

# CONTENTS IN DETAIL

**PREFACE TO THE THIRD EDITION** **xxvii**

**ACKNOWLEDGMENTS** **xxxix**

**INTRODUCTION** **xxxiii**

Who Is This Book For? . . . . . xxxiv  
What Can You Expect to Learn? . . . . . xxxiv  
Online Resources . . . . . xxxv  
Why Python? . . . . . xxxvi

**PART I: BASICS** **1**

**1**  
**GETTING STARTED** **3**

Setting Up Your Programming Environment . . . . . 3  
    Python Versions . . . . . 4  
    Running Snippets of Python Code . . . . . 4  
    About the VS Code Editor . . . . . 4  
Python on Different Operating Systems . . . . . 5  
    Python on Windows . . . . . 5  
    Python on macOS . . . . . 7  
    Python on Linux . . . . . 8  
Running a Hello World Program . . . . . 9  
    Installing the Python Extension for VS Code . . . . . 9  
    Running `hello_world.py` . . . . . 10  
Troubleshooting . . . . . 10  
Running Python Programs from a Terminal . . . . . 11  
    On Windows . . . . . 12  
    On macOS and Linux . . . . . 12  
    *Exercise 1-1: python.org* . . . . . 13  
    *Exercise 1-2: Hello World Typos* . . . . . 13  
    *Exercise 1-3: Infinite Skills* . . . . . 13  
Summary . . . . . 13

**2**  
**VARIABLES AND SIMPLE DATA TYPES** **15**

What Really Happens When You Run `hello_world.py` . . . . . 15  
Variables . . . . . 16  
    Naming and Using Variables . . . . . 17  
    Avoiding Name Errors When Using Variables . . . . . 17  
    Variables Are Labels . . . . . 18  
    *Exercise 2-1: Simple Message* . . . . . 19  
    *Exercise 2-2: Simple Messages* . . . . . 19

Strings . . . . .	19
Changing Case in a String with Methods . . . . .	20
Using Variables in Strings . . . . .	20
Adding Whitespace to Strings with Tabs or Newlines . . . . .	21
Stripping Whitespace . . . . .	22
Removing Prefixes . . . . .	23
Avoiding Syntax Errors with Strings . . . . .	24
<i>Exercise 2-3: Personal Message</i> . . . . .	25
<i>Exercise 2-4: Name Cases</i> . . . . .	25
<i>Exercise 2-5: Famous Quote</i> . . . . .	25
<i>Exercise 2-6: Famous Quote 2</i> . . . . .	25
<i>Exercise 2-7: Stripping Names</i> . . . . .	25
<i>Exercise 2-8: File Extensions</i> . . . . .	25
Numbers . . . . .	26
Integers . . . . .	26
Floats . . . . .	26
Integers and Floats . . . . .	27
Underscores in Numbers . . . . .	28
Multiple Assignment . . . . .	28
Constants . . . . .	28
<i>Exercise 2-9: Number Eight</i> . . . . .	29
<i>Exercise 2-10: Favorite Number</i> . . . . .	29
Comments . . . . .	29
How Do You Write Comments? . . . . .	29
What Kinds of Comments Should You Write? . . . . .	29
<i>Exercise 2-11: Adding Comments</i> . . . . .	30
The Zen of Python . . . . .	30
<i>Exercise 2-12: Zen of Python</i> . . . . .	31
Summary . . . . .	32

### 3

## INTRODUCING LISTS

33

What Is a List? . . . . .	33
Accessing Elements in a List . . . . .	34
Index Positions Start at 0, Not 1 . . . . .	34
Using Individual Values from a List . . . . .	35
<i>Exercise 3-1: Names</i> . . . . .	36
<i>Exercise 3-2: Greetings</i> . . . . .	36
<i>Exercise 3-3: Your Own List</i> . . . . .	36
Modifying, Adding, and Removing Elements . . . . .	36
Modifying Elements in a List . . . . .	36
Adding Elements to a List . . . . .	37
Removing Elements from a List . . . . .	38
<i>Exercise 3-4: Guest List</i> . . . . .	41
<i>Exercise 3-5: Changing Guest List</i> . . . . .	42
<i>Exercise 3-6: More Guests</i> . . . . .	42
<i>Exercise 3-7: Shrinking Guest List</i> . . . . .	42
Organizing a List . . . . .	42
Sorting a List Permanently with the <code>sort()</code> Method . . . . .	43
Sorting a List Temporarily with the <code>sorted()</code> Function . . . . .	43
Printing a List in Reverse Order . . . . .	44

Finding the Length of a List . . . . .	44
<i>Exercise 3-8: Seeing the World</i> . . . . .	45
<i>Exercise 3-9: Dinner Guests</i> . . . . .	45
<i>Exercise 3-10: Every Function</i> . . . . .	45
Avoiding Index Errors When Working with Lists . . . . .	46
<i>Exercise 3-11: Intentional Error</i> . . . . .	47
Summary . . . . .	47

## **4 WORKING WITH LISTS 49**

Looping Through an Entire List . . . . .	49
A Closer Look at Looping . . . . .	50
Doing More Work Within a for Loop . . . . .	51
Doing Something After a for Loop . . . . .	52
Avoiding Indentation Errors . . . . .	53
Forgetting to Indent . . . . .	53
Forgetting to Indent Additional Lines . . . . .	54
Indenting Unnecessarily . . . . .	54
Indenting Unnecessarily After the Loop . . . . .	55
Forgetting the Colon . . . . .	55
<i>Exercise 4-1: Pizzas</i> . . . . .	56
<i>Exercise 4-2: Animals</i> . . . . .	56
Making Numerical Lists . . . . .	56
Using the range() Function . . . . .	57
Using range() to Make a List of Numbers . . . . .	58
Simple Statistics with a List of Numbers . . . . .	59
List Comprehensions . . . . .	59
<i>Exercise 4-3: Counting to Twenty</i> . . . . .	60
<i>Exercise 4-4: One Million</i> . . . . .	60
<i>Exercise 4-5: Summing a Million</i> . . . . .	60
<i>Exercise 4-6: Odd Numbers</i> . . . . .	60
<i>Exercise 4-7: Threes</i> . . . . .	60
<i>Exercise 4-8: Cubes</i> . . . . .	60
<i>Exercise 4-9: Cube Comprehension</i> . . . . .	60
Working with Part of a List . . . . .	61
Slicing a List . . . . .	61
Looping Through a Slice . . . . .	62
Copying a List . . . . .	63
<i>Exercise 4-10: Slices</i> . . . . .	65
<i>Exercise 4-11: My Pizzas, Your Pizzas</i> . . . . .	65
<i>Exercise 4-12: More Loops</i> . . . . .	65
Tuples . . . . .	65
Defining a Tuple . . . . .	65
Looping Through All Values in a Tuple . . . . .	66
Writing Over a Tuple . . . . .	67
<i>Exercise 4-13: Buffet</i> . . . . .	67
Styling Your Code . . . . .	68
The Style Guide . . . . .	68
Indentation . . . . .	68
Line Length . . . . .	69
Blank Lines . . . . .	69

Other Style Guidelines . . . . .	69
Exercise 4-14: PEP 8 . . . . .	70
Exercise 4-15: Code Review . . . . .	70
Summary . . . . .	70

## **5**

### **IF STATEMENTS** **71**

A Simple Example . . . . .	72
Conditional Tests . . . . .	72
Checking for Equality . . . . .	72
Ignoring Case When Checking for Equality . . . . .	73
Checking for Inequality . . . . .	74
Numerical Comparisons . . . . .	74
Checking Multiple Conditions . . . . .	75
Checking Whether a Value Is in a List . . . . .	76
Checking Whether a Value Is Not in a List . . . . .	76
Boolean Expressions . . . . .	77
Exercise 5-1: Conditional Tests . . . . .	77
Exercise 5-2: More Conditional Tests . . . . .	78
if Statements . . . . .	78
Simple if Statements . . . . .	78
if-else Statements . . . . .	79
The if-elif-else Chain . . . . .	80
Using Multiple elif Blocks . . . . .	81
Omitting the else Block . . . . .	82
Testing Multiple Conditions . . . . .	82
Exercise 5-3: Alien Colors #1 . . . . .	84
Exercise 5-4: Alien Colors #2 . . . . .	84
Exercise 5-5: Alien Colors #3 . . . . .	84
Exercise 5-6: Stages of Life . . . . .	84
Exercise 5-7: Favorite Fruit . . . . .	85
Using if Statements with Lists . . . . .	85
Checking for Special Items . . . . .	85
Checking That a List Is Not Empty . . . . .	86
Using Multiple Lists . . . . .	87
Exercise 5-8: Hello Admin . . . . .	88
Exercise 5-9: No Users . . . . .	88
Exercise 5-10: Checking Usernames . . . . .	88
Exercise 5-11: Ordinal Numbers . . . . .	88
Styling Your if Statements . . . . .	89
Exercise 5-12: Styling if Statements . . . . .	89
Exercise 5-13: Your Ideas . . . . .	89
Summary . . . . .	89

## **6**

### **DICTIONARIES** **91**

A Simple Dictionary . . . . .	92
Working with Dictionaries . . . . .	92
Accessing Values in a Dictionary . . . . .	92
Adding New Key-Value Pairs . . . . .	93
Starting with an Empty Dictionary . . . . .	94

Modifying Values in a Dictionary . . . . .	94
Removing Key-Value Pairs . . . . .	96
A Dictionary of Similar Objects . . . . .	96
Using get() to Access Values . . . . .	97
<i>Exercise 6-1: Person</i> . . . . .	98
<i>Exercise 6-2: Favorite Numbers</i> . . . . .	98
<i>Exercise 6-3: Glossary</i> . . . . .	99
Looping Through a Dictionary . . . . .	99
Looping Through All Key-Value Pairs . . . . .	99
Looping Through All the Keys in a Dictionary . . . . .	101
Looping Through a Dictionary's Keys in a Particular Order . . . . .	102
Looping Through All Values in a Dictionary . . . . .	103
<i>Exercise 6-4: Glossary 2</i> . . . . .	104
<i>Exercise 6-5: Rivers</i> . . . . .	105
<i>Exercise 6-6: Polling</i> . . . . .	105
Nesting . . . . .	105
A List of Dictionaries . . . . .	105
A List in a Dictionary . . . . .	108
A Dictionary in a Dictionary . . . . .	110
<i>Exercise 6-7: People</i> . . . . .	111
<i>Exercise 6-8: Pets</i> . . . . .	111
<i>Exercise 6-9: Favorite Places</i> . . . . .	111
<i>Exercise 6-10: Favorite Numbers</i> . . . . .	111
<i>Exercise 6-11: Cities</i> . . . . .	111
<i>Exercise 6-12: Extensions</i> . . . . .	111
Summary . . . . .	111

## 7

### USER INPUT AND WHILE LOOPS

113

How the input() Function Works . . . . .	114
Writing Clear Prompts . . . . .	114
Using int() to Accept Numerical Input . . . . .	115
The Modulo Operator . . . . .	116
<i>Exercise 7-1: Rental Car</i> . . . . .	117
<i>Exercise 7-2: Restaurant Seating</i> . . . . .	117
<i>Exercise 7-3: Multiples of Ten</i> . . . . .	117
Introducing while Loops . . . . .	117
The while Loop in Action . . . . .	117
Letting the User Choose When to Quit . . . . .	118
Using a Flag . . . . .	120
Using break to Exit a Loop . . . . .	121
Using continue in a Loop . . . . .	122
Avoiding Infinite Loops . . . . .	122
<i>Exercise 7-4: Pizza Toppings</i> . . . . .	123
<i>Exercise 7-5: Movie Tickets</i> . . . . .	123
<i>Exercise 7-6: Three Exits</i> . . . . .	123
<i>Exercise 7-7: Infinity</i> . . . . .	123
Using a while Loop with Lists and Dictionaries . . . . .	124
Moving Items from One List to Another . . . . .	124
Removing All Instances of Specific Values from a List . . . . .	125
Filling a Dictionary with User Input . . . . .	125
<i>Exercise 7-8: Deli</i> . . . . .	127

<i>Exercise 7-9: No Pastrami</i> . . . . .	127
<i>Exercise 7-10: Dream Vacation</i> . . . . .	127
Summary . . . . .	127

## **8 FUNCTIONS 129**

Defining a Function . . . . .	130
Passing Information to a Function . . . . .	130
Arguments and Parameters . . . . .	131
<i>Exercise 8-1: Message</i> . . . . .	131
<i>Exercise 8-2: Favorite Book</i> . . . . .	131
Passing Arguments . . . . .	131
Positional Arguments . . . . .	132
Keyword Arguments . . . . .	133
Default Values . . . . .	134
Equivalent Function Calls . . . . .	135
Avoiding Argument Errors . . . . .	136
<i>Exercise 8-3: T-Shirt</i> . . . . .	136
<i>Exercise 8-4: Large Shirts</i> . . . . .	137
<i>Exercise 8-5: Cities</i> . . . . .	137
Return Values . . . . .	137
Returning a Simple Value . . . . .	137
Making an Argument Optional . . . . .	138
Returning a Dictionary . . . . .	139
Using a Function with a while Loop . . . . .	140
<i>Exercise 8-6: City Names</i> . . . . .	141
<i>Exercise 8-7: Album</i> . . . . .	142
<i>Exercise 8-8: User Albums</i> . . . . .	142
Passing a List . . . . .	142
Modifying a List in a Function . . . . .	143
Preventing a Function from Modifying a List . . . . .	145
<i>Exercise 8-9: Messages</i> . . . . .	146
<i>Exercise 8-10: Sending Messages</i> . . . . .	146
<i>Exercise 8-11: Archived Messages</i> . . . . .	146
Passing an Arbitrary Number of Arguments . . . . .	146
Mixing Positional and Arbitrary Arguments . . . . .	147
Using Arbitrary Keyword Arguments . . . . .	148
<i>Exercise 8-12: Sandwiches</i> . . . . .	149
<i>Exercise 8-13: User Profile</i> . . . . .	149
<i>Exercise 8-14: Cars</i> . . . . .	149
Storing Your Functions in Modules . . . . .	149
Importing an Entire Module . . . . .	150
Importing Specific Functions . . . . .	151
Using as to Give a Function an Alias . . . . .	151
Using as to Give a Module an Alias . . . . .	152
Importing All Functions in a Module . . . . .	152
Styling Functions . . . . .	153
<i>Exercise 8-15: Printing Models</i> . . . . .	154
<i>Exercise 8-16: Imports</i> . . . . .	154
<i>Exercise 8-17: Styling Functions</i> . . . . .	154
Summary . . . . .	154

## 9

### CLASSES

157

Creating and Using a Class . . . . .	158
Creating the Dog Class . . . . .	158
The <code>__init__()</code> Method . . . . .	159
Making an Instance from a Class . . . . .	159
<i>Exercise 9-1: Restaurant</i> . . . . .	162
<i>Exercise 9-2: Three Restaurants</i> . . . . .	162
<i>Exercise 9-3: Users</i> . . . . .	162
Working with Classes and Instances . . . . .	162
The Car Class . . . . .	162
Setting a Default Value for an Attribute . . . . .	163
Modifying Attribute Values . . . . .	164
<i>Exercise 9-4: Number Served</i> . . . . .	166
<i>Exercise 9-5: Login Attempts</i> . . . . .	167
Inheritance . . . . .	167
The <code>__init__()</code> Method for a Child Class . . . . .	167
Defining Attributes and Methods for the Child Class . . . . .	169
Overriding Methods from the Parent Class . . . . .	170
Instances as Attributes . . . . .	170
Modeling Real-World Objects . . . . .	172
<i>Exercise 9-6: Ice Cream Stand</i> . . . . .	173
<i>Exercise 9-7: Admin</i> . . . . .	173
<i>Exercise 9-8: Privileges</i> . . . . .	173
<i>Exercise 9-9: Battery Upgrade</i> . . . . .	173
Importing Classes . . . . .	173
Importing a Single Class . . . . .	174
Storing Multiple Classes in a Module . . . . .	175
Importing Multiple Classes from a Module . . . . .	176
Importing an Entire Module . . . . .	176
Importing All Classes from a Module . . . . .	177
Importing a Module into a Module . . . . .	177
Using Aliases . . . . .	178
Finding Your Own Workflow . . . . .	179
<i>Exercise 9-10: Imported Restaurant</i> . . . . .	179
<i>Exercise 9-11: Imported Admin</i> . . . . .	179
<i>Exercise 9-12: Multiple Modules</i> . . . . .	179
The Python Standard Library . . . . .	179
<i>Exercise 9-13: Dice</i> . . . . .	180
<i>Exercise 9-14: Lottery</i> . . . . .	180
<i>Exercise 9-15: Lottery Analysis</i> . . . . .	180
<i>Exercise 9-16: Python Module of the Week</i> . . . . .	180
Styling Classes . . . . .	181
Summary . . . . .	181

## 10

### FILES AND EXCEPTIONS

183

Reading from a File . . . . .	184
Reading the Contents of a File . . . . .	184
Relative and Absolute File Paths . . . . .	186
Accessing a File's Lines . . . . .	186

Working with a File's Contents . . . . .	187
Large Files: One Million Digits . . . . .	188
Is Your Birthday Contained in Pi? . . . . .	189
Exercise 10-1: Learning Python . . . . .	189
Exercise 10-2: Learning C . . . . .	190
Exercise 10-3: Simpler Code . . . . .	190
Writing to a File. . . . .	190
Writing a Single Line . . . . .	190
Writing Multiple Lines . . . . .	191
Exercise 10-4: Guest . . . . .	192
Exercise 10-5: Guest Book . . . . .	192
Exceptions. . . . .	192
Handling the ZeroDivisionError Exception . . . . .	192
Using try-except Blocks . . . . .	193
Using Exceptions to Prevent Crashes . . . . .	193
The else Block. . . . .	194
Handling the FileNotFoundError Exception . . . . .	195
Analyzing Text . . . . .	196
Working with Multiple Files . . . . .	197
Failing Silently . . . . .	198
Deciding Which Errors to Report. . . . .	199
Exercise 10-6: Addition . . . . .	200
Exercise 10-7: Addition Calculator . . . . .	200
Exercise 10-8: Cats and Dogs . . . . .	200
Exercise 10-9: Silent Cats and Dogs . . . . .	200
Exercise 10-10: Common Words . . . . .	200
Storing Data . . . . .	201
Using json.dumps() and json.loads() . . . . .	201
Saving and Reading User-Generated Data . . . . .	202
Refactoring. . . . .	204
Exercise 10-11: Favorite Number . . . . .	206
Exercise 10-12: Favorite Number Remembered . . . . .	206
Exercise 10-13: User Dictionary . . . . .	206
Exercise 10-14: Verify User . . . . .	206
Summary . . . . .	207

## 11

<b>TESTING YOUR CODE</b>	<b>209</b>
Installing pytest with pip . . . . .	210
Updating pip . . . . .	210
Installing pytest. . . . .	211
Testing a Function. . . . .	211
Unit Tests and Test Cases . . . . .	212
A Passing Test. . . . .	212
Running a Test . . . . .	213
A Failing Test . . . . .	214
Responding to a Failed Test . . . . .	215
Adding New Tests. . . . .	216
Exercise 11-1: City, Country. . . . .	217
Exercise 11-2: Population . . . . .	217



Testing a Class . . . . .	217
A Variety of Assertions . . . . .	217
A Class to Test . . . . .	218
Testing the AnonymousSurvey Class . . . . .	220
Using Fixtures . . . . .	221
<i>Exercise 11-3: Employee</i> . . . . .	223
Summary . . . . .	223

## PART II: PROJECTS

**225**

### 12

#### A SHIP THAT FIRES BULLETS

**227**

Planning Your Project . . . . .	228
Installing Pygame . . . . .	228
Starting the Game Project . . . . .	229
Creating a Pygame Window and Responding to User Input . . . . .	229
Controlling the Frame Rate . . . . .	230
Setting the Background Color . . . . .	231
Creating a Settings Class . . . . .	232
Adding the Ship Image . . . . .	233
Creating the Ship Class . . . . .	234
Drawing the Ship to the Screen . . . . .	235
Refactoring: The <code>_check_events()</code> and <code>_update_screen()</code> Methods . . . . .	237
The <code>_check_events()</code> Method . . . . .	237
The <code>_update_screen()</code> Method . . . . .	237
<i>Exercise 12-1: Blue Sky</i> . . . . .	238
<i>Exercise 12-2: Game Character</i> . . . . .	238
Piloting the Ship . . . . .	238
Responding to a Keypress . . . . .	238
Allowing Continuous Movement . . . . .	239
Moving Both Left and Right . . . . .	241
Adjusting the Ship's Speed . . . . .	242
Limiting the Ship's Range . . . . .	243
Refactoring <code>_check_events()</code> . . . . .	244
Pressing Q to Quit . . . . .	244
Running the Game in Fullscreen Mode . . . . .	245
A Quick Recap . . . . .	245
alien_invasion.py . . . . .	246
settings.py . . . . .	246
ship.py . . . . .	246
<i>Exercise 12-3: Pygame Documentation</i> . . . . .	246
<i>Exercise 12-4: Rocket</i> . . . . .	246
<i>Exercise 12-5: Keys</i> . . . . .	246
Shooting Bullets . . . . .	247
Adding the Bullet Settings . . . . .	247
Creating the Bullet Class . . . . .	247
Storing Bullets in a Group . . . . .	248
Firing Bullets . . . . .	249
Deleting Old Bullets . . . . .	250

Limiting the Number of Bullets . . . . .	251
Creating the <code>_update_bullets()</code> Method . . . . .	252
<i>Exercise 12-6: Sideways Shooter</i> . . . . .	253
Summary . . . . .	253

## 13

### ALIENS! 255

Reviewing the Project . . . . .	256
Creating the First Alien . . . . .	256
Creating the Alien Class . . . . .	257
Creating an Instance of the Alien . . . . .	257
Building the Alien Fleet . . . . .	259
Creating a Row of Aliens . . . . .	259
Refactoring <code>_create_fleet()</code> . . . . .	260
Adding Rows . . . . .	261
<i>Exercise 13-1: Stars</i> . . . . .	263
<i>Exercise 13-2: Better Stars</i> . . . . .	263
Making the Fleet Move . . . . .	263
Moving the Aliens Right . . . . .	263
Creating Settings for Fleet Direction . . . . .	264
Checking Whether an Alien Has Hit the Edge . . . . .	265
Dropping the Fleet and Changing Direction . . . . .	265
<i>Exercise 13-3: Raindrops</i> . . . . .	266
<i>Exercise 13-4: Steady Rain</i> . . . . .	266
Shooting Aliens . . . . .	266
Detecting Bullet Collisions . . . . .	267
Making Larger Bullets for Testing . . . . .	268
Repopulating the Fleet . . . . .	268
Speeding Up the Bullets . . . . .	269
Refactoring <code>_update_bullets()</code> . . . . .	269
<i>Exercise 13-5: Sideways Shooter Part 2</i> . . . . .	270
Ending the Game . . . . .	270
Detecting Alien-Ship Collisions . . . . .	270
Responding to Alien-Ship Collisions . . . . .	271
Aliens That Reach the Bottom of the Screen . . . . .	273
Game Over! . . . . .	274
Identifying When Parts of the Game Should Run . . . . .	275
<i>Exercise 13-6: Game Over</i> . . . . .	275
Summary . . . . .	275

## 14

### SCORING 277

Adding the Play Button . . . . .	278
Creating a Button Class . . . . .	278
Drawing the Button to the Screen . . . . .	279
Starting the Game . . . . .	281
Resetting the Game . . . . .	281
Deactivating the Play Button . . . . .	282
Hiding the Mouse Cursor . . . . .	282
<i>Exercise 14-1: Press P to Play</i> . . . . .	283
<i>Exercise 14-2: Target Practice</i> . . . . .	283

Leveling Up . . . . .	283
Modifying the Speed Settings . . . . .	283
Resetting the Speed . . . . .	285
<i>Exercise 14-3: Challenging Target Practice</i> . . . . .	286
<i>Exercise 14-4: Difficulty Levels</i> . . . . .	286
Scoring . . . . .	286
Displaying the Score . . . . .	286
Making a Scoreboard . . . . .	287
Updating the Score as Aliens Are Shot Down . . . . .	289
Resetting the Score . . . . .	289
Making Sure to Score All Hits . . . . .	290
Increasing Point Values . . . . .	290
Rounding the Score . . . . .	291
High Scores . . . . .	292
Displaying the Level. . . . .	294
Displaying the Number of Ships . . . . .	296
<i>Exercise 14-5: All-Time High Score</i> . . . . .	299
<i>Exercise 14-6: Refactoring</i> . . . . .	299
<i>Exercise 14-7: Expanding the Game</i> . . . . .	299
<i>Exercise 14-8: Sideways Shooter, Final Version</i> . . . . .	299
Summary . . . . .	299

## 15

### GENERATING DATA

**301**

Installing Matplotlib . . . . .	302
Plotting a Simple Line Graph . . . . .	302
Changing the Label Type and Line Thickness . . . . .	303
Correcting the Plot. . . . .	305
Using Built-in Styles . . . . .	306
Plotting and Styling Individual Points with <code>scatter()</code> . . . . .	306
Plotting a Series of Points with <code>scatter()</code> . . . . .	308
Calculating Data Automatically. . . . .	308
Customizing Tick Labels . . . . .	309
Defining Custom Colors . . . . .	310
Using a Colormap. . . . .	310
Saving Your Plots Automatically . . . . .	311
<i>Exercise 15-1: Cubes</i> . . . . .	311
<i>Exercise 15-2: Colored Cubes</i> . . . . .	311
Random Walks . . . . .	312
Creating the RandomWalk Class. . . . .	312
Choosing Directions . . . . .	312
Plotting the Random Walk . . . . .	313
Generating Multiple Random Walks . . . . .	314
Styling the Walk . . . . .	315
<i>Exercise 15-3: Molecular Motion</i> . . . . .	319
<i>Exercise 15-4: Modified Random Walks</i> . . . . .	319
<i>Exercise 15-5: Refactoring</i> . . . . .	319
Rolling Dice with Plotly . . . . .	319
Installing Plotly . . . . .	320
Creating the Die Class. . . . .	320
Rolling the Die . . . . .	320
Analyzing the Results. . . . .	321

Making a Histogram . . . . .	322
Customizing the Plot . . . . .	323
Rolling Two Dice . . . . .	324
Further Customizations. . . . .	325
Rolling Dice of Different Sizes. . . . .	326
Saving Figures . . . . .	327
<i>Exercise 15-6: Two D8s</i> . . . . .	328
<i>Exercise 15-7: Three Dice</i> . . . . .	328
<i>Exercise 15-8: Multiplication</i> . . . . .	328
<i>Exercise 15-9: Die Comprehensions</i> . . . . .	328
<i>Exercise 15-10: Practicing with Both Libraries.</i> . . . . .	328
Summary . . . . .	328

## **16**

### **DOWNLOADING DATA** **329**

The CSV File Format . . . . .	330
Parsing the CSV File Headers . . . . .	330
Printing the Headers and Their Positions. . . . .	331
Extracting and Reading Data . . . . .	332
Plotting Data in a Temperature Chart . . . . .	332
The datetime Module . . . . .	333
Plotting Dates . . . . .	334
Plotting a Longer Timeframe . . . . .	336
Plotting a Second Data Series. . . . .	336
Shading an Area in the Chart. . . . .	337
Error Checking . . . . .	338
Downloading Your Own Data. . . . .	341
<i>Exercise 16-1: Sitka Rainfall</i> . . . . .	342
<i>Exercise 16-2: Sitka–Death Valley Comparison.</i> . . . . .	342
<i>Exercise 16-3: San Francisco</i> . . . . .	342
<i>Exercise 16-4: Automatic Indexes</i> . . . . .	342
<i>Exercise 16-5: Explore.</i> . . . . .	342
Mapping Global Datasets: GeoJSON Format . . . . .	342
Downloading Earthquake Data . . . . .	343
Examining GeoJSON Data. . . . .	343
Making a List of All Earthquakes . . . . .	345
Extracting Magnitudes . . . . .	346
Extracting Location Data . . . . .	346
Building a World Map . . . . .	347
Representing Magnitudes . . . . .	348
Customizing Marker Colors . . . . .	349
Other Color Scales . . . . .	350
Adding Hover Text . . . . .	350
<i>Exercise 16-6: Refactoring</i> . . . . .	352
<i>Exercise 16-7: Automated Title.</i> . . . . .	352
<i>Exercise 16-8: Recent Earthquakes</i> . . . . .	352
<i>Exercise 16-9: World Fires</i> . . . . .	352
Summary . . . . .	352

## 17

### WORKING WITH APIS

355

Using an API . . . . .	355
Git and GitHub . . . . .	356
Requesting Data Using an API Call . . . . .	356
Installing Requests . . . . .	357
Processing an API Response . . . . .	357
Working with the Response Dictionary . . . . .	358
Summarizing the Top Repositories . . . . .	361
Monitoring API Rate Limits . . . . .	362
Visualizing Repositories Using Plotly . . . . .	362
Styling the Chart . . . . .	364
Adding Custom Tooltips . . . . .	365
Adding Clickable Links . . . . .	366
Customizing Marker Colors . . . . .	367
More About Plotly and the GitHub API . . . . .	368
The Hacker News API . . . . .	368
<i>Exercise 17-1: Other Languages</i> . . . . .	371
<i>Exercise 17-2: Active Discussions</i> . . . . .	371
<i>Exercise 17-3: Testing python_repos.py</i> . . . . .	372
<i>Exercise 17-4: Further Exploration</i> . . . . .	372
Summary . . . . .	372

## 18

### GETTING STARTED WITH DJANGO

373

Setting Up a Project . . . . .	374
Writing a Spec . . . . .	374
Creating a Virtual Environment . . . . .	374
Activating the Virtual Environment . . . . .	375
Installing Django . . . . .	375
Creating a Project in Django . . . . .	376
Creating the Database . . . . .	376
Viewing the Project . . . . .	377
<i>Exercise 18-1: New Projects</i> . . . . .	378
Starting an App . . . . .	379
Defining Models . . . . .	379
Activating Models . . . . .	380
The Django Admin Site . . . . .	381
Defining the Entry Model . . . . .	384
Migrating the Entry Model . . . . .	385
Registering Entry with the Admin Site . . . . .	385
The Django Shell . . . . .	386
<i>Exercise 18-2: Short Entries</i> . . . . .	387
<i>Exercise 18-3: The Django API</i> . . . . .	388
<i>Exercise 18-4: Pizzeria</i> . . . . .	388
Making Pages: The Learning Log Home Page . . . . .	388
Mapping a URL . . . . .	388
Writing a View . . . . .	390
Writing a Template . . . . .	390

<i>Exercise 18-5: Meal Planner</i> . . . . .	392
<i>Exercise 18-6: Pizzeria Home Page</i> . . . . .	392
Building Additional Pages . . . . .	392
Template Inheritance . . . . .	392
The Topics Page . . . . .	394
Individual Topic Pages . . . . .	397
<i>Exercise 18-7: Template Documentation</i> . . . . .	400
<i>Exercise 18-8: Pizzeria Pages</i> . . . . .	400
Summary . . . . .	400

## 19

### **USER ACCOUNTS 403**

Allowing Users to Enter Data . . . . .	404
Adding New Topics . . . . .	404
Adding New Entries . . . . .	408
Editing Entries . . . . .	412
<i>Exercise 19-1: Blog</i> . . . . .	415
Setting Up User Accounts . . . . .	415
The accounts App . . . . .	415
The Login Page . . . . .	416
Logging Out . . . . .	419
The Registration Page . . . . .	420
<i>Exercise 19-2: Blog Accounts</i> . . . . .	423
Allowing Users to Own Their Data . . . . .	423
Restricting Access with @login_required . . . . .	423
Connecting Data to Certain Users . . . . .	425
Restricting Topics Access to Appropriate Users . . . . .	427
Protecting a User's Topics . . . . .	428
Protecting the edit_entry Page . . . . .	429
Associating New Topics with the Current User . . . . .	429
<i>Exercise 19-3: Refactoring</i> . . . . .	430
<i>Exercise 19-4: Protecting new_entry</i> . . . . .	430
<i>Exercise 19-5: Protected Blog</i> . . . . .	430
Summary . . . . .	430

## 20

### **STYLING AND DEPLOYING AN APP 433**

Styling Learning Log . . . . .	434
The django-bootstrap5 App . . . . .	434
Using Bootstrap to Style Learning Log . . . . .	434
Modifying base.html . . . . .	435
Styling the Home Page Using a Jumbotron . . . . .	440
Styling the Login Page . . . . .	441
Styling the Topics Page . . . . .	442
Styling the Entries on the Topic Page . . . . .	443
<i>Exercise 20-1: Other Forms</i> . . . . .	445
<i>Exercise 20-2: Stylish Blog</i> . . . . .	445
Deploying Learning Log . . . . .	445
Making a Platform.sh Account . . . . .	445
Installing the Platform.sh CLI . . . . .	446
Installing platformshconfig . . . . .	446

Creating a requirements.txt File . . . . .	446
Additional Deployment Requirements . . . . .	447
Adding Configuration Files . . . . .	447
Modifying settings.py for Platform.sh . . . . .	451
Using Git to Track the Project's Files . . . . .	451
Creating a Project on Platform.sh . . . . .	453
Pushing to Platform.sh . . . . .	455
Viewing the Live Project . . . . .	456
Refining the Platform.sh Deployment . . . . .	456
Creating Custom Error Pages . . . . .	459
Ongoing Development . . . . .	460
Deleting a Project on Platform.sh . . . . .	461
<i>Exercise 20-3: Live Blog</i> . . . . .	461
<i>Exercise 20-4: Extended Learning Log</i> . . . . .	462
Summary . . . . .	462

## **A** **INSTALLATION AND TROUBLESHOOTING** **463**

Python on Windows . . . . .	463
Using py Instead of python . . . . .	463
Rerunning the Installer . . . . .	464
Python on macOS . . . . .	464
Accidentally Installing Apple's Version of Python . . . . .	464
Python 2 on Older Versions of macOS . . . . .	465
Python on Linux . . . . .	465
Using the Default Python Installation . . . . .	465
Installing the Latest Version of Python . . . . .	465
Checking Which Version of Python You're Using . . . . .	466
Python Keywords and Built-in Functions . . . . .	466
Python Keywords . . . . .	466
Python Built-in Functions . . . . .	467

## **B** **TEXT EDITORS AND IDES** **469**

Working Efficiently with VS Code . . . . .	470
Configuring VS Code . . . . .	470
VS Code Shortcuts . . . . .	473
Other Text Editors and IDEs . . . . .	474
IDLE . . . . .	474
Geany . . . . .	474
Sublime Text . . . . .	474
Emacs and Vim . . . . .	475
PyCharm . . . . .	475
Jupyter Notebooks . . . . .	475

## **C** **GETTING HELP** **477**

First Steps . . . . .	477
Try It Again . . . . .	478
Take a Break . . . . .	478
Refer to This Book's Resources . . . . .	478

Searching Online . . . . .	479
Stack Overflow . . . . .	479
The Official Python Documentation . . . . .	479
Official Library Documentation . . . . .	480
r/learnpython . . . . .	480
Blog Posts . . . . .	480
Discord . . . . .	480
Slack . . . . .	481

**D**  
**USING GIT FOR VERSION CONTROL** **483**

Installing Git . . . . .	484
Configuring Git . . . . .	484
Making a Project . . . . .	484
Ignoring Files . . . . .	484
Initializing a Repository . . . . .	485
Checking the Status . . . . .	485
Adding Files to the Repository . . . . .	486
Making a Commit . . . . .	486
Checking the Log . . . . .	487
The Second Commit . . . . .	487
Abandoning Changes . . . . .	488
Checking Out Previous Commits . . . . .	489
Deleting the Repository . . . . .	491

**E**  
**TROUBLESHOOTING DEPLOYMENTS** **493**

Understanding Deployments . . . . .	494
Basic Troubleshooting . . . . .	494
Follow Onscreen Suggestions . . . . .	495
Read the Log Output . . . . .	496
OS-Specific Troubleshooting . . . . .	497
Deploying from Windows . . . . .	497
Deploying from macOS . . . . .	499
Deploying from Linux . . . . .	499
Other Deployment Approaches . . . . .	500

**INDEX** **503**