

CONTENTS IN DETAIL

INTRODUCTION	xv
Using Python for Data Science	xvi
Who Should Read This Book?	xvi
What's in the Book?	xvii
1	
THE BASICS OF DATA	1
Categories of Data	2
Unstructured Data	2
Structured Data	2
Semistructured Data	4
Time Series Data	5
Sources of Data	6
APIs	7
Web Pages	7
Databases	8
Files	9
The Data Processing Pipeline	9
Acquisition	10
Cleansing	10
Transformation	11
Analysis	11
Storage	12
The Pythonic Way	13
Summary	13
2	
PYTHON DATA STRUCTURES	15
Lists	16
Creating a List	16
Using Common List Object Methods	16
Using Slice Notation	18
Using a List as a Queue	19
Using a List as a Stack	20
Using Lists and Stacks for Natural Language Processing	21
Making Improvements with List Comprehensions	23
Tuples	27
A List of Tuples	27
Immutability	28
Dictionaries	28
A List of Dictionaries	29

Adding to a Dictionary with setdefault()	29
Loading JSON into a Dictionary	31
Sets	32
Removing Duplicates from Sequences	32
Performing Common Set Operations	33
Exercise #1: Improved Photo Tag Analysis	34
Summary	35

3 PYTHON DATA SCIENCE LIBRARIES 37

NumPy	37
Installing NumPy	38
Creating a NumPy Array	38
Performing Element-Wise Operations	39
Using NumPy Statistical Functions	39
Exercise #2: Using NumPy Statistical Functions	40
pandas	40
pandas Installation	41
pandas Series	41
Exercise #3: Combining Three Series	43
pandas DataFrames	43
Exercise #4: Using Different Joins	50
scikit-learn	52
Installing scikit-learn	53
Obtaining a Sample Dataset	53
Loading the Sample Dataset into a pandas DataFrame	54
Splitting the Sample Dataset into a Training Set and a Test Set	54
Transforming Text into Numerical Feature Vectors	54
Training and Evaluating the Model	55
Making Predictions on New Data	56
Summary	56

4 ACCESSING DATA FROM FILES AND APIS 57

Importing Data Using Python's open() Function	57
Text Files	58
Tabular Data Files	59
Exercise #5: Opening JSON Files	61
Binary Files	62
Exporting Data to Files	62
Accessing Remote Files and APIs	63
How HTTP Requests Work	64
The urllib3 Library	65
The Requests Library	67
Exercise #6: Accessing an API with Requests	67
Moving Data to and from a DataFrame	68
Importing Nested JSON Structures	68
Converting a DataFrame to JSON	69
Exercise #7: Manipulating Complex JSON Structures	70
Loading Online Data into a DataFrame with pandas-datareader	71
Summary	72

5		
WORKING WITH DATABASES		73
Relational Databases		74
Understanding SQL Statements		75
Getting Started with MySQL		75
Defining the Database Structure		76
Inserting Data into the Database		79
Querying Database Data		80
Exercise #8: Performing a One-to-Many Join		82
Using Database Analytics Tools		82
NoSQL Databases		88
Key-Value Stores		89
Document-Oriented Databases		90
Exercise #9: Inserting and Querying Multiple Documents		92
Summary		93
6		
AGGREGATING DATA		95
Data to Aggregate		96
Combining DataFrames		98
Grouping and Aggregating the Data		100
Viewing Specific Aggregations by MultiIndex		101
Slicing a Range of Aggregated Values		103
Slicing Within Aggregation Levels		103
Adding a Grand Total		104
Adding Subtotals		105
Exercise #10: Excluding Total Rows from the DataFrame		106
Selecting All Rows in a Group		106
Summary		107
7		
COMBINING DATASETS		109
Combining Built-in Data Structures		110
Combining Lists and Tuples with +		110
Combining Dictionaries with **		111
Combining Corresponding Rows from Two Structures		112
Implementing Different Types of Joins for Lists		114
Concatenating NumPy Arrays		116
Exercise #11: Adding New Rows/Columns to a NumPy Array		117
Combining pandas Data Structures		117
Concatenating DataFrames		118
Joining Two DataFrames		122
Summary		126
8		
CREATING VISUALIZATIONS		127
Common Visualizations		128
Line Graphs		128
Bar Graphs		129

Pie Charts	130
Histograms	130
Plotting with Matplotlib	131
Installing Matplotlib	131
Using matplotlib.pyplot	131
Working with Figure and Axes Objects	133
Exercise #12: Combining Bins into an “Other” Slice	136
Using Other Libraries with Matplotlib	137
Plotting pandas Data	137
Plotting Geospatial Data with Cartopy	139
Exercise#13: Drawing a Map with Cartopy and Matplotlib.	143
Summary	143

9 ANALYZING LOCATION DATA 145

Obtaining Location Data	146
Turning a Human-Readable Address into Geo Coordinates	146
Getting the Geo Coordinates of a Moving Object	147
Spatial Data Analysis with geopy and Shapely	150
Finding the Closest Object	150
Finding Objects in a Certain Area	152
Exercise #14: Defining Two or More Polygons	154
Combining Both Approaches	154
Exercise #15: Further Improving the Pick-Up Algorithm	156
Combining Spatial and Nonspatial Data	156
Deriving Nonspatial Attributes	156
Exercise #16: Filtering Data with a List Comprehension	158
Joining Spatial and Nonspatial Datasets	158
Summary	159

10 ANALYZING TIME SERIES DATA 161

Regular vs. Irregular Time Series	161
Common Time Series Analysis Techniques	163
Calculating Percentage Changes	164
Rolling Window Calculations	166
Calculating the Percentage Change of a Rolling Average	167
Multivariate Time Series	167
Processing Multivariate Time Series	168
Analyzing Dependencies Between Variables	169
Exercise #17: Adding More Metrics to Analyze Dependencies.	172
Summary	174

11 GAINING INSIGHTS FROM DATA 175

Association Rules	176
Support	177
Confidence	177
Lift	178

The Apriori Algorithm	178
Creating a Transaction Dataset	179
Identifying Frequent Itemsets	180
Generating Association Rules	181
Visualizing Association Rules	182
Gaining Actionable Insights from Association Rules	186
Generating Recommendations	186
Planning Discounts Based on Association Rules	187
Exercise #18: Mining Real Transaction Data	189
Summary	192

12 MACHINE LEARNING FOR DATA ANALYSIS 193

Why Machine Learning?	194
Types of Machine Learning	194
Supervised Learning	194
Unsupervised Learning	195
How Machine Learning Works	196
Data to Learn From	196
A Statistical Model	197
Previously Unseen Data	197
A Sentiment Analysis Example: Classifying Product Reviews	198
Obtaining Product Reviews	198
Cleansing the Data	199
Splitting and Transforming the Data	201
Training the Model	203
Evaluating the Model	203
Exercise #19: Expanding the Example Set	206
Predicting Stock Trends	206
Getting Data	207
Deriving Features from Continuous Data	208
Generating the Output Variable	209
Training and Evaluating the Model	210
Exercise #20: Experimenting with Different Stocks and New Metrics	211
Summary	211

INDEX 213