

Contents

Acknowledgments	xiii
Introduction	1
Exploration vs. Exploitation	3
A Justification for Learning to Program?	5
Creative Computing and Programming as Inquiry	6
Programming Breakthroughs	8
Programming Languages Used	9
Free Software and No-Cost Software	10
How to Program and Explore	13
Programming as You Go	15
Essential Concepts	16
Creative Computing and Programming as Inquiry	17
Programming Is a Practice and Requires Practice	17
Installation and Setup	19
Text Editor	19
Python	20
GNU/Linux	22
Mac OS X and Windows	22
Checking the Installation	23
Python Libraries: Pillow/PIL	23
Python Libraries: TextBlob	24
Processing	25
The Command Line	25
1	Modifying a Program 27
1.1	Appropriating a Page 28

1.2	Quick and Easy Modifications	30
	Free Project: Modifying a Simple Text Machine	32
	Share and Discuss Your Project	32
	Essential Concepts	33
	Programming Is Editing Text	33
	Code and Data	33
2	Calculating	35
2.1	Encountering an Error	38
2.2	Syntax and Semantics	40
2.3	A Curious Counterexample of the Valid and Intentional	42
	Essential Concepts	44
	Arithmetic Expressions	44
	Syntax, Syntax Errors, and Formal Validity	44
	Valid Programs vs. Intentional Programs	44
3	Double, Double	45
3.1	Trying out the Function	48
3.2	Describing the Function	50
	Free Project: A Modified “Double, Double”	54
	Essential Concepts	55
	Interface	55
	Patterns in Code	55
4	Programming Fundamentals	57
4.1	Abstracting Related Code: Functions	58
	One Complexity: Scope	62
4.2	Abstracting along Sequences: Iteration	64
4.3	Abstracting across Types: Polymorphism	68
4.4	Revisiting <code>double()</code>	70
4.5	Another Fundamental: The Conditional	72
4.6	Division and Types	74
	Exercise: Positive Numbers	77
	Free Project: Another Modified “Double, Double”	77
	Essential Concepts	77
	Functions Bundle Code	77
	Arithmetic Expressions Can Be Made into Functions	77
	Iteration	78

- Types 78
- The Conditional 78
- 5 Standard Starting Points 79**
 - 5.1 Hello World 79**
 - Alternate Strings and String Theories 84
 - Exercise: Rewriting the Greeting 86**
 - 5.2 Temperature Conversion 86**
 - 5.3 Object-Oriented Temperature 89**
 - 5.4 "Converting" a Number to Its Sign 94**
 - Exercise: A Conversion Experience 98**
 - Exercise: Categorical, Imperative 98**
 - 5.5 Factorial 99**
 - Exercise: Negative Factorial Fix 102**
 - Exercise: Factorial Mash-up 103**
 - 5.6 "Double, Double" Again 103**
 - Free Project: Modify and Improve a Starter Program 104**
 - Free Project: A Starter Program 104**
 - Exercise: Critique My Starter Programs 105**
 - Essential Concepts 106**
 - Computing Is Cultural 106
 - Classes, Objects, Methods, Attributes 106
 - Categorizing with the Conditional 106
 - Iteration and Recursion 106
- 6 Text I 107**
 - 6.1 Strings, Their Characters, and Their Slices 107**
 - Selecting a Slice 109
 - Detecting Double Letters 112
 - 6.2 Splitting Strings, Joining and Sorting Lists of Strings 115**
 - Splitting a Text into Words (First Attempt) 116
 - Working across Strings: Joining, Sorting 117
 - Existence without Joining 120
 - Exercise: Same Last Character 121**
 - Exercise: Counting Spaces 121**
 - Exercise: Counting Nonspaces 121**
 - Exercise: Determining Initials 122**
 - Exercise: Removing Vowels 122**

	Exercise: Tautonyms	123
	Essential Concepts	123
	Examining and Manipulating Strings	123
	Iterating over Strings, Accepting Strings, Returning Strings	123
7	Text II	125
	7.1 Verifying Palindromes by Reversing	125
	7.2 Verifying Palindromes with Iteration and Recursion	128
	7.3 Introducing Regular Expressions	133
	A Simple Python Program with Regular Expressions	138
	Counting Words Again, with Regular Expressions	142
	7.4 Verifying Palindromes—This Time, with Feeling	144
	Exercise: Match within Text	145
	Free Project: A Poetry vs. Prose Shootout	145
	Essential Concepts	145
	Solving Problems with Recursion and Iteration	145
	Regular Expressions	145
8	Image I	147
	8.1 A New Data Type: Tuples	148
	8.2 Generating Very Simple Images	150
	8.3 Pixel-by-Pixel Image Manipulation	155
	Generalizing to Images of Any Size	158
	Loading an Existing Image	160
	Lightening and Darkening an Image	161
	Increasing the Contrast of an Image	164
	8.4 Flipping an Image	165
	Exercise: Flipping along the Other Axis	167
	Free Project: Cell-by-Cell Generator	167
	Essential Concepts	168
	Using a Library	168
	Image Basics	168
	Two-Dimensional, Nested Iteration	168
	Swapping Values	168
9	Image II	169
	9.1 Blurring an Image	169
	Visiting Every Pixel	177

- 9.2 Manipulating Many Images 178**
 - Inverting Images 179
 - Exercise: Old Skool Filter 180**
 - Practical Python and Imagemagick Manipulations 181
 - Free Project: Image Manipulation as You Like It 184**
 - Essential Concepts 184**
 - Checking the Neighborhood 184
 - Generalizing to Many Files in a Directory 184
- 10 Text III 185**
 - 10.1 Words and Sentences 185**
 - Adjective Counting (with Part-of-Speech Tagging) 188
 - Sentence Counting 190
 - Comparing the Number of Adjectives 190
 - 10.2 Text Classification: Verse or Prose? 192**
 - 10.3 Text Classification: Sentiment Analysis 196**
 - Training on Positive Words and Negative Words 197
 - A Thought Experiment 200
 - Using the Included Sentiment System 201
 - Approaches to Classification 204
 - 10.4 Word Lists and Beyond 205**
 - Accessing WordNet in a Program 208
 - Free Project: Creative Conflation 212**
 - Free Project: Your Very Own Classifier 213**
 - Essential Concepts 213**
 - Words, Sentences, and Parts of Speech 213
 - Classification 213
 - Lexical Resources 213
- 11 Statistics and Visualization 215**
 - 11.1 The Mean in Processing 216**
 - 11.2 A First Visualization in Processing 220**
 - 11.3 Statistics, Descriptive and Inferential 226**
 - 11.4 The Centers and Spread of a Distribution 227**
 - Exercise: Median 228**
 - Exercise: Mode 228**
 - Exercise: Variance and Standard Deviation 229**
 - The Meaning of the Mean 230

- 11.5 Gathering and Preparing Data 231
- 11.6 Probability and Generating Numbers 232
- Free Project: Reweighting Your Text Generator 235
- 11.7 Correlations and Causality 235
- 11.8 More with Statistics, Visualization, and Processing 238
- Free Project: An End-to-End Statistical Exploration 239
- Essential Concepts 240
 - Programming Fundamentals Span Languages 240
 - Different Averages Have Different Meanings 240
 - Probability and Statistics: Two Sides of the Same Coin 240
 - Principled Visualization 240
- 12 Animation 241
 - 12.1 Drawing in Frames 241
 - Exercise: The Bounce Test 244
 - 12.2 Changing Intensity 245
 - Exercise: Multiple Rectangles with Color 246
 - Exercise: Fifty Rectangles 246
 - 12.3 Exploring Animation Further 247
 - Free Project: A Novel Clock 247
 - Essential Concepts 248
 - Functions as Part of a Framework 248
 - Drawing in Time 248
- 13 Sound 249
 - 13.1 Bytebeat from Zero 250
 - Sidebar: The Math Joke 251
 - 13.2 Exploring Bytebeat, Bit by Bit 252
 - Free Project: Two Bytebeat Songs 255
 - 13.3 Further Exploration of Sound 255
 - Essential Concepts 255
 - Bitwise Operations 255
 - Sound as a Stream of Bytes 256
- 14 Interaction 257
 - 14.1 Typed Input in Python 257
 - Free Project: Word to You 258
 - 14.2 Key Presses in Processing 258
 - Free Project: Create a Virtual, Navigable Space 260

Essential Concepts	261
Accepting Input	261
Controlling a Window	261
15 Onward	263
Appendix A: Why Program?	267
How People Benefit from Learning to Program	267
Cognitively: Programming Helps Us Think	269
Modeling Humanistic and Artistic Processes Is a Way of Thinking	270
Programming Could Improve Our Thinking Generally	272
Culturally: Programming Gives Insight into Cultural Systems	273
Programming Allows Better Analysis of Cultural Systems	273
Programming Enables the Development of Cultural Systems	274
Socially: Computation Can Help to Build a Better World	275
Programming Is Creative and Fun	277
Appendix B: Contexts for Learning	279
Semester-Long (Fourteen-Week) Course	280
Quarter-Long (Ten-Week) Course	280
One-Day Workshop	281
Individual and Informal Learning	281
A Final Suggestion for Everyone	281
Glossary	283
References	289
Index	293