

Beginning Python

From Novice to Professional,
Second Edition



Magnus Lie Hetland

Contents at a Glance

About the Author	xxiii
About the Technical Reviewer	xxv
Preface	xxvii
Introduction	xxix
CHAPTER 1 Instant Hacking: The Basics	1
CHAPTER 2 Lists and Tuples	31
CHAPTER 3 Working with Strings	53
CHAPTER 4 Dictionaries: When Indices Won't Do	69
CHAPTER 5 Conditionals, Loops, and Some Other Statements	83
CHAPTER 6 Abstraction	113
CHAPTER 7 More Abstraction	141
CHAPTER 8 Exceptions	161
CHAPTER 9 Magic Methods, Properties, and Iterators	175
CHAPTER 10 Batteries Included	209
CHAPTER 11 Files and Stuff	261
CHAPTER 12 Graphical User Interfaces	277
CHAPTER 13 Database Support	293
CHAPTER 14 Network Programming	305
CHAPTER 15 Python and the Web	321
CHAPTER 16 Testing, 1-2-3	349
CHAPTER 17 Extending Python	365
CHAPTER 18 Packaging Your Programs	383
CHAPTER 19 Playful Programming	393
CHAPTER 20 Project 1: Instant Markup	403
CHAPTER 21 Project 2: Painting a Pretty Picture	425
CHAPTER 22 Project 3: XML for All Occasions	435
CHAPTER 23 Project 4: In the News	453

■ CHAPTER 24	Project 5: A Virtual Tea Party	469
■ CHAPTER 25	Project 6: Remote Editing with CGI	489
■ CHAPTER 26	Project 7: Your Own Bulletin Board	499
■ CHAPTER 27	Project 8: File Sharing with XML-RPC	517
■ CHAPTER 28	Project 9: File Sharing II—Now with GUI!	537
■ CHAPTER 29	Project 10: Do-It-Yourself Arcade Game	547
■ APPENDIX A	The Short Version	569
■ APPENDIX B	Python Reference	579
■ APPENDIX C	Online Resources	595
■ APPENDIX D	Python 3.0	599
■ INDEX		607

Contents

About the Author	xxiii
About the Technical Reviewer.....	xxv
Preface	xxvii
Introduction	xxix
CHAPTER 1	
Instant Hacking: The Basics	1
Installing Python	1
Windows	1
Linux and UNIX	3
Macintosh.....	5
Other Distributions	5
Keeping in Touch and Up-to-Date	7
The Interactive Interpreter.....	7
Algo . . . What?	9
Numbers and Expressions.....	9
Large Integers	11
Hexadecimals and Octals.....	12
Variables.....	13
Statements.....	13
Getting Input from the User.....	14
Functions	16
Modules	17
cmath and Complex Numbers.....	18
Back to the <code>__future__</code>	19
Saving and Executing Your Programs	19
Running Your Python Scripts from a Command Prompt.....	20
Making Your Scripts Behave Like Normal Programs	20
Comments	22

Strings	22
Single-Quoted Strings and Escaping Quotes	23
Concatenating Strings	24
String Representations, str and repr	24
input vs. raw_input	26
Long Strings, Raw Strings, and Unicode	26
A Quick Summary	29
New Functions in This Chapter	30
What Now?	30
CHAPTER 2 Lists and Tuples	31
Sequence Overview	31
Common Sequence Operations	32
Indexing	32
Slicing	34
Adding Sequences	37
Multiplication	37
Membership	38
Length, Minimum, and Maximum	40
Lists: Python's Workhorse	40
The list Function	40
Basic List Operations	41
List Methods	43
Tuples: Immutable Sequences	49
The tuple Function	50
Basic Tuple Operations	50
So What's the Point?	51
A Quick Summary	51
New Functions in This Chapter	52
What Now?	52
CHAPTER 3 Working with Strings	53
Basic String Operations	53
String Formatting: The Short Version	53

String Formatting: The Long Version	56
Simple Conversion	57
Width and Precision	57
Signs, Alignment, and Zero-Padding	58
String Methods	60
find	60
join	61
lower	62
replace	63
split	63
strip	64
translate	64
A Quick Summary	66
New Functions in This Chapter	66
What Now?	67
CHAPTER 4 Dictionaries: When Indices Won't Do	69
Dictionary Uses	69
Creating and Using Dictionaries	70
The dict Function	71
Basic Dictionary Operations	71
String Formatting with Dictionaries	73
Dictionary Methods	74
A Quick Summary	81
New Functions in This Chapter	81
What Now?	81
CHAPTER 5 Conditionals, Loops, and Some Other Statements	83
More About print and import	83
Printing with Commas	83
Importing Something As Something Else	84
Assignment Magic	85
Sequence Unpacking	85
Chained Assignments	87
Augmented Assignments	87

Blocks: The Joy of Indentation	88
Conditions and Conditional Statements	88
So That’s What Those Boolean Values Are For	89
Conditional Execution and the if Statement	90
else Clauses	90
elif Clauses	91
Nesting Blocks	91
More Complex Conditions	92
Assertions	97
Loops	97
while Loops	98
for Loops	99
Iterating Over Dictionaries	100
Some Iteration Utilities	100
Breaking Out of Loops	102
else Clauses in Loops	105
List Comprehension—Slightly Loopy	105
And Three for the Road	107
Nothing Happened!	107
Deleting with del	107
Executing and Evaluating Strings with exec and eval	108
A Quick Summary	111
New Functions in This Chapter	112
What Now?	112
CHAPTER 6 Abstraction	113
Laziness Is a Virtue	113
Abstraction and Structure	114
Creating Your Own Functions	115
Documenting Functions	116
Functions That Aren’t Really Functions	117
The Magic of Parameters	117
Where Do the Values Come From?	118
Can I Change a Parameter?	118
Keyword Parameters and Defaults	123
Collecting Parameters	125
Reversing the Process	128
Parameter Practice	129
Scoping	131

Recursion	133
Two Classics: Factorial and Power	134
Another Classic: Binary Search	136
A Quick Summary	139
New Functions in This Chapter	140
What Now?	140
CHAPTER 7 More Abstraction	141
The Magic of Objects	141
Polymorphism	142
Encapsulation	145
Inheritance	147
Classes and Types	147
What Is a Class, Exactly?	147
Making Your Own Classes	148
Attributes, Functions, and Methods	150
Privacy Revisited	150
The Class Namespace	152
Specifying a Superclass	153
Investigating Inheritance	154
Multiple Superclasses	155
Interfaces and Introspection	156
Some Thoughts on Object-Oriented Design	157
A Quick Summary	158
New Functions in This Chapter	159
What Now?	159
CHAPTER 8 Exceptions	161
What Is an Exception?	161
Making Things Go Wrong . . . Your Way	161
The raise Statement	162
Custom Exception Classes	163
Catching Exceptions	163
Look, Ma, No Arguments!	164
More Than One except Clause	165
Catching Two Exceptions with One Block	166
Catching the Object	166
A Real Catchall	167

When All Is Well	168
And Finally	169
Exceptions and Functions	170
The Zen of Exceptions	171
A Quick Summary	173
New Functions in This Chapter	174
What Now?	174

CHAPTER 9	Magic Methods, Properties, and Iterators	175
	Before We Begin	175
	Constructors	176
	Overriding Methods in General, and the Constructor in Particular	177
	Calling the Unbound Superclass Constructor	179
	Using the super Function	180
	Item Access	182
	The Basic Sequence and Mapping Protocol	182
	Subclassing list, dict, and str	185
	More Magic	187
	Properties	187
	The property Function	188
	Static Methods and Class Methods	189
	__getattr__, __setattr__, and Friends	191
	Iterators	192
	The Iterator Protocol	192
	Making Sequences from Iterators	194
	Generators	194
	Making a Generator	195
	A Recursive Generator	196
	Generators in General	197
	Generator Methods	198
	Simulating Generators	199
	The Eight Queens	200
	Generators and Backtracking	200
	The Problem	201
	State Representation	202
	Finding Conflicts	202
	The Base Case	203
	The Recursive Case	204
	Wrapping It Up	205

A Quick Summary	206
New Functions in This Chapter	207
What Now?	207
CHAPTER 10 Batteries Included	209
Modules	209
Modules Are Programs	209
Modules Are Used to Define Things	211
Making Your Modules Available	214
Packages	217
Exploring Modules	218
What's in a Module?	218
Getting Help with help	219
Documentation	220
Use the Source	221
The Standard Library: A Few Favorites	221
sys	222
os	223
fileinput	225
Sets, Heaps, and Deques	227
time	232
random	234
shelve	238
re	242
Other Interesting Standard Modules	258
A Quick Summary	259
New Functions in This Chapter	260
What Now?	260
CHAPTER 11 Files and Stuff	261
Opening Files	261
File Modes	261
Buffering	263
The Basic File Methods	263
Reading and Writing	264
Piping Output	264
Reading and Writing Lines	266
Closing Files	267
Using the Basic File Methods	268

Iterating over File Contents	270
Doing It Byte by Byte	270
One Line at a Time	271
Reading Everything	271
Lazy Line Iteration with fileinput	272
File Iterators	272
A Quick Summary	274
New Functions in This Chapter	275
What Now?	275
CHAPTER 12 Graphical User Interfaces	277
A Plethora of Platforms	277
Downloading and Installing wxPython	278
Building a Sample GUI Application	279
Getting Started	280
Windows and Components	281
Labels, Titles, and Positions	282
More Intelligent Layout	284
Event Handling	286
The Finished Program	286
But I'd Rather Use	288
Using Tkinter	289
Using Jython and Swing	290
Using Something Else	290
A Quick Summary	291
What Now?	291
CHAPTER 13 Database Support	293
The Python Database API	294
Global Variables	294
Exceptions	295
Connections and Cursors	296
Types	297
SQLite and PySQLite	298
Getting Started	300
A Sample Database Application	300
A Quick Summary	303
New Functions in This Chapter	304
What Now?	304

CHAPTER 14	Network Programming	305
	A Handful of Networking Modules	305
	The socket Module	306
	The urllib and urllib2 Modules	308
	Other Modules	310
	SocketServer and Friends	310
	Multiple Connections	311
	Forking and Threading with SocketServer	313
	Asynchronous I/O with select and poll	313
	Twisted	316
	Downloading and Installing Twisted	317
	Writing a Twisted Server	317
	A Quick Summary	319
	New Functions in This Chapter	320
	What Now?	320
CHAPTER 15	Python and the Web	321
	Screen Scraping	321
	Tidy and XHTML Parsing	322
	Beautiful Soup	327
	Dynamic Web Pages with CGI	328
	Step 1. Preparing the Web Server	328
	Step 2. Adding the Pound Bang Line	329
	Step 3. Setting the File Permissions	329
	CGI Security Risks	330
	A Simple CGI Script	331
	Debugging with cgitb	331
	Using the cgi Module	333
	A Simple Form	334
	One Step Up: mod_python	336
	Installing mod_python	337
	CGI Handler	338
	PSP	339
	The Publisher	341
	Web Application Frameworks	343
	Web Services: Scraping Done Right	344
	RSS and Friends	345
	Remote Procedure Calls with XML-RPC	345
	SOAP	346

A Quick Summary	346
New Functions in This Chapter	347
What Now?	347
CHAPTER 16 Testing, 1-2-3	349
Test First, Code Later	349
Precise Requirement Specification	350
Planning for Change	351
The 1-2-3 (and 4) of Testing	352
Tools for Testing	352
doctest	353
unittest	355
Beyond Unit Tests	358
Source Code Checking with PyChecker and PyLint	359
Profiling	362
A Quick Summary	364
New Functions in This Chapter	364
What Now?	364
CHAPTER 17 Extending Python	365
The Best of Both Worlds	365
The Really Easy Way: Jython and IronPython	367
Writing C Extensions	369
A Swig of . . . SWIG	371
Hacking It on Your Own	375
A Quick Summary	380
New Functions in This Chapter	381
What Now?	381
CHAPTER 18 Packaging Your Programs	383
Distutils Basics	383
Wrapping Things Up	386
Building an Archive File	386
Creating a Windows Installer or an RPM Package	387
Compiling Extensions	388
Creating Executable Programs with py2exe	389

A Quick Summary	390
New Functions in This Chapter	391
What Now?	391
CHAPTER 19 Playful Programming	393
Why Playful?	393
The Jujitsu of Programming	393
Prototyping	394
Configuration	396
Extracting Constants	396
Configuration Files	396
Logging	399
If You Can't Be Bothered	400
If You Want to Learn More	400
A Quick Summary	401
What Now?	401
CHAPTER 20 Project 1: Instant Markup	403
What's the Problem?	403
Useful Tools	404
Preparations	405
First Implementation	406
Finding Blocks of Text	406
Adding Some Markup	407
Second Implementation	408
Handlers	409
A Handler Superclass	410
Rules	412
A Rule Superclass	413
Filters	413
The Parser	413
Constructing the Rules and Filters	415
Putting It All Together	418
Further Exploration	423
What Now?	424

CHAPTER 21	Project 2: Painting a Pretty Picture	425
	What's the Problem?	425
	Useful Tools	426
	Preparations	426
	First Implementation	427
	Drawing with ReportLab	427
	Constructing Some PolyLines	429
	Writing the Prototype	430
	Second Implementation	431
	Getting the Data	432
	Using the LinePlot Class	432
	Further Exploration	434
	What Now?	434
CHAPTER 22	Project 3: XML for All Occasions	435
	What's the Problem?	435
	Useful Tools	436
	Preparations	437
	First Implementation	438
	Creating a Simple Content Handler	439
	Creating HTML Pages	442
	Second Implementation	444
	A Dispatcher Mix-In Class	444
	Factoring Out the Header, Footer, and Default Handling	446
	Support for Directories	447
	The Event Handlers	448
	Further Exploration	451
	What Now?	452
CHAPTER 23	Project 4: In the News	453
	What's the Problem?	453
	Useful Tools	454
	Preparations	454
	First Implementation	455

Second Implementation.....	458
Further Exploration.....	467
What Now?.....	468
CHAPTER 24 Project 5: A Virtual Tea Party	469
What's the Problem?	469
Useful Tools	470
Preparations	470
First Implementation	471
The ChatServer Class	471
The ChatSession Class.....	473
Putting It Together.....	475
Second Implementation.....	477
Basic Command Interpretation	477
Rooms	478
Login and Logout Rooms.....	479
The Main Chat Room	479
The New Server	480
Further Exploration.....	486
What Now?.....	487
CHAPTER 25 Project 6: Remote Editing with CGI	489
What's the Problem?	489
Useful Tools	490
Preparations	490
First Implementation	490
Second Implementation.....	491
Creating the File Name Form	492
Writing the Editor Script.....	492
Writing the Save Script.....	494
Running the Editor.....	496
Further Exploration.....	497
What Now?.....	498

CHAPTER 26	Project 7: Your Own Bulletin Board	499
	What's the Problem?	499
	Useful Tools	500
	Preparations	500
	First Implementation	502
	Second Implementation.....	506
	Writing the Main Script.....	507
	Writing the View Script.....	508
	Writing the Edit Script.....	510
	Writing the Save Script.....	511
	Trying It Out	513
	Further Exploration	515
	What Now?	515
CHAPTER 27	Project 8: File Sharing with XML-RPC	517
	What's the Problem?	517
	Useful Tools	518
	Preparations	519
	First Implementation	519
	Implementing a Simple Node	520
	Trying Out the First Implementation	525
	Second Implementation.....	527
	Creating the Client Interface	527
	Raising Exceptions	528
	Validating File Names.....	529
	Trying Out the Second Implementation.....	534
	Further Exploration	534
	What Now?	535
CHAPTER 28	Project 9: File Sharing II—Now with GUI!	537
	What's the Problem?	537
	Useful Tools	537
	Preparations	538
	First Implementation	538
	Second Implementation.....	541
	Further Exploration	545
	What Now?	545

CHAPTER 29	Project 10: Do-It-Yourself Arcade Game	547
	What's the Problem?	547
	Useful Tools	548
	pygame	548
	pygame.locals	549
	pygame.display	549
	pygame.font	550
	pygame.sprite	550
	pygame.mouse	550
	pygame.event	550
	pygame.image	551
	Preparations	551
	First Implementation	551
	Second Implementation	556
	Further Exploration	567
	What Now?	567
APPENDIX A	The Short Version	569
	The Basics	569
	Functions	571
	Objects and Stuff	572
	Some Loose Ends	576
APPENDIX B	Python Reference	579
	Expressions	579
	Statements	589
	Simple Statements	589
	Compound Statements	592
APPENDIX C	Online Resources	595
	Python Distributions	595
	Python Documentation	596
	Useful Toolkits and Modules	596
	Newsgroups, Mailing Lists, and Blogs	597

APPENDIX D Python 3.0	599
Strings and I/O	599
Strings, Bytes, and Encodings	599
Console I/O	600
New String Formatting	600
Classes and Functions	601
Function Annotation	601
Abstract Base Classes	601
Class Decorators and New Metaclass Syntax	601
Keyword-Only Parameters	602
Nonlocal Variables	602
Iterables, Comprehensions, and Views	603
Extended Iterable Unpacking	603
Dictionary and Set Comprehension	603
Dictionary Views	603
Iterator Return Values	603
Things That Have Gone	604
Some Minor Issues	604
The Standard Library	604
Other Stuff	605
INDEX	607