

# **AUTOMATE THE BORING STUFF WITH PYTHON**

## **2ND EDITION**

**Practical Programming  
for Total Beginners**

by Al Sweigart



**no starch  
press**

San Francisco

**AUTOMATE THE BORING STUFF WITH PYTHON, 2ND EDITION.** Copyright © 2020 by Al Sweigart.

All rights reserved. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage or retrieval system, without the prior written permission of the copyright owner and the publisher.

ISBN-10: 1-59327-992-2

ISBN-13: 978-1-59327-992-9

Publisher: William Pollock

Production Editor: Laurel Chun

Cover Illustration: Josh Ellingson

Interior Design: Octopod Studios

Developmental Editors: Frances Saux and Jan Cash

Technical Reviewers: Ari Lacenski and Philip James

Copyeditors: Kim Wimpsett, Britt Bogan, and Paula L. Fleming

Compositors: Susan Glinert Stevens and Danielle Foster

Proofreaders: Lisa Devoto Farrell and Emelie Burnette

Indexer: BIM Indexing and Proofreading Services

For information on distribution, translations, or bulk sales,  
please contact No Starch Press, Inc. directly:

No Starch Press, Inc.

245 8th Street, San Francisco, CA 94103

phone: 1.415.863.9900; [info@nostarch.com](mailto:info@nostarch.com)

[www.nostarch.com](http://www.nostarch.com)

The Library of Congress Control Number for the first edition is: 2014953114

No Starch Press and the No Starch Press logo are registered trademarks of No Starch Press, Inc. Other product and company names mentioned herein may be the trademarks of their respective owners. Rather than use a trademark symbol with every occurrence of a trademarked name, we are using the names only in an editorial fashion and to the benefit of the trademark owner, with no intention of infringement of the trademark.

The information in this book is distributed on an “As Is” basis, without warranty. While every precaution has been taken in the preparation of this work, neither the author nor No Starch Press, Inc. shall have any liability to any person or entity with respect to any loss or damage caused or alleged to be caused directly or indirectly by the information contained in it.

This work is licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 United States License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc-sa/3.0/us/> or send a letter to Creative Commons, PO Box 1866, Mountain View, CA 94042, USA.

# BRIEF CONTENTS

Acknowledgments . . . . .	xxv
Introduction . . . . .	xxvii

## PART I: PYTHON PROGRAMMING BASICS

Chapter 1: Python Basics . . . . .	3
Chapter 2: Flow Control . . . . .	21
Chapter 3: Functions . . . . .	57
Chapter 4: Lists . . . . .	77
Chapter 5: Dictionaries and Structuring Data. . . . .	111
Chapter 6: Manipulating Strings . . . . .	129

## PART II: AUTOMATING TASKS

Chapter 7: Pattern Matching with Regular Expressions . . . . .	161
Chapter 8: Input Validation . . . . .	187
Chapter 9: Reading and Writing Files . . . . .	201
Chapter 10: Organizing Files . . . . .	231
Chapter 11: Debugging . . . . .	249
Chapter 12: Web Scraping . . . . .	267
Chapter 13: Working with Excel Spreadsheets . . . . .	301
Chapter 14: Working with Google Sheets . . . . .	329
Chapter 15: Working with PDF and Word Documents . . . . .	347
Chapter 16: Working with CSV Files and JSON Data . . . . .	371
Chapter 17: Keeping Time, Scheduling Tasks, and Launching Programs . . . . .	389
Chapter 18: Sending Email and Text Messages . . . . .	415

Chapter 19: Manipulating Images . . . . .	447
Chapter 20: Controlling the Keyboard and Mouse with GUI Automation . . . . .	473
Appendix A: Installing Third-Party Modules . . . . .	507
Appendix B: Running Programs . . . . .	511
Appendix C: Answers to the Practice Questions. . . . .	517
Index . . . . .	531

# CONTENTS IN DETAIL

## ACKNOWLEDGMENTS

**xxv**

## INTRODUCTION

**xxvii**

Whom Is This Book For? . . . . .	xxviii
Conventions . . . . .	xxviii
What Is Programming? . . . . .	xxix
What Is Python? . . . . .	xxx
Programmers Don't Need to Know Much Math . . . . .	xxx
You Are Not Too Old to Learn Programming . . . . .	xxxi
Programming Is a Creative Activity . . . . .	xxxi
About This Book. . . . .	xxxi
Downloading and Installing Python . . . . .	xxxiii
Downloading and Installing Mu . . . . .	xxxiv
Starting Mu . . . . .	xxxiv
Starting IDLE . . . . .	xxxv
The Interactive Shell . . . . .	xxxv
Installing Third-Party Modules . . . . .	xxxvi
How to Find Help. . . . .	xxxvi
Asking Smart Programming Questions . . . . .	xxxviii
Summary . . . . .	xxxix

## PART I: PYTHON PROGRAMMING BASICS

### 1

## PYTHON BASICS

**3**

Entering Expressions into the Interactive Shell. . . . .	4
The Integer, Floating-Point, and String Data Types . . . . .	7
String Concatenation and Replication. . . . .	7
Storing Values in Variables . . . . .	9
Assignment Statements. . . . .	9
Variable Names . . . . .	10
Your First Program . . . . .	11
Dissecting Your Program. . . . .	13
Comments . . . . .	13
The print() Function . . . . .	13
The input() Function . . . . .	14
Printing the User's Name . . . . .	14
The len() Function . . . . .	14
The str(), int(), and float() Functions . . . . .	15
Summary . . . . .	18
Practice Questions . . . . .	19

<b>2</b>	<b>21</b>
<b>FLOW CONTROL</b>	
Boolean Values . . . . .	22
Comparison Operators . . . . .	23
Boolean Operators . . . . .	25
Binary Boolean Operators . . . . .	25
The not Operator . . . . .	26
Mixing Boolean and Comparison Operators . . . . .	26
Elements of Flow Control . . . . .	27
Conditions . . . . .	27
Blocks of Code . . . . .	27
Program Execution . . . . .	28
Flow Control Statements . . . . .	28
if Statements . . . . .	28
else Statements . . . . .	29
elif Statements . . . . .	30
while Loop Statements . . . . .	35
break Statements . . . . .	39
continue Statements . . . . .	40
for Loops and the range() Function . . . . .	44
Importing Modules . . . . .	47
from import Statements . . . . .	48
Ending a Program Early with the sys.exit() Function . . . . .	49
A Short Program: Guess the Number . . . . .	49
A Short Program: Rock, Paper, Scissors . . . . .	51
Summary . . . . .	55
Practice Questions . . . . .	55
 <b>3</b>	 <b>57</b>
<b>FUNCTIONS</b>	
def Statements with Parameters . . . . .	59
Define, Call, Pass, Argument, Parameter . . . . .	59
Return Values and return Statements . . . . .	60
The None Value . . . . .	61
Keyword Arguments and the print() Function . . . . .	62
The Call Stack . . . . .	63
Local and Global Scope . . . . .	65
Local Variables Cannot Be Used in the Global Scope . . . . .	66
Local Scopes Cannot Use Variables in Other Local Scopes . . . . .	67
Global Variables Can Be Read from a Local Scope . . . . .	67
Local and Global Variables with the Same Name . . . . .	68
The global Statement . . . . .	68
Exception Handling . . . . .	71
A Short Program: Zigzag . . . . .	72
Summary . . . . .	75
Practice Questions . . . . .	75

Practice Projects . . . . .	76
The Collatz Sequence . . . . .	76
Input Validation . . . . .	76

## 4 LISTS 77

The List Data Type . . . . .	78
Getting Individual Values in a List with Indexes . . . . .	78
Negative Indexes . . . . .	80
Getting a List from Another List with Slices . . . . .	80
Getting a List's Length with the len() Function . . . . .	81
Changing Values in a List with Indexes . . . . .	81
List Concatenation and List Replication . . . . .	81
Removing Values from Lists with del Statements . . . . .	82
Working with Lists . . . . .	82
Using for Loops with Lists . . . . .	84
The in and not in Operators . . . . .	84
The Multiple Assignment Trick . . . . .	85
Using the enumerate() Function with Lists . . . . .	86
Using the random.choice() and random.shuffle() Functions with Lists . . . . .	86
Augmented Assignment Operators . . . . .	87
Methods . . . . .	88
Finding a Value in a List with the index() Method . . . . .	88
Adding Values to Lists with the append() and insert() Methods . . . . .	89
Removing Values from Lists with the remove() Method . . . . .	90
Sorting the Values in a List with the sort() Method . . . . .	90
Reversing the Values in a List with the reverse() Method . . . . .	91
Example Program: Magic 8 Ball with a List . . . . .	92
Sequence Data Types . . . . .	93
Mutable and Immutable Data Types . . . . .	94
The Tuple Data Type . . . . .	96
Converting Types with the list() and tuple() Functions . . . . .	97
References . . . . .	97
Identity and the id() Function . . . . .	99
Passing References . . . . .	100
The copy Module's copy() and deepcopy() Functions . . . . .	101
A Short Program: Conway's Game of Life . . . . .	102
Summary . . . . .	106
Practice Questions . . . . .	106
Practice Projects . . . . .	107
Comma Code . . . . .	107
Coin Flip Streaks . . . . .	107
Character Picture Grid . . . . .	108

## 5 DICTIONARIES AND STRUCTURING DATA 111

The Dictionary Data Type . . . . .	111
Dictionaries vs. Lists . . . . .	112
The keys(), values(), and items() Methods . . . . .	114

Checking Whether a Key or Value Exists in a Dictionary . . . . .	115
The get() Method . . . . .	116
The setdefault() Method . . . . .	116
Pretty Printing . . . . .	118
Using Data Structures to Model Real-World Things . . . . .	119
A Tic-Tac-Toe Board . . . . .	120
Nested Dictionaries and Lists . . . . .	125
Summary . . . . .	126
Practice Questions . . . . .	126
Practice Projects . . . . .	127
Chess Dictionary Validator . . . . .	127
Fantasy Game Inventory . . . . .	127
List to Dictionary Function for Fantasy Game Inventory . . . . .	128

## 6 **MANIPULATING STRINGS** **129**

Working with Strings . . . . .	130
String Literals . . . . .	130
Indexing and Slicing Strings . . . . .	132
The in and not in Operators with Strings . . . . .	133
Putting Strings Inside Other Strings . . . . .	134
Useful String Methods . . . . .	134
The upper(), lower(), isupper(), and islower() Methods . . . . .	135
The isX() Methods . . . . .	136
The startswith() and endswith() Methods . . . . .	138
The join() and split() Methods . . . . .	138
Splitting Strings with the partition() Method . . . . .	140
Justifying Text with the rjust(), ljust(), and center() Methods . . . . .	140
Removing Whitespace with the strip(),rstrip(), and lstrip() Methods . . . . .	142
Numeric Values of Characters with the ord() and chr() Functions . . . . .	143
Copying and Pasting Strings with the pyperclip Module . . . . .	143
Project: Multi-Clipboard Automatic Messages . . . . .	144
Step 1: Program Design and Data Structures . . . . .	144
Step 2: Handle Command Line Arguments . . . . .	145
Step 3: Copy the Right Phrase . . . . .	146
Project: Adding Bullets to Wiki Markup . . . . .	147
Step 1: Copy and Paste from the Clipboard . . . . .	147
Step 2: Separate the Lines of Text and Add the Star . . . . .	148
Step 3: Join the Modified Lines . . . . .	148
A Short Program: Pig Latin . . . . .	149
Summary . . . . .	153
Practice Questions . . . . .	153
Practice Projects . . . . .	154
Table Printer . . . . .	154
Zombie Dice Bots . . . . .	155



## PART II: AUTOMATING TASKS

### 7

## PATTERN MATCHING WITH REGULAR EXPRESSIONS 161

Finding Patterns of Text Without Regular Expressions . . . . .	162
Finding Patterns of Text with Regular Expressions . . . . .	164
Creating Regex Objects . . . . .	165
Matching Regex Objects . . . . .	165
Review of Regular Expression Matching . . . . .	166
More Pattern Matching with Regular Expressions . . . . .	166
Grouping with Parentheses . . . . .	166
Matching Multiple Groups with the Pipe . . . . .	168
Optional Matching with the Question Mark . . . . .	168
Matching Zero or More with the Star . . . . .	169
Matching One or More with the Plus . . . . .	170
Matching Specific Repetitions with Braces . . . . .	170
Greedy and Non-greedy Matching . . . . .	171
The findall() Method . . . . .	171
Character Classes . . . . .	172
Making Your Own Character Classes . . . . .	173
The Caret and Dollar Sign Characters . . . . .	174
The Wildcard Character . . . . .	175
Matching Everything with Dot-Star . . . . .	175
Matching Newlines with the Dot Character . . . . .	176
Review of Regex Symbols . . . . .	177
Case-Insensitive Matching . . . . .	177
Substituting Strings with the sub() Method . . . . .	178
Managing Complex Regexes . . . . .	178
Combining re.IGNORECASE, re.DOTALL, and re.VERBOSE . . . . .	179
Project: Phone Number and Email Address Extractor . . . . .	179
Step 1: Create a Regex for Phone Numbers . . . . .	180
Step 2: Create a Regex for Email Addresses . . . . .	181
Step 3: Find All Matches in the Clipboard Text . . . . .	182
Step 4: Join the Matches into a String for the Clipboard . . . . .	183
Running the Program . . . . .	183
Ideas for Similar Programs . . . . .	183
Summary . . . . .	184
Practice Questions . . . . .	184
Practice Projects . . . . .	186
Date Detection . . . . .	186
Strong Password Detection . . . . .	186
Regex Version of the strip() Method . . . . .	186

### 8

## INPUT VALIDATION 187

The PyInputPlus Module . . . . .	188
The min, max, greaterThan, and lessThan Keyword Arguments . . . . .	190
The blank Keyword Argument . . . . .	191

The limit, timeout, and default Keyword Arguments . . . . .	191
The allowRegexes and blockRegexes Keyword Arguments . . . . .	192
Passing a Custom Validation Function to inputCustom() . . . . .	193
Project: How to Keep an Idiot Busy for Hours. . . . .	194
Project: Multiplication Quiz . . . . .	196
Summary . . . . .	197
Practice Questions . . . . .	198
Practice Projects . . . . .	198
Sandwich Maker. . . . .	198
Write Your Own Multiplication Quiz . . . . .	199

## 9

### READING AND WRITING FILES

**201**

Files and File Paths. . . . .	201
Backslash on Windows and Forward Slash on macOS and Linux . . . . .	202
Using the / Operator to Join Paths . . . . .	204
The Current Working Directory . . . . .	205
The Home Directory. . . . .	206
Absolute vs. Relative Paths . . . . .	206
Creating New Folders Using the os.makedirs() Function . . . . .	207
Handling Absolute and Relative Paths . . . . .	208
Getting the Parts of a File Path . . . . .	209
Finding File Sizes and Folder Contents. . . . .	212
Modifying a List of Files Using Glob Patterns . . . . .	213
Checking Path Validity. . . . .	214
The File Reading/Writing Process . . . . .	215
Opening Files with the open() Function . . . . .	217
Reading the Contents of Files . . . . .	217
Writing to Files . . . . .	218
Saving Variables with the shelve Module . . . . .	219
Saving Variables with the pprint.pformat() Function . . . . .	220
Project: Generating Random Quiz Files. . . . .	221
Step 1: Store the Quiz Data in a Dictionary . . . . .	222
Step 2: Create the Quiz File and Shuffle the Question Order . . . . .	223
Step 3: Create the Answer Options. . . . .	224
Step 4: Write Content to the Quiz and Answer Key Files . . . . .	225
Project: Updatable Multi-Clipboard . . . . .	226
Step 1: Comments and Shelf Setup . . . . .	227
Step 2: Save Clipboard Content with a Keyword . . . . .	227
Step 3: List Keywords and Load a Keyword's Content . . . . .	228
Summary . . . . .	229
Practice Questions . . . . .	229
Practice Projects . . . . .	229
Extending the Multi-Clipboard. . . . .	229
Mad Libs . . . . .	230
Regex Search . . . . .	230

## **10 ORGANIZING FILES 231**

The shutil Module . . . . .	232
Copying Files and Folders . . . . .	232
Moving and Renaming Files and Folders . . . . .	233
Permanently Deleting Files and Folders . . . . .	234
Safe Deletes with the send2trash Module . . . . .	235
Walking a Directory Tree . . . . .	235
Compressing Files with the zipfile Module . . . . .	237
Reading ZIP Files . . . . .	238
Extracting from ZIP Files . . . . .	238
Creating and Adding to ZIP Files . . . . .	239
Project: Renaming Files with American-Style Dates to European-Style Dates . . . . .	240
Step 1: Create a Regex for American-Style Dates . . . . .	240
Step 2: Identify the Date Parts from the Filenames . . . . .	241
Step 3: Form the New Filename and Rename the Files . . . . .	242
Ideas for Similar Programs . . . . .	243
Project: Backing Up a Folder into a ZIP File . . . . .	243
Step 1: Figure Out the ZIP File's Name . . . . .	243
Step 2: Create the New ZIP File . . . . .	245
Step 3: Walk the Directory Tree and Add to the ZIP File . . . . .	245
Ideas for Similar Programs . . . . .	246
Summary . . . . .	246
Practice Questions . . . . .	247
Practice Projects . . . . .	247
Selective Copy . . . . .	247
Deleting Unneeded Files . . . . .	247
Filling in the Gaps . . . . .	248

## **11 DEBUGGING 249**

Raising Exceptions . . . . .	250
Getting the Traceback as a String . . . . .	251
Assertions . . . . .	253
Using an Assertion in a Traffic Light Simulation . . . . .	254
Logging . . . . .	255
Using the logging Module . . . . .	256
Don't Debug with the print() Function . . . . .	257
Logging Levels . . . . .	258
Disabling Logging . . . . .	259
Logging to a File . . . . .	259
Mu's Debugger . . . . .	260
Continue . . . . .	261
Step In . . . . .	261
Step Over . . . . .	261
Step Out . . . . .	261
Stop . . . . .	261

Debugging a Number Adding Program . . . . .	261
Breakpoints . . . . .	263
Summary . . . . .	264
Practice Questions . . . . .	265
Practice Project . . . . .	266
Debugging Coin Toss . . . . .	266

## 12

### WEB SCRAPING

**267**

Project: mapIt.py with the webbrowser Module . . . . .	268
Step 1: Figure Out the URL . . . . .	268
Step 2: Handle the Command Line Arguments . . . . .	269
Step 3: Handle the Clipboard Content and Launch the Browser . . . . .	270
Ideas for Similar Programs . . . . .	270
Downloading Files from the Web with the requests Module . . . . .	271
Downloading a Web Page with the requests.get() Function . . . . .	271
Checking for Errors . . . . .	272
Saving Downloaded Files to the Hard Drive . . . . .	273
HTML . . . . .	274
Resources for Learning HTML . . . . .	274
A Quick Refresher . . . . .	274
Viewing the Source HTML of a Web Page . . . . .	275
Opening Your Browser's Developer Tools . . . . .	276
Using the Developer Tools to Find HTML Elements . . . . .	278
Parsing HTML with the bs4 Module . . . . .	279
Creating a BeautifulSoup Object from HTML . . . . .	280
Finding an Element with the select() Method . . . . .	280
Getting Data from an Element's Attributes . . . . .	282
Project: Opening All Search Results . . . . .	283
Step 1: Get the Command Line Arguments and Request the Search Page . . . . .	283
Step 2: Find All the Results . . . . .	284
Step 3: Open Web Browsers for Each Result . . . . .	285
Ideas for Similar Programs . . . . .	285
Project: Downloading All XKCD Comics . . . . .	286
Step 1: Design the Program . . . . .	287
Step 2: Download the Web Page . . . . .	288
Step 3: Find and Download the Comic Image . . . . .	288
Step 4: Save the Image and Find the Previous Comic . . . . .	289
Ideas for Similar Programs . . . . .	290
Controlling the Browser with the selenium Module . . . . .	291
Starting a selenium-Controlled Browser . . . . .	291
Finding Elements on the Page . . . . .	293
Clicking the Page . . . . .	295
Filling Out and Submitting Forms . . . . .	295
Sending Special Keys . . . . .	296
Clicking Browser Buttons . . . . .	297
More Information on Selenium . . . . .	297

Summary . . . . .	297
Practice Questions . . . . .	297
Practice Projects . . . . .	298
Command Line Emailer . . . . .	298
Image Site Downloader . . . . .	298
2048 . . . . .	299
Link Verification . . . . .	299

## 13

### **WORKING WITH EXCEL SPREADSHEETS 301**

Excel Documents . . . . .	302
Installing the openpyxl Module . . . . .	302
Reading Excel Documents . . . . .	302
Opening Excel Documents with OpenPyXL . . . . .	303
Getting Sheets from the Workbook . . . . .	304
Getting Cells from the Sheets . . . . .	304
Converting Between Column Letters and Numbers . . . . .	306
Getting Rows and Columns from the Sheets . . . . .	306
Workbooks, Sheets, Cells . . . . .	308
Project: Reading Data from a Spreadsheet . . . . .	308
Step 1: Read the Spreadsheet Data . . . . .	309
Step 2: Populate the Data Structure . . . . .	310
Step 3: Write the Results to a File . . . . .	311
Ideas for Similar Programs . . . . .	312
Writing Excel Documents . . . . .	313
Creating and Saving Excel Documents . . . . .	313
Creating and Removing Sheets . . . . .	314
Writing Values to Cells . . . . .	314
Project: Updating a Spreadsheet . . . . .	315
Step 1: Set Up a Data Structure with the Update Information . . . . .	316
Step 2: Check All Rows and Update Incorrect Prices . . . . .	317
Ideas for Similar Programs . . . . .	317
Setting the Font Style of Cells . . . . .	318
Font Objects . . . . .	318
Formulas . . . . .	319
Adjusting Rows and Columns . . . . .	320
Setting Row Height and Column Width . . . . .	321
Merging and Unmerging Cells . . . . .	322
Freezing Panes . . . . .	322
Charts . . . . .	324
Summary . . . . .	325
Practice Questions . . . . .	326
Practice Projects . . . . .	326
Multiplication Table Maker . . . . .	326
Blank Row Inserter . . . . .	327
Spreadsheet Cell Inverter . . . . .	327
Text Files to Spreadsheet . . . . .	328
Spreadsheet to Text Files . . . . .	328

## 14 **WORKING WITH GOOGLE SHEETS** **329**

Installing and Setting Up EZSheets . . . . .	329
Obtaining Credentials and Token Files . . . . .	330
Revoking the Credentials File . . . . .	332
Spreadsheet Objects . . . . .	332
Creating, Uploading, and Listing Spreadsheets . . . . .	333
Spreadsheet Attributes . . . . .	334
Downloading and Uploading Spreadsheets . . . . .	335
Deleting Spreadsheets . . . . .	336
Sheet Objects . . . . .	336
Reading and Writing Data . . . . .	337
Creating and Deleting Sheets . . . . .	341
Copying Sheets . . . . .	343
Working with Google Sheets Quotas . . . . .	343
Summary . . . . .	344
Practice Questions . . . . .	344
Practice Projects . . . . .	345
Downloading Google Forms Data . . . . .	345
Converting Spreadsheets to Other Formats . . . . .	345
Finding Mistakes in a Spreadsheet . . . . .	345

## 15 **WORKING WITH PDF AND WORD DOCUMENTS** **347**

PDF Documents . . . . .	347
Extracting Text from PDFs . . . . .	348
Decrypting PDFs . . . . .	349
Creating PDFs . . . . .	350
Project: Combining Select Pages from Many PDFs . . . . .	355
Step 1: Find All PDF Files . . . . .	355
Step 2: Open Each PDF . . . . .	356
Step 3: Add Each Page . . . . .	357
Step 4: Save the Results . . . . .	357
Ideas for Similar Programs . . . . .	358
Word Documents . . . . .	358
Reading Word Documents . . . . .	359
Getting the Full Text from a .docx File . . . . .	360
Styling Paragraph and Run Objects . . . . .	361
Creating Word Documents with Nondefault Styles . . . . .	362
Run Attributes . . . . .	362
Writing Word Documents . . . . .	364
Adding Headings . . . . .	366
Adding Line and Page Breaks . . . . .	366
Adding Pictures . . . . .	367
Creating PDFs from Word Documents . . . . .	367
Summary . . . . .	368
Practice Questions . . . . .	368

Practice Projects . . . . .	369
PDF Paranoia . . . . .	369
Custom Invitations as Word Documents . . . . .	369
Brute-Force PDF Password Breaker . . . . .	370

## 16

### **WORKING WITH CSV FILES AND JSON DATA 371**

The csv Module . . . . .	372
reader Objects . . . . .	373
Reading Data from reader Objects in a for Loop . . . . .	374
writer Objects . . . . .	374
The delimiter and lineterminator Keyword Arguments . . . . .	375
DictReader and DictWriter CSV Objects . . . . .	376
Project: Removing the Header from CSV Files . . . . .	378
Step 1: Loop Through Each CSV File . . . . .	378
Step 2: Read in the CSV File . . . . .	379
Step 3: Write Out the CSV File Without the First Row . . . . .	380
Ideas for Similar Programs . . . . .	381
JSON and APIs . . . . .	381
The json Module . . . . .	382
Reading JSON with the loads() Function . . . . .	382
Writing JSON with the dumps() Function . . . . .	383
Project: Fetching Current Weather Data . . . . .	383
Step 1: Get Location from the Command Line Argument . . . . .	384
Step 2: Download the JSON Data . . . . .	385
Step 3: Load JSON Data and Print Weather . . . . .	385
Ideas for Similar Programs . . . . .	387
Summary . . . . .	387
Practice Questions . . . . .	387
Practice Project . . . . .	388
Excel-to-CSV Converter . . . . .	388

## 17

### **KEEPING TIME, SCHEDULING TASKS, AND LAUNCHING PROGRAMS 389**

The time Module . . . . .	390
The time.time() Function . . . . .	390
The time.sleep() Function . . . . .	391
Rounding Numbers . . . . .	392
Project: Super Stopwatch . . . . .	392
Step 1: Set Up the Program to Track Times . . . . .	393
Step 2: Track and Print Lap Times . . . . .	393
Ideas for Similar Programs . . . . .	394
The datetime Module . . . . .	395
The timedelta Data Type . . . . .	396
Pausing Until a Specific Date . . . . .	397
Converting datetime Objects into Strings . . . . .	398
Converting Strings into datetime Objects . . . . .	399

Review of Python's Time Functions . . . . .	399
Multithreading . . . . .	400
Passing Arguments to the Thread's Target Function . . . . .	402
Concurrency Issues . . . . .	403
Project: Multithreaded XKCD Downloader . . . . .	403
Step 1: Modify the Program to Use a Function . . . . .	403
Step 2: Create and Start Threads . . . . .	405
Step 3: Wait for All Threads to End . . . . .	405
Launching Other Programs from Python . . . . .	406
Passing Command Line Arguments to the Popen() Function . . . . .	408
Task Scheduler, launchd, and cron . . . . .	408
Opening Websites with Python . . . . .	409
Running Other Python Scripts . . . . .	409
Opening Files with Default Applications . . . . .	409
Project: Simple Countdown Program . . . . .	410
Step 1: Count Down . . . . .	410
Step 2: Play the Sound File . . . . .	411
Ideas for Similar Programs . . . . .	412
Summary . . . . .	412
Practice Questions . . . . .	412
Practice Projects . . . . .	413
Prettified Stopwatch . . . . .	413
Scheduled Web Comic Downloader . . . . .	413

## 18

### SENDING EMAIL AND TEXT MESSAGES

415

Sending and Receiving Email with the Gmail API . . . . .	416
Enabling the Gmail API . . . . .	416
Sending Mail from a Gmail Account . . . . .	417
Reading Mail from a Gmail Account . . . . .	418
Searching Mail from a Gmail Account . . . . .	419
Downloading Attachments from a Gmail Account . . . . .	419
SMTP . . . . .	420
Sending Email . . . . .	420
Connecting to an SMTP Server . . . . .	421
Sending the SMTP "Hello" Message . . . . .	422
Starting TLS Encryption . . . . .	422
Logging In to the SMTP Server . . . . .	423
Sending an Email . . . . .	423
Disconnecting from the SMTP Server . . . . .	424
IMAP . . . . .	424
Retrieving and Deleting Emails with IMAP . . . . .	424
Connecting to an IMAP Server . . . . .	425
Logging In to the IMAP Server . . . . .	426
Searching for Email . . . . .	426
Fetching an Email and Marking It as Read . . . . .	430
Getting Email Addresses from a Raw Message . . . . .	431



Getting the Body from a Raw Message . . . . .	431
Deleting Emails . . . . .	432
Disconnecting from the IMAP Server . . . . .	433
Project: Sending Member Dues Reminder Emails . . . . .	433
Step 1: Open the Excel File . . . . .	434
Step 2: Find All Unpaid Members . . . . .	435
Step 3: Send Customized Email Reminders. . . . .	436
Sending Text Messages with SMS Email Gateways . . . . .	437
Sending Text Messages with Twilio . . . . .	438
Signing Up for a Twilio Account . . . . .	439
Sending Text Messages . . . . .	439
Project: "Just Text Me" Module. . . . .	441
Summary . . . . .	442
Practice Questions . . . . .	443
Practice Projects . . . . .	443
Random Chore Assignment Emailer. . . . .	443
Umbrella Reminder . . . . .	444
Auto Unsubscriber. . . . .	444
Controlling Your Computer Through Email . . . . .	444

## 19

### **MANIPULATING IMAGES 447**

Computer Image Fundamentals . . . . .	448
Colors and RGBA Values . . . . .	448
Coordinates and Box Tuples. . . . .	449
Manipulating Images with Pillow . . . . .	450
Working with the Image Data Type. . . . .	451
Cropping Images . . . . .	453
Copying and Pasting Images onto Other Images. . . . .	454
Resizing an Image. . . . .	456
Rotating and Flipping Images. . . . .	457
Changing Individual Pixels. . . . .	459
Project: Adding a Logo. . . . .	460
Step 1: Open the Logo Image. . . . .	461
Step 2: Loop Over All Files and Open Images . . . . .	462
Step 3: Resize the Images . . . . .	463
Step 4: Add the Logo and Save the Changes . . . . .	463
Ideas for Similar Programs . . . . .	465
Drawing on Images . . . . .	465
Drawing Shapes . . . . .	466
Drawing Text . . . . .	468
Summary . . . . .	469
Practice Questions . . . . .	470
Practice Projects . . . . .	470
Extending and Fixing the Chapter Project Programs. . . . .	470
Identifying Photo Folders on the Hard Drive . . . . .	471
Custom Seating Cards . . . . .	472

## CONTROLLING THE KEYBOARD AND MOUSE WITH GUI AUTOMATION

473

Installing the pyautogui Module . . . . .	474
Setting Up Accessibility Apps on macOS . . . . .	474
Staying on Track . . . . .	475
Pauses and Fail-Safes . . . . .	475
Shutting Down Everything by Logging Out . . . . .	475
Controlling Mouse Movement . . . . .	475
Moving the Mouse . . . . .	477
Getting the Mouse Position . . . . .	477
Controlling Mouse Interaction . . . . .	478
Clicking the Mouse . . . . .	478
Dragging the Mouse . . . . .	479
Scrolling the Mouse . . . . .	480
Planning Your Mouse Movements . . . . .	481
Working with the Screen . . . . .	482
Getting a Screenshot . . . . .	482
Analyzing the Screenshot . . . . .	483
Image Recognition . . . . .	484
Getting Window Information . . . . .	485
Obtaining the Active Window . . . . .	486
Other Ways of Obtaining Windows . . . . .	487
Manipulating Windows . . . . .	487
Controlling the Keyboard . . . . .	489
Sending a String from the Keyboard . . . . .	489
Key Names . . . . .	490
Pressing and Releasing the Keyboard . . . . .	491
Hotkey Combinations . . . . .	492
Setting Up Your GUI Automation Scripts . . . . .	492
Review of the PyAutoGUI Functions . . . . .	493
Project: Automatic Form Filler . . . . .	495
Step 1: Figure Out the Steps . . . . .	496
Step 2: Set Up Coordinates . . . . .	496
Step 3: Start Typing Data . . . . .	498
Step 4: Handle Select Lists and Radio Buttons . . . . .	499
Step 5: Submit the Form and Wait . . . . .	500
Displaying Message Boxes . . . . .	501
Summary . . . . .	502
Practice Questions . . . . .	503
Practice Projects . . . . .	503
Looking Busy . . . . .	503
Using the Clipboard to Read a Text Field . . . . .	503
Instant Messenger Bot . . . . .	504
Game-Playing Bot Tutorial . . . . .	505

<b>A</b>	
<b>INSTALLING THIRD-PARTY MODULES</b>	<b>507</b>
The pip Tool . . . . .	507
Installing Third-Party Modules . . . . .	508
Installing Modules for the Mu Editor . . . . .	510
<b>B</b>	
<b>RUNNING PROGRAMS</b>	<b>511</b>
Running Programs from the Terminal Window . . . . .	511
Running Python Programs on Windows. . . . .	513
Running Python Programs on macOS . . . . .	514
Running Python Programs on Ubuntu Linux . . . . .	514
Running Python Programs with Assertions Disabled . . . . .	515
<b>C</b>	
<b>ANSWERS TO THE PRACTICE QUESTIONS</b>	<b>517</b>
Chapter 1 . . . . .	518
Chapter 2 . . . . .	518
Chapter 3 . . . . .	520
Chapter 4 . . . . .	520
Chapter 5 . . . . .	521
Chapter 6 . . . . .	521
Chapter 7 . . . . .	522
Chapter 8 . . . . .	523
Chapter 9 . . . . .	523
Chapter 10 . . . . .	524
Chapter 11 . . . . .	524
Chapter 12 . . . . .	525
Chapter 13 . . . . .	526
Chapter 14 . . . . .	527
Chapter 15 . . . . .	527
Chapter 16 . . . . .	528
Chapter 17 . . . . .	528
Chapter 18 . . . . .	529
Chapter 19 . . . . .	529
Chapter 20 . . . . .	529
<b>INDEX</b>	<b>531</b>