Contents

Foreword v

Preface xxi

Book Outline xxiii

Acknowledgements xxv

I Basics 1

1 Introduction to LaTeX 3
1.1 Pros and Cons 4
1.2 Basics 6
1.2.1 The TeX Processors 6
1.2.2 From `tex` to `dvi` and Friends 6
1.2.3 The Name of the Game 8
1.2.4 Staying in Sync 8
1.2.5 Writing a LaTeX Input Document 8
1.2.6 The Abstract 11
1.2.7 Spaces, Comments, and Paragraphs 12
1.3 Document Hierarchy 12
1.3.1 Minor Document Divisions 13
1.3.2 Major Document Divisions 14
1.3.3 The Appendix 15
1.4 Document Management 15
1.5 Labels and Cross-references 16
1.6 Controlling the Style of References 18
1.7 The Bibliography 19
1.7.1 The `bibtex` Program 23
1.7.2 The `biblatex` Package 25
1.7.3 End-of-Chapter Bibliographies 27
1.7.4 Classified Bibliographies 28
1.8 Table of Contents and Lists of Things 29
1.8.1 Controlling the Table of Contents 30
1.8.2 Controlling the Sectional Unit Numbering . . . 30
1.8.3 Indexes and Glossaries 30
1.9 Class Files 32

1.10 Packages 34
1.11 Useful Classes and Packages 35
1.12 Errors and Troubleshooting 35

II Basic Typesetting **39**

2 Running Text **41**
2.1 Special Characters 41
2.1.1 Tieing Text 41
2.1.2 Grouping 43
2.2 Diacritics 44
2.3 Ligatures 44
2.4 Quotation Marks 45
2.5 Dashes 46
2.6 Full Stops 46
2.7 Ellipsis 47
2.8 Emphasis 48
2.9 Borderline Punctuation 48
2.10 Footnotes and Marginal Notes 48
2.11 Displayed Quotations and Verses 49
2.12 Line Breaks 49
2.13 Controlling the Size 50
2.14 Seriffed and Sans Serif Typefaces 51
2.15 Small Caps Letters 52
2.16 Controlling the Type Style 53
2.17 Abbreviations 53
2.17.1 Initialisms 53
2.17.2 Acronyms 54
2.17.3 Shortenings 54
2.17.4 Introducing Abbreviations 55
2.17.5 British and American Spelling 55
2.17.6 Latin Abbreviations 56
2.17.7 Units 56
2.18 Phantom Text 57
2.19 Alignment 58
2.19.1 Centred Text 58
2.19.2 Flushed/Ragged Text 58
2.19.3 Basic `tabular` Constructs 58
2.19.4 The `booktabs` Package 61
2.19.5 Advanced `tabular` Constructs 61
2.19.6 The `tabbing` Environment 63
2.20 Language Related Issues 65
2.20.1 Hyphenation 65
2.20.2 Foreign Languages 65
2.20.3 Spell-Checking 66

3 Lists **67**
3.1 Unordered Lists 67

3.2 Ordered Lists 68
3.3 The enumerate Package 69
3.4 Description Lists 69
3.5 Making your Own Lists 70

III Tables, Diagrams, and Data Plots 73

4 Presenting External Pictures 75
4.1 The figure Environment 75
4.2 Special Packages 76
4.2.1 Floats 76
4.2.2 Legends 77
4.3 External Picture Files 77
4.4 The graphicx Package 77
4.5 Setting Default Key Values 78
4.6 Setting a Search Path 79
4.7 Graphics Extensions 79

5 Presenting Diagrams 81
5.1 Why Specify your Diagrams? 81
5.2 The tikzpicture Environment 82
5.3 The \tikz Command 82
5.4 Grids 83
5.5 Paths 83
5.6 Coordinate Labels 84
5.7 Extending Paths 85
5.8 Actions on Paths 88
5.8.1 Colour 89
5.8.2 Drawing the Path 91
5.8.3 Line Width 91
5.8.4 Dash Patterns 91
5.8.5 Predefined Styles 92
5.8.6 Line Cap and Join 92
5.8.7 Arrows 93
5.8.8 Filling a Path 94
5.8.9 Path Filling Rules 95
5.9 Nodes and Node Labels 96
5.9.1 Predefined Nodes Shapes 97
5.9.2 Node Options 98
5.9.3 Connecting Nodes 99
5.9.4 Special Node Shapes 100
5.10 The spy Library 101
5.11 Trees 101
5.12 Logic Circuits 103
5.13 Commutative Diagrams 104
5.14 Coordinate Systems 105
5.15 Coordinate Calculations 108
5.15.1 Relative and Incremental Coordinates 108

5.15.2 Complex Coordinate Calculations 109
5.16 Options 111
5.17 Styles 111
5.18 Scopes 112
5.19 The \foreach Command 113
5.20 The let Operation 114
5.21 The To Path Operation 115

6 Presenting Data in Tables **117**
6.1 Why Use Tables? 117
6.2 Table Taxonomy 117
6.3 Table Anatomy 118
6.4 Table Design 119
6.5 Aligning Columns with Numbers 121
6.5.1 Aligning Columns by Hand 122
6.5.2 The dcolumn Package 123
6.5.3 The siunitx Package 124
6.6 The table Environment 124
6.7 Wide Tables 125
6.8 Multi-page Tables 125
6.9 Databases and Spreadsheets 126

7 Presenting Data with Plots **129**
7.1 The Purpose of Data Plots 129
7.2 Pie Charts 129
7.3 Introduction to pgfplots 131
7.4 Bar Graphs 132
7.5 Paired Bar Graphs 134
7.6 Component Bar Graphs 135
7.7 Coordinate Systems 136
7.8 Line Graphs 137
7.9 Scatter Plots 139

IV Mathematics and Algorithms **143**

8 Mathematics **145**
8.1 The AMS-LaTeX Platform 145
8.2 LaTeX's Math Modes 146
8.3 Ordinary Math Mode 146
8.4 Subscripts and Superscripts 147
8.5 Greek Letters 147
8.6 Display Math Mode 149
8.6.1 The equation Environment 149
8.6.2 The split Environment 150
8.6.3 The gather Environment 151
8.6.4 The align Environment 151
8.6.5 Interrupting a Display 153
8.6.6 Low-level Alignment Building Blocks 153
8.6.7 The eqnarray Environment 154

8.7 Text in Formulae . . . 154
8.8 Delimiters . . . 154
8.8.1 Scaling Left and Right Delimiters . . . 155
8.8.2 Bars . . . 156
8.8.3 Tuples . . . 157
8.8.4 Floors and Ceilings . . . 157
8.8.5 Delimiter Commands . . . 158
8.9 Fractions . . . 158
8.10 Sums, Products, and Friends . . . 159
8.10.1 Basic Typesetting Commands . . . 159
8.10.2 Overriding Text and Display Style . . . 160
8.10.3 Multi-line Limits . . . 160
8.11 Existing Functions and Operators . . . 161
8.12 Integration and Differentiation . . . 162
8.12.1 Integration . . . 162
8.12.2 Differentiation . . . 163
8.13 Roots . . . 164
8.14 Changing the Style . . . 164
8.15 Symbol Tables . . . 165
8.15.1 Operator Symbols . . . 165
8.15.2 Relation Symbols . . . 165
8.15.3 Arrows . . . 166
8.15.4 Miscellaneous Symbols . . . 166

9 Advanced Mathematics 169
9.1 Declaring New Operators . . . 169
9.2 Managing Content with the `cool` Package . . . 170
9.3 Arrays and Matrices . . . 170
9.4 Accents, Hats, and Other Decorations . . . 171
9.5 Braces . . . 172
9.6 Case-based Definitions . . . 172
9.7 Function Definitions . . . 173
9.8 Theorems . . . 174
9.8.1 Theorem Taxonomy . . . 174
9.8.2 Styles for Theorem-like Environments . . . 175
9.8.3 Defining Theorem-like Environments . . . 175
9.8.4 Defining Theorem-like Styles . . . 177
9.8.5 Proofs . . . 177
9.9 Mathematical Punctuation . . . 178
9.10 Spacing and Linebreaks . . . 179
9.10.1 Line Breaks . . . 179
9.10.2 Conditions . . . 180
9.10.3 Physical Units . . . 181
9.10.4 Sets . . . 181
9.10.5 More Spacing Commands . . . 182

10 Algorithms and Listings 183
10.1 Presenting Pseudo-Code with `algorithm2e` . . . 183
10.1.1 Loading `algorithm2e` . . . 183

10.1.2 Basic Environments 184
10.1.3 Describing Input and Output 185
10.1.4 Conditional Statements 185
10.1.5 The Switch Statement 187
10.1.6 Iterative Statements 188
10.1.7 Comments 189
10.2 The listings Package 190

V Automation **193**

11 Commands and Environments **195**
11.1 Some Terminology 195
11.2 Advantages and Disadvantages 195
11.3 User-defined Commands 197
11.3.1 Defining Commands Without Parameters . . . 197
11.3.2 Defining Commands With Parameters 198
11.3.3 Fragile and Robust Commands 199
11.3.4 Defining Robust Commands 200
11.4 Commands and Parameters 200
11.5 Defining Commands with TEX 202
11.6 Tweaking Existing Commands with \let 206
11.7 Using More than Nine Parameters 206
11.8 Using Environments 207

12 Branching **209**
12.1 Counters, Switches, and Lengths 209
12.1.1 Counters 209
12.1.2 Switches 210
12.1.3 Lengths 211
12.1.4 Scoping 213
12.2 The ifthen Package 213
12.3 The calc Package 215
12.4 Looping 215
12.5 Tail Recursion 216

13 Option Parsing **217**
13.1 What is a ⟨Key⟩=⟨Value⟩ Interface? 217
13.2 Why Use a ⟨Key⟩=⟨Value⟩ Interface? 218
13.3 The pgfkeys Package 218
13.4 Providing and Using the Values 218
13.5 Traversing the Key Tree 219
13.6 Executing Keys 220
13.7 Error Handling 220
13.8 Storing Values in Macros 221
13.9 Decisions 221
13.10 Choice Keys 222

VI Miscellany 223

14 Beamer Presentations 225
14.1 Frames . . . 225
14.2 Modal Presentations . . . 227
14.3 Incremental Presentations . . . 229
14.4 Visual Alerts . . . 231
14.5 Adding Some Style . . . 231

15 Writing Classes and Packages 237
15.1 The Structure of Classes and Packages . . . 237
15.2 Dependencies . . . 237
15.3 Identification . . . 238
15.4 Defining and Parsing the Options . . . 238
15.5 Loading Existing Classes and Packages . . . 239
15.6 Final Configuration . . . 240

16 Using OpenType Fonts 243
16.1 OpenType Font Features . . . 244
16.2 LaTeX Font Selection Mechanism . . . 246
16.3 Overview of Functionality . . . 249
16.4 Inspecting the Font . . . 250
16.5 Current Alternatives . . . 252
16.6 Designing the Font Families . . . 252
16.7 Extracting the Fonts . . . 253
16.8 Font Definition Files . . . 255
16.9 Creating the Font Definition Files . . . 256
16.10 Implementing a Font Package . . . 257
16.10.1 Parsing the Point Size . . . 257
16.10.2 Loading the Font . . . 260
16.10.3 Changing the Features . . . 261
16.11 Using the Fonts . . . 263

VII References and Bibliography 265

Typographic Jargon 267

Bibliography 273

Acronyms and Abbreviations 279

Indexes 281
LaTeX and TeX Commands . . . 283
Environments . . . 293
Classes . . . 295
Packages . . . 297
Languages and External Commands . . . 299

List of Figures

1.1 Typical LaTeX program 9
1.2 Defining comments 12
1.3 Coarse document divisions 14
1.4 Closed fold in folding editor. 15
1.5 Open fold in folding editor. 15
1.6 the Using `\includeonly` and `\include` commands . . . 16
1.7 Using `\label` and `\ref` 17
1.8 Using `\pageref` 17
1.9 Using the `prettyref` package 19
1.10 A minimal bibliography 20
1.11 The `\cite` command 21
1.12 Using `\cite` with an optional argument 22
1.13 Including a bibliography 24
1.14 Some BibTeX entries 24
1.15 Using `biblatex` 25
1.16 Textual and parenthetical citations 26
1.17 Getting the author and year of a citation 26
1.18 Using `biblatex`'s citation commands 27
1.19 Including reference lists 30
1.20 Minimal letter 34

2.1 Quotes 45
2.2 Nested quotations 45
2.3 Dashes 47
2.4 Good borderline punctuation 48
2.5 Poor borderline punctuation 48
2.6 Using footnotes 49
2.7 The `quote` environment 50
2.8 The `verse` environment 50
2.9 Controlling the size 51
2.10 Finer points of typesetting abbreviations 54
2.11 The `\phantom` command 57
2.12 The `center` environment 58
2.13 The `flushleft` environment 59
2.14 Using the `tabular` environment 60
2.15 Input of `booktabs` package 62
2.16 Output of `booktabs` package 62
2.17 Controlling column widths with an `@`-expression . . . 63

2.18 The tabbing environment 64
2.19 Advanced tabbing 64
2.20 Using the babel package 65

3.1 The itemize environment 68
3.2 Changing the item label 68
3.3 The enumerate environment 69
3.4 Using the enumerate package 70
3.5 Using the description environment 70
3.6 Lengths that affect list formatting 71
3.7 A user-defined list 72
3.8 A user-defined environment for lists 72

4.1 Using the dpfloat package 77
4.2 Including an external graphics file 78

5.1 Drawing a grid 83
5.2 Creating a path 84
5.3 Cubic spline in tikz 86
5.4 Using a dash pattern 91
5.5 Using a dash phase 91
5.6 Using the miter option 93
5.7 Using the nonzero rule 96
5.8 Using the even odd rule 96
5.9 Nodes and implicit labels 97
5.10 Low-level node control 98
5.11 Node placement 99
5.12 Drawing lines between node shapes 100
5.13 The circle split node style 100
5.14 A node with rectangle style and several parts 101
5.15 Using the spy library 102
5.16 Drawing a tree 102
5.17 Using implicit node labels in trees 102
5.18 Controlling the node style 103
5.19 A tree with a 'missing' node 103
5.20 Drawing a half adder with tikz 105
5.21 Input of commutative diagram 106
5.22 Commutative diagram 106
5.23 Using four coordinate systems 107
5.24 Computing the intersection of perpendicular lines . . 107
5.25 Absolute, relative, and incremental coordinates 108
5.26 Computations with partway modifiers 109
5.27 Computations with partway and distance modifiers . . 109
5.28 Computations with projection modifiers 109
5.29 Predefining options with the \tikzset command . . . 112
5.30 Using scopes 113
5.31 The \foreach command 113
5.32 Simple to path example 116
5.33 User-defined to path 116

6.1 Components of a demonstration table 118
6.2 Aligning columns with the dcolumn package 124
6.3 Aligning columns with the siunitx package 124
6.4 Creating a table 125
6.5 Using the longtable package 126

7.1 A pie chart 130
7.2 Using the axis environment 131
7.3 Sample output of the axis environment 131
7.4 A bar graph 133
7.5 Creating a bar graph 133
7.6 A paired bar graph 135
7.7 Creating a paired bar graph 135
7.8 A component bar graph 137
7.9 Creating a component bar graph 137
7.10 A line graph 138
7.11 Creating a line graph 139
7.12 A scatter plot 140
7.13 Creating a scatter plot 140

8.1 The equation environment 150
8.2 The split environment 151
8.3 The gather environment 151
8.4 Using the align environment 152
8.5 Output of input in Figure 8.4 152
8.6 The align environment 153
8.7 Output of input in Figure 8.6 153
8.8 Using the \shortintertext command 153
8.9 The aligned environment 154
8.10 Angular delimiters 157
8.11 The \substack command with centred lines 161
8.12 The subarray environment with different alignments . 161
8.13 Limit of a log-like function 162

9.1 The array environment 170
9.2 The smallmatrix environment 171
9.3 Typesetting an underbrace 173
9.4 Using the amsthm package 177
9.5 Using the mathematical punctuation commands 179

10.1 Algorithm style 184
10.2 Using algorithm2e 185
10.3 Typesetting conditional statements 187
10.4 Using algorithm2e's switch statements 188
10.5 Creating a partial listing with the listings package . . 191
10.6 Listing created from input in Figure 10.5 191
10.7 Setting new defaults with the \lstset command 192

11.1 User-defined commands 199
11.2 A program with user-defined combinators 202

11.3 Using the \expandafter command 205
11.4 Defining commands with default parameters 205
11.5 A sectional unit environment 206
11.6 Accessing parameters by defining commands 207
11.7 Accessing parameters with a nested definition 207
11.8 User-defined environment 208

12.1 Tail recursion 216

14.1 Creating a titlepage with the beamer class 226
14.2 Creating frame titles 226
14.3 Using the beamerarticle package 228
14.4 Using modes 228
14.5 Using the \pause command 230
14.6 Using overlay specifications 231
14.7 Adding visual alerts 231
14.8 Sample output of beamer's default theme 233
14.9 Sample output of beamer's Boadilla theme 233
14.10 Sample output of beamer's Antibes theme 234
14.11 Sample output of beamer's Goettingen theme 234
14.12 Using a beamer theme 235

15.1 Declaring class options 239
15.2 Loading auxiliary classes and packages 240

16.1 Stylistic alternates 245
16.2 A typical font encoding file 248
16.3 Glyph sample 251
16.4 Partial font definition file 255
16.5 *Nexus* font definition file 256
16.6 Sample \fonttable output 258
16.7 Baseline and mean line 268
16.8 Bounding boxes 268
16.9 Word formation 268
16.10 Computing the point size 268
16.11 Kerning 269
16.12 Ligatures 269
16.13 Seriffed versus sans serif letters 270

List of Tables

1.1 Depth values of sectional unit commands 31
1.2 Using the `\index` command 33

2.1 Ten special characters 42
2.2 Common diacritics 44
2.3 Other special characters 44
2.4 Foreign ligatures 45
2.5 Size-affecting declarations and environments 51
2.6 Type style affecting declarations and commands 53
2.7 Latin abbreviations 56

5.1 The `xcolor` colours 90
5.2 Line width and dash pattern styles 92
5.3 Arrow head types 94
5.4 Node shapes provided by logic gate shape libraries . . . 104
5.5 Shorthand notation for the `\foreach` command 114

6.1 A poorly designed table 119
6.2 An improved version of Table 6.1 120

7.1 Allowed values for `mark` option 141

8.1 Lowercase Greek letters 148
8.2 Uppercase Greek letters 149
8.3 Variable-size delimiters 158
8.4 Variable-sized symbols 160
8.5 Log-like functions 162
8.6 Integration signs 163
8.7 Binary operation symbols 165
8.8 Relation symbols 166
8.9 Additional relational symbols 166
8.10 Fixed-size arrow symbols 167
8.11 Extensible arrow symbols provided by `amsmath` 167
8.12 Extensible `mathtools`-provided arrow symbols 167
8.13 Options for `mathtools`-provided arrow symbols 168
8.14 Miscellaneous math mode symbols 168

9.1 Math mode accents, hats, and other decorations 172
9.2 The `\overbrace` and `\underbrace` commands 172

9.3 Math mode dot-like symbols 178
9.4 Positive and negative spacing 182

11.1 TEX's Expansion Processor 203

12.1 Length units 211

16.1 OpenType font features 244
16.2 Figure feature combinations 245
16.3 *Nexus* font features 253