeX. In Section E.1, I describe how easy it is to use standard PostScript fonts, such as Times. In Section E.2, I show you how to replace the CM and AMS fonts in a LaTeX document with the Lucida Bright fonts.

"PostScript font" is the terminology that lay people, like me, use. The proper terminology is *Adobe Type 1 format font.* PostScript has provision for a wide range of fonts including Type 3 and Type 1 (as well as Type 42 and Type 5, and so on). The Type 3 font category is very general and includes bitmap fonts, grayscaled fonts, and so on. Type 1 fonts are tightly constrained *outline* fonts, which can be accurately rendered at almost any resolution, and have a special purpose code that deals only with Type 1 fonts.

G. Grätzer, *More Math Into* LaTeX, DOI 10.1007/978-3-319-23796-1

E.1 The Times font and MathTime

In this section, we step through the process of incorporating the Adobe Times font into a LaTeX document to replace the Computer Modern text fonts, and, optionally, of using the *MathTime Pro 2* math fonts to replace the Computer Modern math fonts. To do so, we use the PSNFSS packages (see Section 10.3).

A document class specifies three standard font families (see Section 3.6.2):

- A roman (or serif) font family
- A sans serif font family
- A typewriter style font family

The `times` package in the PSNFSS distribution makes Times the roman font family, Helvetica the sans serif font family, and Courier the typewriter style font family.

Setting up Times

First, install the Adobe Times, Helvetica, and Courier PostScript fonts and their TeX font metric files.

Now typeset the `psfonts.ins` file—in the PSNFSS distribution. This produces `sty` files for the standard PostScript fonts. The Times style file is called `times.sty`. If you do not already have it, copy it into a folder LaTeX can access.

To use the `times` package, you must have the *font definition* (`fd`) files for the fonts specified. By checking the `times.sty` file, you see that you need three files for the three fonts: Times, Helvetica, and Courier. In the `times` package these are named `ptm`, `phv`, and `pcr`, respectively. The three file names, each comprising three characters, are the font names in the naming scheme devised by Karl Berry. In `ptm`, `p` stands for the foundry's name (in this case, Adobe), `tm` stands for Times, `hv` for Helvetica, and `cr` for Courier. The corresponding font definition files are named `ot1ptm.fd`, `ot1phv.fd`, and `ot1pcr.fd`, respectively. `OT1` designates the old TeX font encoding scheme, which is not discussed here. You can get these files from CTAN (see Section D.1). If you do not already have it, copy it into a folder LaTeX can access.

Using Times

In the preamble of your document, type

```
\usepackage{times}
```

after the `\documentclass` line. Then Times becomes the roman, Helvetica the sans serif, and Courier the typewriter style document font family. That is all there is to it.

Using the `times` package changes the document font family throughout your document. To switch to Times only occasionally, type

```
{\fontfamily{ptm}\selectfont phrase}
```

The text preceding and following this construct is not affected. For example,

```
{\fontfamily{ptm}\selectfont
This text is typeset in the Times font.}
```

typesets as

This text is typeset in the Times font.

Similarly,

```
\fontfamily{ptm}\selectfont
This text is typeset in the Times font.
\normalfont
```

also typesets the same phrase in Times. Recall that the `\normalfont` command restores the document font family (see Section 3.6.2).

Setting up *MathTıme*

Looking at a mathematical article typeset with the Times text font, you may find that the Computer Modern math symbols look too thin. To more closely match Times and other PostScript fonts, Michael Spivak modified the CM math symbols, calling these modified fonts *MathTıme Pro 2*. You can purchase these fonts from Personal TeX,

```
http://store.pctexstore.com/
```

Install the *MathTıme Pro 2* PostScript fonts and the TEX font metric files. If you do not already have them, copy from PSNFSS the files

```
mathtime.ins   mathtime.dtx  mtfonts.fdd
```

into a folder LATEX can access.

Typeset `mathtime.ins` to produce the necessary `fd` files and the `mathtime.sty` file.

Using *MathTıme*

If you want to use Times as the document font family and *MathTıme* as the default math font, specify

```
\usepackage[LY1]{fontenc}          %specify font encoding
\usepackage[LY1,mtbold]{mathtime}  %switch math fonts
\usepackage{times}                 %switch text fonts
```

in the preamble of your document.

The `mathtime` package has many options. See its documentation for more information; typeset `mathtime.dtx` to get it.

E.2 Lucida Bright fonts

Another alternative to Computer Modern fonts is *Lucida Bright* for both text and math fonts. You can purchase the Lucida Bright fonts from TUG.

Copy the files

```
lucidabr.ins, lucidabr.dtx,
lucidabr.fdd,lucidabr.yy
```

into your TEX input folder. Typeset `lucidabr.yy`, producing the `lucidabr.sty` file and a large number of `fd` files.

Now add the lines

```
\usepackage[LY1]{fontenc}     %specify font encoding
\usepackage[LY1]{lucidabr}    %switch text and math fonts
```

in the preamble of your document. The `lucidabr` package has many options. See its documentation—typeset `lucidabr.dtx` to get it.

E.3 More PostScript fonts

You can obtain PostScript fonts from a wide variety of sources. There are many free PostScript fonts on CTAN. Table E.1 is a short list of the more prominent commercial vendors.

See also the Web page at `http://www.microsoft.com/typography/` for a lot of useful information and links.

Foundry	URL
Adobe	`www.adobe.com/type/`
Agfa/Monotype	`www.agfamonotype.com/`
Berthold	`www.bertholdtypes.com/`
Bitstream	`www.bitstream.com/`
Emigre	`www.emigre.com/`
Hoefler	`www.typography.com/`
ITC	`www.itcfonts.com/`
Linotype	`www.linotype.com/`
Monotype	`www.fonts.com/`
Scriptorium	`www.fontcraft.com/`
Vintage	`www.vintagetype.com/`

Table E.1: Some type foundries on the Internet.

APPENDIX

F

LaTeX *localized*

If the language in which you write articles is not American English and/or your keyboard is not the standard American keyboard, you may find it annoying and sometimes difficult to use standard LaTeX. The annoyance may start with finding out how to type ~ for a nonbreakable space, to LaTeX's inability to properly hyphenate `Gr\"{a}tzer`, and LaTeX's inability to use a different alphabet.

Many of the improvements to LaTeX in recent years have been to localize LaTeX, that is, to adapt LaTeX for use with languages other than American English and keyboards other than standard American keyboards. The `babel`, `fontenc`, `inputenc` packages are the major players, along with new font-encoding schemes, including the T1 encoding. You find these packages as part of the LaTeX distribution (see Section 10.3).

The `babel` package is described in detail in Johannes Braams, *Babel, a multilingual package for use with LaTeX's standard document classes* [7] and in Chapter 9 of *The LaTeX Companion,* 2nd edition [56].

G. Grätzer, *More Math Into LaTeX*, DOI 10.1007/978-3-319-23796-1

If you are interested in using a localized LaTeX, you should turn to the TeX user group for that linguistic group to find out what is available. You should also consult the `babel` user guide.

At a minimum, a supported language has translated redefinable names (see Table 14.1), and a localized variant of the `\today` command. Two very advanced language adaptations are German and French.

We first illustrate the use of the `babel` package with the German language, which gives you a rich set of features, including

- Allows you to type `"a` for `\"{a}`
- Introduces `"s` for sharp s (eszett)
- Introduces `"ck` for a `ck` that becomes k-k when hyphenated

Type the following test file: (`german.tex` in the `samples` folder):

```
\documentclass{article}
\usepackage[german]{babel}
\usepackage[T1]{fontenc}

\begin{document}
\section{H"ullenoperatoren}
Es sei $P$ eine teilweise geordnete Menge. Wir sagen,
dass in $P$ ein \emph{H"ullenoperator} $\lambda$
erkl"art ist, wenn sich jedem $a \in  P$ ein eindeutig
bestimmtes $\lambda(a) \in P$ zuordnen l"a"st, so  dass
die folgenden Bedingungen erf"ullt sind.
\end{document}
```

And here it is typeset:

1 Hüllenoperatoren

Es sei P eine teilweise geordnete Menge. Wir sagen, dass in P ein *Hüllenoperator* λ erklärt ist, wenn sich jedem $a \in P$ ein eindeutig bestimmtes $\lambda(a) \in P$ zuordnen läßt, so dass die folgenden Bedingungen erfüllt sind.

The second example uses the following options for the packages:

```
\usepackage[T2A]{fontenc}
\usepackage[koi8-u]{inputenc}
\usepackage[ukrainian]{babel}
```

The encoding `koi8-u` is appropriate for Ukrainian.

And here is the typeset Ukrainian sample file:

Поняття теорії ігор

Віктор Анякін

31 липня 2006 р.

Логічною основою теорії ігор є формалізація трьох понять, які входять в її визначення і є фундаментальними для всієї теорії:

- Конфлікт,
- Прийняття рішення в конфлікті,
- Оптимальність прийнятого рішення.

Ці поняття розглядаються в теорії ігор у найширшому сенсі. Їх формалізації відповідають змістовним уявленням про відповідні об'єкти.

Змістовно, конфліктом можна вважати всяке явище, відносно якого можна казати про його учасників, про їхні дії, про результати явищ, до яких призводять ці дії, про сторони, які так чи інакше зацікавлені в таких наслідках, і про сутність цієї зацікавленості.

Якщо назвати учасників конфлікту *коаліціями дії* (позначивши їхню множину як $\Re_D$, можливі дії кожної із коаліції дії — її *стратегіями* (множина всіх стратегій коаліції дії K позначається як S), результати конфлікту — *ситуаціями* (множина всіх ситуацій позначається як S; вважається, що кожна ситуація складається внаслідок вибору кожної із коаліцій дії деякої своєї стратегії, так, що $S \subset \prod_{K \in \Re} S_K$), зацікавлені сторони — *коаліціями інтересів* (їх множина — $\Re_I$) і, нарешті, говорити про можливі переваги для кожної коаліції інтересів K однієї ситуації s' перед іншою s'' (цей факт позначається як $s' \underset{K}{\prec} s''$), то конфлікт в цілому може бути описаний як система

$$\Gamma = \langle \Re_D, \{S_K\}_{K \in \Re_D}, S, \Re_I, \{\underset{K}{\prec}\}_{K \in \Re_I} \rangle$$

Така система, яка представляє конфлікт, називається *грою*. Конкретизації складових, які задають гру, призводять до різноманітних класів ігор.

APPENDIX

G

LaTeX *on the iPad*

A few years back, personal computing was desktop-centric. For many tasks, for instance, for back up and for updating the operating system, you had to connect your smartphone and tablet with a computer. Tim Cook (Apple's CEO as I am writing this book) coined the term "Post PC revolution" to describe the trend that a tablet is no longer a younger brother of a PC, but an equal partner; in fact, for many users, it can be the only computer they will ever need.

But can you use it for your LaTeX documents? Isn't the iPad designed only for e-mail, to read news, and enjoy entertainment? Certainly. While it has a fast CPU, it has an even more powerful graphics chip so viewing videos and complex Web pages is quick. The operating system is designed to make performing these basic tasks very easy and intuitive. iOS masks the complexities of the underlying computer.

Nevertheless, underneath this easy-to-use interface there is a Mac. Get a little familiar with the iPad as a computer, and you can work with your LaTeX documents pretty well.

There are good reasons why the iPad is the only tablet I'll discuss. Today, the iPad is clearly the dominant tablet of more than a hundred on the market and the iPad is the only tablet with a decent market share that is in an *ecosystem*: the iPad is just one device under iCloud along with the iPhone, the Mac desktops, and the Mac notebooks.

G. Grätzer, *More Math Into* LaTeX, DOI 10.1007/978-3-319-23796-1

I work on a LaTeX document on my iMac, and when I am away from home, I continue my work on my MacBook Air or iPad; there is no interruption, all the devices are fully synchronized.

In Section G.1, we discuss the iPad file system, sandboxing, file transfers, printing, and text editing. We discuss where are the files to be LaTeXed and where the LaTeX process takes place in Section G.2. Finally, in Section G.3, we introduce two LaTeX implementations for the iPad: Texpad and TeX Writer.

This appendix is based on my articles in the Notices of the Amer. Math. Soc. **60** (2013), pp. 332–334 and 434–439. You can find these two articles, `NoticesV.pdf` and `NoticesVI.pdf`, in the `samples` folder for some more detail.

G.1 The iPad as a computer

To work on a LaTeX document, you sit in front of your computer, in the complex folder hierarchy you find `document.tex`, double clicks it to start the LaTeX implementation, edit the document, typeset it. Then you print `document.pdf`, proofread it, and then you go back to editing...

How do you do these steps on an iPad? On the iPad, there is only a rectangular array of apps, see Figure G.1. No documents are visible. There may be folders containing more apps, but no folder in a folder. There are no Library folders, no Download folder. And no File menu containing the Print command!

I have `document.tex` on my desktop, but how do I transfer it to the iPad? I would plug in my thumb drive to facilitate the transfer, but the iPad has no USB port.

G.1.1 File system

As we pointed out, the iPad starts up displaying a rectangular array of icons and folders for apps, as in see Figure G.1. There are no icons for documents. There is no familiar Desktop for documents and folders. No Applications folder. The screen is always occupied by a single window; the file system, as we know it from desktop computers, is gone.

In its place is an app-centric starting point. Touch the icon of an app and you are in business. When the app opens, you get access to the documents of the app.

For security reasons, the apps are sandboxed, limiting an app's access to files, preferences, network resources, hardware, and so on. Ars Technica's John Siracusa described the goal of sandboxing as follows: "Running an application inside a sandbox is meant to minimize the damage that could be caused if that application is compromised by a piece of malware. A sandboxed application voluntarily surrenders the ability to do many things that a normal process run by the same user could do. For example, a normal application run by a user has the ability to delete every single file owned by that user. Obviously, a well-behaved application will not do this. But if an application becomes compromised, it can be coerced into doing something destructive."

Figure G.1: A rectangular array of apps

Of course, the iPad is a computer, and it has a File System, we just do not see it. But it is important to visualize it. To help us along, we will use an app.

G.1.2 FileApp

If you search the iPad's App Store for "file" apps, there are more than 1,000 of them. Many of them could be used to help us understand the iPad file system. I choose FileApp by DigiDNA (Figures G.2 and G.3).

Toget started, plug the iPad into a desktop computer, download and start the application iMazing on the computer; download and start FileApp on the iPad. On the left panel of iMazing, click on Apps, then on FileApp. Anything you drag into the right pane of DiskAid is copied to FileApp. So much for file transfer. To see the file structure of the various iPad apps, click on their names.

Of course, for file transfers I should also mention the ubiquitous Dropbox. Download it for the iPad, sign in (as you did for your computer Dropbox); that's it.

Figure G.2: iMazing

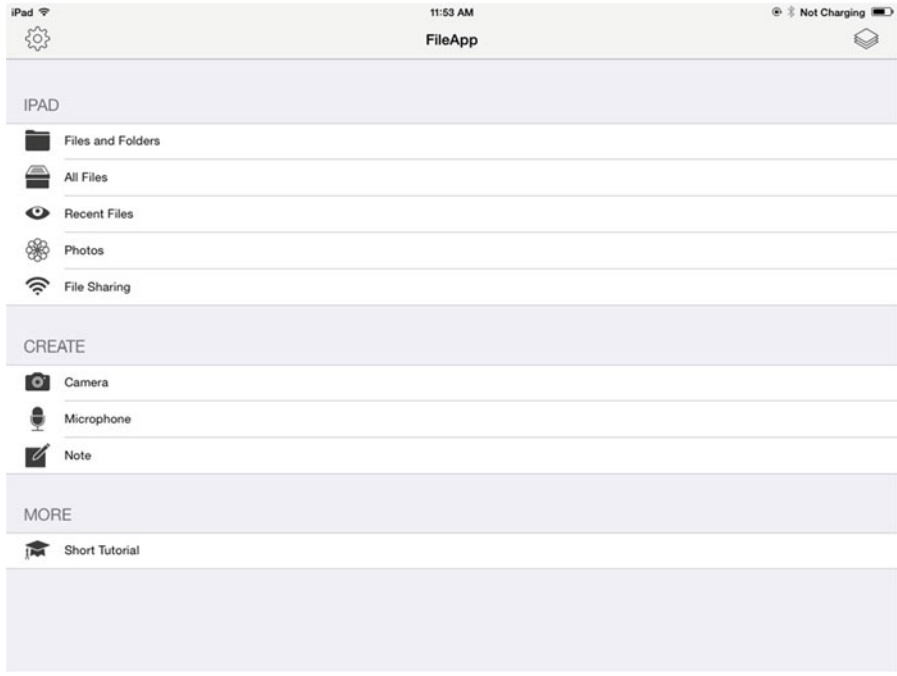

Figure G.3: FileApp

G.1.3 Printing

When I first wanted to print from my iPhone, I realized that there is no print command. However, lots of apps would do the job. In fact, searching for "print" in the App Store, I discovered over 600 apps; many of them print, utilizing my desktop computer.

Typical of these apps is PrintDirect (EuroSmartz) and Printer Pro (Readdle Productivity). They can use any printer connected with your desktop computer. They wirelessly connect to your computer and print with its help.

If so many apps can help me out with printing, how come iOS does not? Read the comments about iOS printing; I was not the only one confused.

However, if the iPad is the poster child of the Post PC Revolution, its native printing solution cannot involve desktop computers. Apple introduced the appropriate technology; they named it AirPrint. The idea is simple: the iPad collaborates with the printer. Of course, for this you need a wireless printer that is AirPrint aware. Apple lists all the AirPrint aware printers:

`http://support.apple.com/kb/ht4356`

as of this writing, about 2,000. If you are lucky and have one of these printers, test it. Open an e-mail and touch the Action icon (here it is the Reply icon); this offers you the options: Reply, Forward, and Print. Touch Print. Printer Options appears, and you can choose how many copies and on which printer. (Lots of apps provide more choices, such as page range.) Choose the printer and print.

For a second test, open a Web page in Safari. There is only one difference: the action icon is a curved arrow in a rectangle.

As a third test, open the Drudge Report. It has the familiar Action icon; we are in business. Finally, open the Politico app, read the news and look for an action icon. There is none. So to use AirPrint, you need an AirPrint aware printer and an AirPrint aware app! For the time being, these are limiting restrictions.

G.1.4 Text editors

Many of us edit LaTeX documents in text editors more sophisticated than the text editor that comes with the LaTeX implementation. There are so many text editors, well over 200..., see the table at

`http://brettterpstra.com/ios-text-editors/`

Keeping the iPad horizontal, the keyboard gobbles up too much real estate. Keeping it vertical, the keyboard is less intrusive, but the keys are smaller. If you want to do serious work on the iPad, use a keyboard.

The iOS's touch text editing is nice, but it lacks a feature crucial for text editing: moving the cursor a character ahead or back. (Of course, keyboards have cursor keys!) Text editors offer a variety of solutions, for instance, finger swiping.

I will discuss briefly a very sophisticated text editor: Textastics. If you want Syntax Highlighting, Search and Replace, and Text Expander, this a good choice. In Figure G.4, you see me editing a document.

You can see the cursor navigation wheel (which appears with a two finger tap—finger swipe also moves the cursor). It comes with an excellent user manual. Textastics also has a Mac version. And if you spend time shaping it to your liking, then you would like the same tamed editor for all your work.

G.2 Files

The LaTeX files, of course, can always be composed in the app. You can obtain your existing files in two ways:

1. Using iTunes. To transfer files—one at a time—to your app from your computer using iTunes, connect your iPad to your computer and start iTunes by double clicking on its icon. Under Devices, we selected the iPad from the left side of the iTunes window (see Figure G.5). At the top of the iTunes window, next to Summary and Info, select Apps (see Figure G.6). The lower part of the window now has File Sharing; see Figure G.7. On the left, you see a listing of the apps available for file transfer. Select the app; the files already in the app are then listed in the right pane. Click on the add button and a file browser appears. Choose the file you want to transfer.

2. Via Dropbox. I assume that you have Dropbox. For an introduction, go to `dropbox.com`. In the app, you sign in to Dropbox. Now the app can see the contents of your Dropbox, or some part of it (at the Dropbox server) as long as you have an Internet connection.

3. With FileApp. See the discussion in Section G.1.2 (Figures G.2 and G.3).

G.3 Two LaTeX implementations for the iPad

We now discuss two LaTeX implementations.

G.3.1 Texpad

There are three ways Texpad can typeset.

A. On your iPad. The app places a LaTeX distribution on the iPad and you typeset with it. However, a complete LaTeX distribution is about 4 GB! No app can be this big. So you only get a small LaTeX distribution.

B. On your computer via Dropbox. This is the most powerful option. You have all the packages and fonts on your computer available to you. An app (such as AutomaTeX by Jonathan Weisberg) monitors if there is any change in the LaTeX file in Dropbox. If there is, the file is retypeset and the pdf is made available to you via the Dropbox.

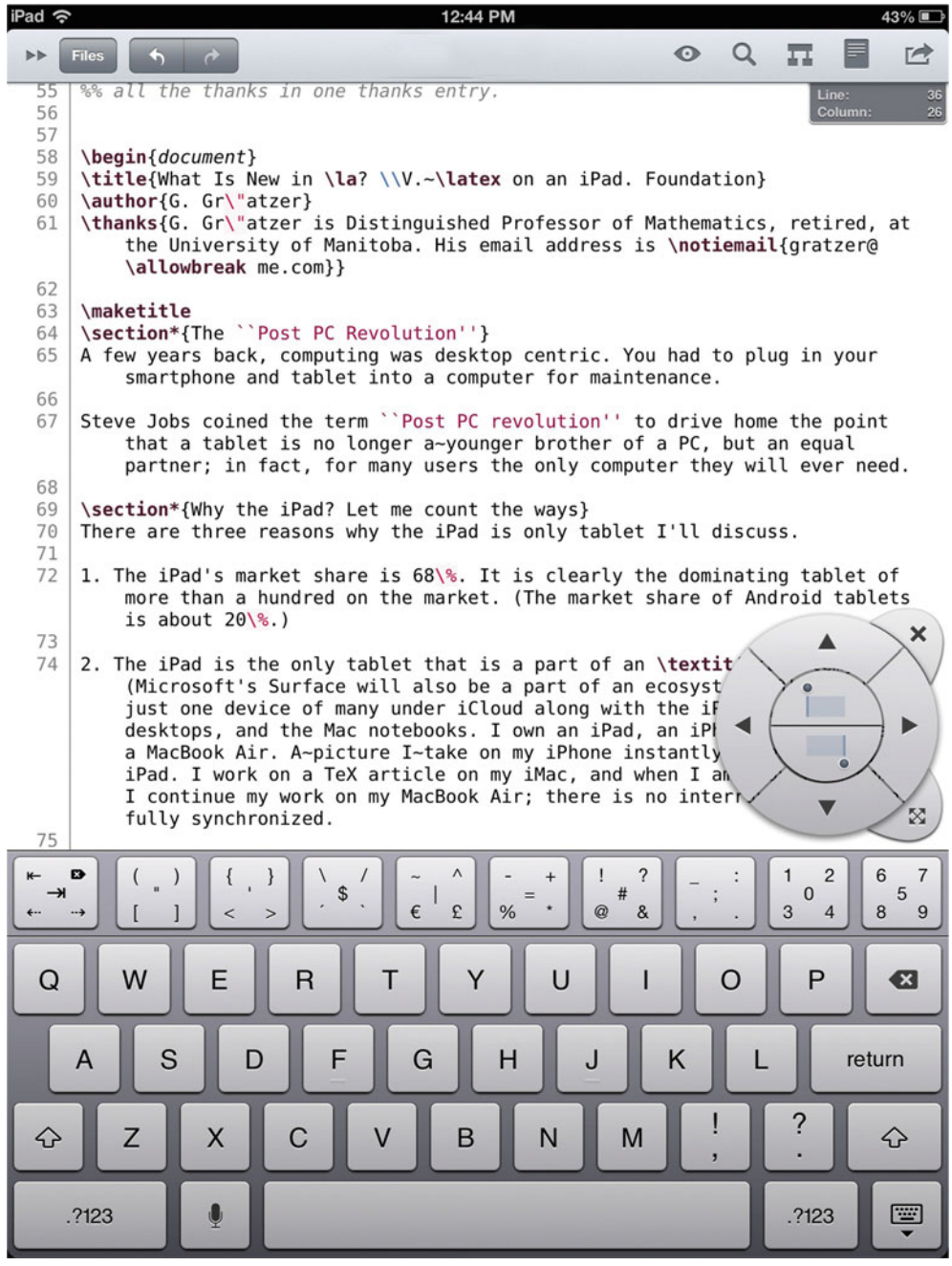

Figure G.4: Editing with Textastics

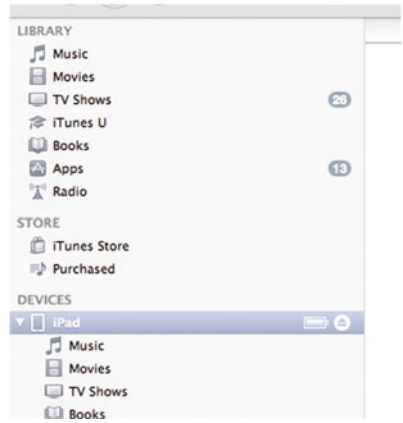

Figure G.5: Under Devices, we selected the iPad

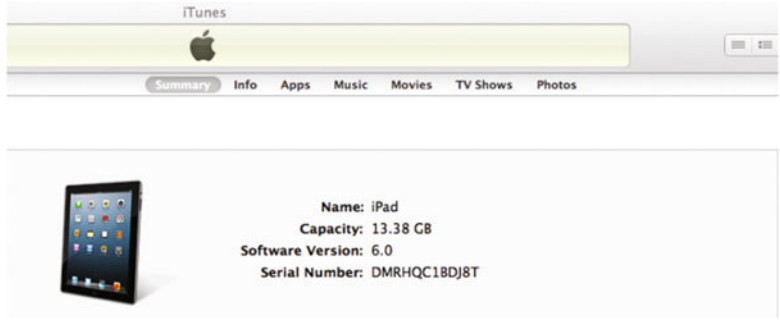

Figure G.6: Choose Apps

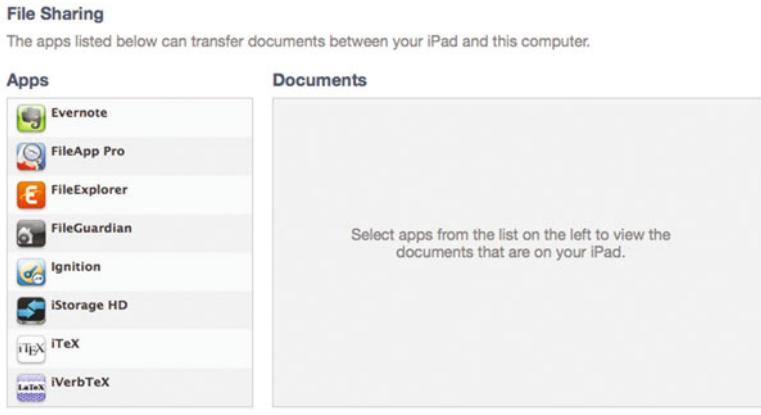

Figure G.7: Select app

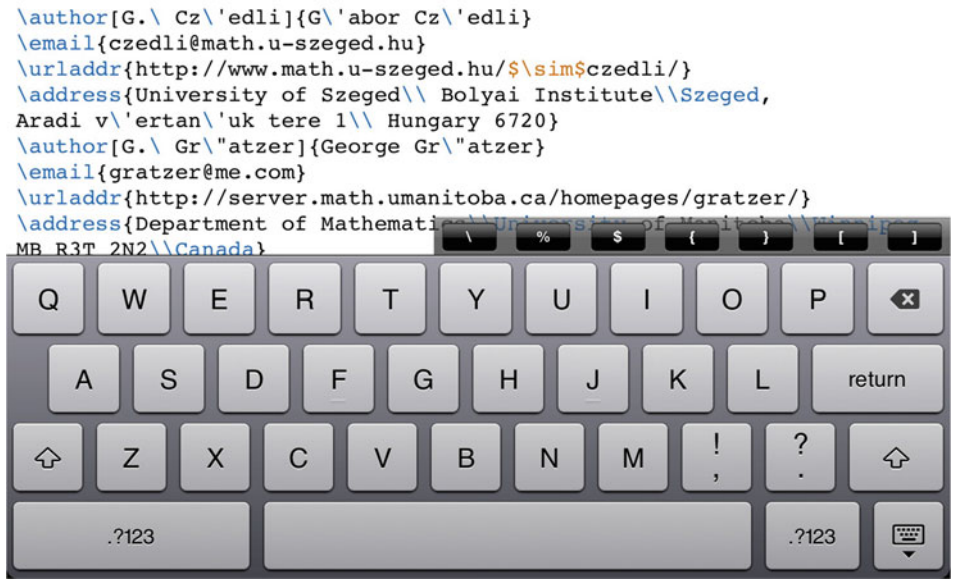

Figure G.8: Editing with soft keyboard

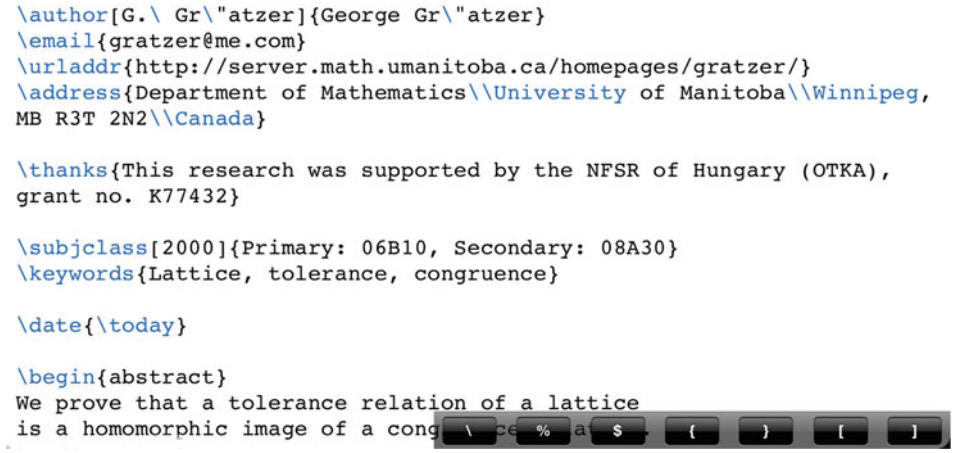

Figure G.9: Editing with Bluetooth keyboard

C. In the Cloud. This option provides you with a remote server, the Cloud; you connect to it with Wi-Fi. The server has a full LaTeX implementation, so you miss only the special fonts. And, of course, you must have Wi-Fi to use it. So you can polish up your lecture on the airplane on the way to a meeting.

Texpad has some interesting features, including:

- Autocompletion of all common commands and autofilling `\cite`-s and `\ref`-s.
- Replacement of the LaTeX console with a list of errors and warnings linked to the source.
- Global search, outline view, and syntax highlight.

Step 1. To get started with Texpad, go to the iPad App Store and install Texpad. Sign up for Dropbox with the same e-mail address and password as for your computer's Dropbox.

Step 2. Now open Texpad. Figure G.10 shows Texpad at the first startup. The Help button gets the help file.

Step 3. Touch Off to turn Dropbox On. (If you have Dropbox installed and connected, it's even simpler, you just have to Allow the connection.) Your File Storage now gives two options: iPad and Dropbox (see Figure G.11). It is important to understand that your LaTeX files will live in the Dropbox (in the Cloud, at the Dropbox server) or locally on your iPad.

Step 4. The Dropbox files are now available to you by touching Dropbox under File Storage, see Figure G.11.

- First, create a folder for the LaTeX files to be transferred. Navigate to iPad file storage. Touch the + in the bottom right, and choose Folder. Name the folder.
- Second, navigate to the Dropbox file system view and to the folder containing the file you want to copy. Touch Edit. Select the file to transfer. At the bottom center, touch Copy. Navigate to the folder into which you want to copy the file and touch Copy.

Step 5. Typesetting will take place either on the iPad or in the Cloud. Go to the folder of a LaTeX file, touch the file (on the iPad or in the Dropbox), and typeset it on the iPad (touch Local Typeset) or in the Cloud, that is, at Valletta's server (touch Cloud Typeset).

Step 6. Try to visualize what is happening.

- If you typeset on the iPad and the file is on the iPad, it just typesets locally; that is it.
- If you typeset on the iPad and the file is in Dropbox, the file is transferred to the iPad, typeset, and the resulting pdf is sent back to the Dropbox; nothing is kept at the iPad.
- If you typeset in the Cloud and the file is in Dropbox, the file is transferred to the Cloud, typeset, and the resulting pdf is sent back to the Dropbox; nothing is kept in the Cloud.

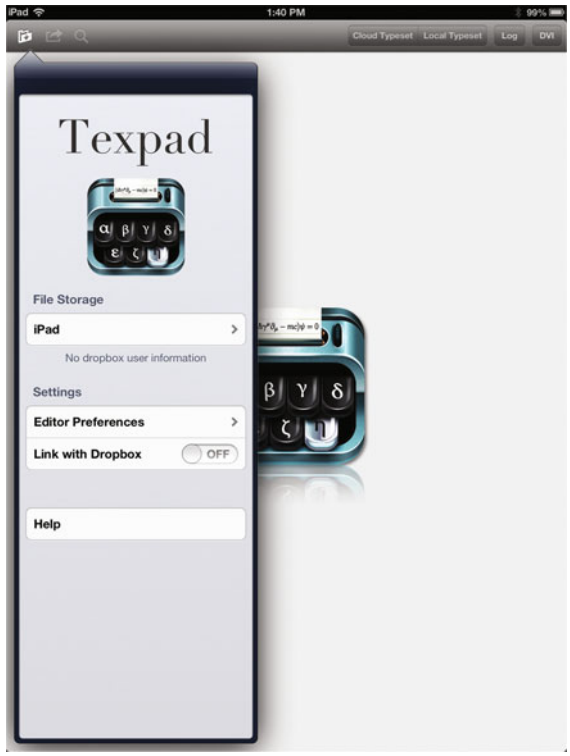

Figure G.10: Texpad first start up

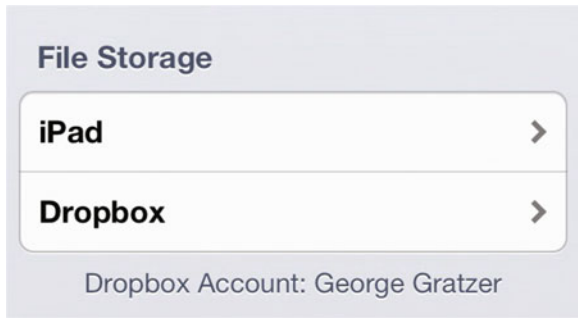

Figure G.11: Expanded File Storage

- If you typeset in the Cloud and the file is on the iPad, the file is transferred to the Cloud, typeset, and the resulting pdf is sent back to the iPad.

Step 7. Once you touch a LaTeX file, you are ready to edit it. Cursor control is very important. You do it with a two finger swipe. Of course, this is not so important if you use a Bluetooth keyboard; it has cursor keys.

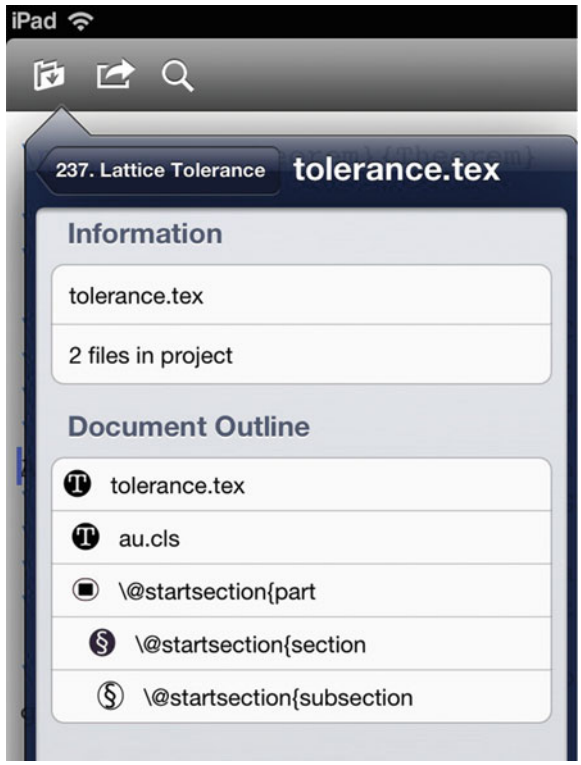

Figure G.12: Organizer window

Step 8. You edited and typeset your LaTeX file. You want to get to another file. Touch the organize button (the folder icon on the upper left). You get the Organizer window (see Figure G.12). Touch the button in the upper left of the window, you get back to Dropbox, eventually, to the expanded File Storage of Figure 7.

These eight steps should be enough to get you started. Read the detailed Help file for some more information. It is available as a help file and also at

`https://www.texpadapp.com/support/ios`

G.3.2 TeX Writer

You get your files via Dropbox, typeset on your iPad. Documentation: `readme.pdf` is no quick start, but it is useful for understanding how TeX Writer works and how to customize it. TeX Writer was the first to typeset on the iPad. It could only typeset TeX files. Now it has LaTeX and the AMS packages on board.

Step 1. When you start up TeX Writer, first link to Dropbox. In TeX Writer, you get a display showing the source file `readme.tex`; see Figure G.13. Pressing the

More icon (right pointing arrow), you get more icons, to read the pdf version or Air Printing `readme.pdf`. On the left is the Organize icon; touching it, you get a file listing: `readme.tex` and `readme.pdf`. At the bottom is New File; touch it to compose one.

Step 2. So you are perplexed about what to do next, you ran out of icons. You have to know that TeX Writer accesses the Dropbox in a special way. When you connect to Dropbox from TeX Writer, it creates a new folder `App` in Dropbox. In the folder `App` it creates the subfolder `TeX Writer`. In this subfolder you find `readme.tex`. Anything you put in the `TeX Writer` subfolder is visible in the file listing window on the iPad; anything not in this subfolder is not visible to TeX Writer.

Step 3. TeX Writer gets your files from this subfolder in Dropbox. Place a folder in there with the files of your current project. These will be available to you on your iPad. Moreover, these files are fully synchronized, so the editing changes you make on your iPad show up in Dropbox.

Step 4. LaTeXing, you spend most of your time editing. TeX Writer's editor has some interesting features. Excellent cursor control. Touch `begin{}`, type in the name of the environment, and the environment is placed in your document. You also have undo, redo, search, and so on.

When typing, you retain the editing functions you get at the start, and in addition, you get an extra row of LaTeX specific keys. You do not get them with a Bluetooth keyboard; however, the keyboard can have many of these keys you need for typing LaTeX. Nice feature: the Log viewer links to error lines.

G.4 Conclusion

Jason Snell was interviewing Craig Federighi, Apple senior vice president of software engineering (and two more executives of Apple), for MacWorld. Snell writes:

"When I walked into Apple's offices for my conversation with the three executives, they noticed that I had brought a phone, a tablet, and a laptop, and had ultimately selected my MacBook Air as my tool of choice for the interview.

'You had a bunch of tools,' Federighi said, pointing at my bag. 'And you pulled out the one that felt right for the job that you were doing. It wasn't because it had more computing power… You pulled it out because it was the most natural device to accomplish a task.' "

I'm not suggesting that you write all your document on an iPad. I do suggest, however, that you can LaTeX with ease, say on a trip, correcting a document or adding a slide to your presentation. Use your iPad to LaTeX when appropriate.

LaTeXing on an iPad requires some compromises, for instance, you cannot use nonstandard fonts. Nevertheless, when not at your desk, the iPad will be nearly as functional as your MacBook Air, and it is so much easier to carry around…

And the best is yet to come: the larger iPad will make working on the iPad easier.

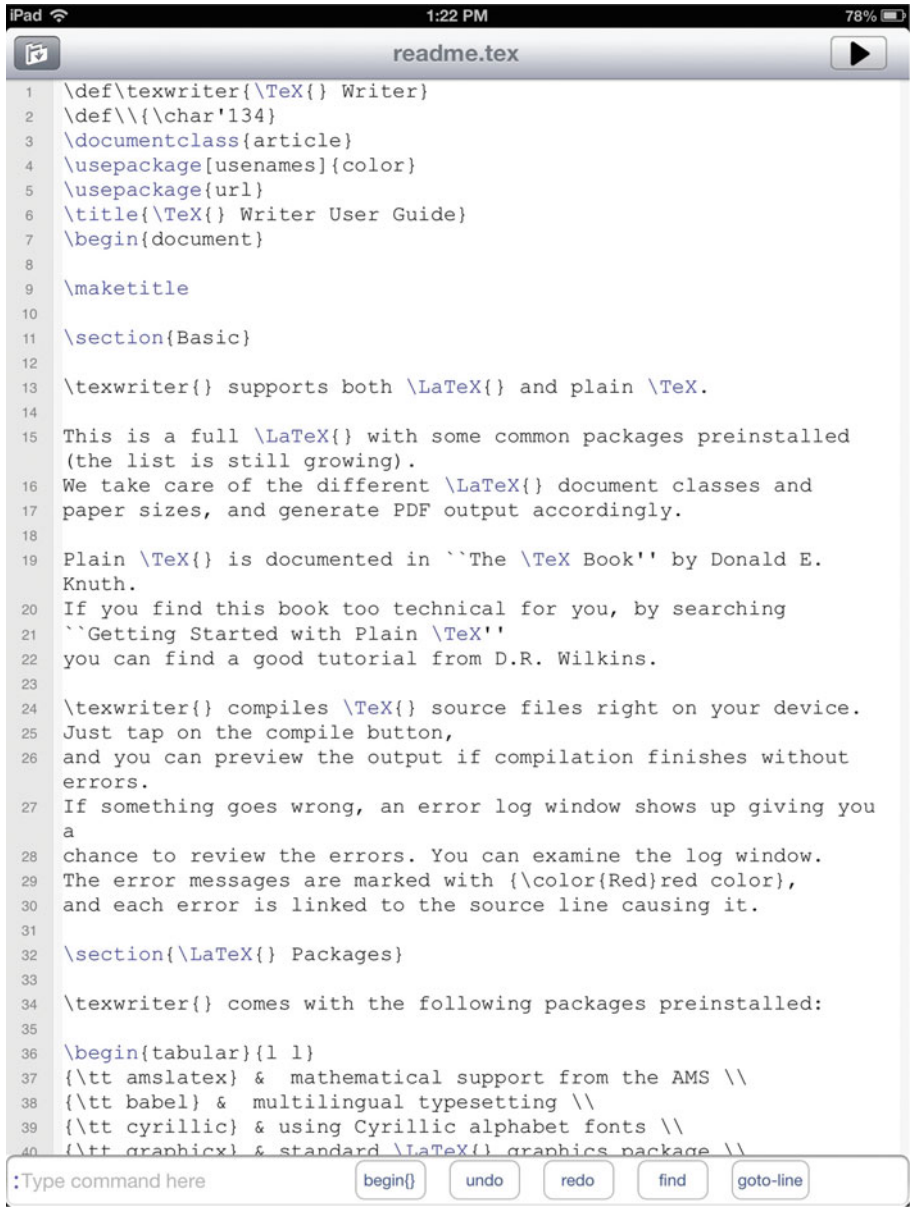

Figure G.13: TeX Writer startup

APPENDIX

H

Final thoughts

In this final appendix, I will outline some of the material I did not discuss and suggest some additional reading to learn more about LaTeX, typesetting, and writing. We conclude by looking at some projects that may come to fruition soon.

H.1 What was left out?

The mission statement in the introduction stated that my goal for this book was to provide you with a good foundation in LaTeX including the AMS packages, and that we would not cover programming or visual design. As a result, I have omitted a great deal of material.

H.1.1 LaTeX omissions

LaTeX has some additional features that I have not discussed in this book:

1. The `picture` environment allows you to draw simple pictures with lines and circles.
2. The `array`, `tabular`, and `tabbing` environments have a number of additional features.

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3. LaTeX makes the style parameters of a document and of most LaTeX constructs available to the user for modification. Very few of these parameters have been mentioned in this book.

4. Low-level NFSS commands provide finer control over fonts.

The following are some pointers to additional information on these topics:

1. Drawing with the `picture` environment has the advantage of portability. This environment is described in Leslie Lamport's LaTeX*: A Document Preparation System,* 2nd edition [53]. A very advanced internal drawing system is TikZ by Till Tantau, see

   `http://sourceforge.net/projects/pgf/`

   However, I believe that the best approach is to use a drawing application that can save your illustrations in EPS or PDF format so that you can include them in your document using the `graphicx` package (see Section 8.4.3).

2. The `tabbing`, `tabular`, and `array` environments—and their extensions—are described in detail in Leslie Lamport's LaTeX*: A Document Preparation System,* 2nd edition [53] and Chapter 5 of *The* LaTeX *Companion,* 2nd edition [56].

3. The style parameters for LaTeX are set by the document class. When a publisher changes the document class loaded by your document, the style parameters are set to its specifications. If you explicitly change style parameters in your document, a publisher will have trouble getting your source file to conform to their publishing style. If you must change any basic style parameters, be sure to explain what you did with comments.

4. There are two types of commands defined in the NFSS, high-level and low-level commands. The latter are, by and large, meant for style designers and package writers. Nevertheless, anyone who wants to use fonts other than Computer Modern (the default) would do well to read Chapter 7 of *The* LaTeX *Companion,* 2nd edition [56].

   Low-level NFSS commands are briefly mentioned in Section 3.6.9 and are used in Appendix E.

H.1.2 TeX *omissions*

Almost all discussions of Plain TeX were omitted from this book. TeX is a powerful programming language, allowing you to design any page layout or formula. Remember, however, that to change any design feature, you should be knowledgeable not only about TeX, but also about document design. Also keep in mind that making such changes may make it difficult or impossible for a publisher to make your document conform to its own specifications.

H.2 Further reading

Much documentation is included with the LaTeX and the AMS distributions and many third-party packages are also well documented. You will also find a great deal of documentation on CTAN.

As you have no doubt noticed, there are many references to *The* LaTeX *Companion,* 2nd edition [56] in this book. While it is not a beginner's book, it is indispensable for advanced LaTeX users with special needs. It is also the best overview of more than a hundred important packages. For package writers and students of NFSS, it is *the* basic textbook. For graphics work, read *The* LaTeX *Graphics Companion* [17], and on Web publishing *The* LaTeX *Web Companion* [18].

Learning TeX is a bit more complicated than learning LaTeX. You may want to start with Wynter Snow's TeX *for the Beginner* [67]. It introduces many of TeX's basic concepts in a very relaxed style with many examples. The notes on LaTeX make the book especially useful, and the author gives many examples of writing macros. The use of TeX as a programming language is not discussed.

Raymond Seroul and Silvio Levy's *A Beginner's Book of* TeX [66] is another good introduction. This book also includes a chapter on TeX programming. Donald E. Knuth's *The* TeX*book* [48] provides a nice introduction to TeX.

Paul W. Abrahams, Karl Berry, and Kathryn A. Hargreaves' TeX *for the Impatient* [1] explains many TeX commands, grouped by topic. This book has a very useful, nonsequential approach. Finally, Victor Eijkhout's TeX *by Topic: A* TeX*nician's Reference* [14] is an excellent reference book on TeX, mainly for experts. For many tutorial examples, see the articles and columns in *TUGboat* (see Section D.2).

For advice to authors of mathematical articles and books, see *Mathematics into Type* [68] by Ellen Swanson (updated by Arlene Ann O'Sean and Antoinette Tingley Schleyer). You may find it interesting to see how many of the rules in Swanson's book have been incorporated into LaTeX. The definitive book on style (in North America) is *The Chicago Manual of Style,* 16th edition [11]. Two other views on copy editing are presented in Judith Butcher's *Copy Editing: The Cambridge Handbook* [9] and *Hart's Rules for Compositors and Readers at the University Press, Oxford* by Horace Hart [45], updated in R. M. Ritter's *New Hart's Rules: The Handbook of Style for Writers and Editors* [64]. The special problems of writing about math and computer science are admirably dissected in Lyn Dupré's *BUGS in Writing: A Guide to Debugging Your Prose,* 2nd edition [13].

Most people who write math have little or no background in typography, the art of printing with type. But when you become a typesetter, it can be useful to learn a little bit about typography. I would highly recommend Robert Bringhurst's *The Elements of Typographic Style* [8]. See also Ruari McLean's *The Thames and Hudson Manual of Typography* [54] and Alison Black's *Typefaces for Desktop Publishing: A User Guide* [6].

Harley Hahn's *A Student's Guide to Unix* [44] provides an excellent introduction to UNIX.

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