Artificial Intelligence Programming with Python[®] FROM ZERO TO HERO





Artificial Intelligence Programming with Python®



Artificial Intelligence Programming with Python®

From Zero to Hero

Perry Xiao



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Cover image: © ktsdesign/Adobe Stock Photos Cover design: Wiley This book is dedicated to my family. To my wife, May, my son, Zieger, and my daughter, Jessica, who make my life complete—without them, life would be meaningless. To my parents and my brother, who have shared their life and love with me that ultimately made me who I am today. To my friends and colleagues, who supported me throughout my career.

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Contents at a Glance

Preface		xxiii
Part I	Introduction	
Chapter 1	Introduction to AI	3
Chapter 2	Al Development Tools	23
Part II	Machine Learning and Deep Learning	
Chapter 3	Machine Learning	53
Chapter 4	Deep Learning	117
Part III	AI Applications	
Chapter 5	Image Classification	201
Chapter 6	Face Detection and Face Recognition	265
Chapter 7	Object Detections and Image Segmentations	337
Chapter 8	Pose Detection	433
Chapter 9	GAN and Neural-Style Transfer	465
Chapter 10	Natural Language Processing	491
Chapter 11	Data Analysis	543
Chapter 12	Advanced AI Computing	613
Index		659

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- MATLAB for AI Cheat Sheets
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Contents

Preface		xxiii
Part I	Introduction	
Chapter 1	Introduction to AI	3
	1.1 What Is AI?	3
	1.2 The History of AI	5
	1.3 AI Hypes and AI Winters	9
	1.4 The Types of AI	11
	1.5 Edge AI and Cloud AI	12
	1.6 Key Moments of AI	14
	1.7 The State of AI	17
	1.8 AI Resources	19
	1.9 Summary	21
	1.10 Chapter Review Questions	22
Chapter 2	AI Development Tools	23
	2.1 AI Hardware Tools	23
	2.2 AI Software Tools	24
	2.3 Introduction to Python	27
	2.4 Python Development Environments	30
	2.4 Getting Started with Python	34
	2.5 AI Datasets	45
	2.6 Python AI Frameworks	47
	2.7 Summary	49
	2.8 Chapter Review Questions	50
Part II	Machine Learning and Deep Learning	
Chapter 3	Machine Learning	53
-	3.1 Introduction	53
	3.2 Supervised Learning: Classifications	55

	Scikit-Learn Datasets	56
	Support Vector Machines	56
	Naive Bayes	67
	Linear Discriminant Analysis	69
	Principal Component Analysis	70
	Decision Tree	73
	Random Forest	76
	K-Nearest Neighbors	77
	Neural Networks	78
	3.3 Supervised Learning: Regressions	80
	3.4 Unsupervised Learning	89
	K-means Clustering	89
	3.5 Semi-supervised Learning	91
	3.6 Reinforcement Learning	93
	Q-Learning	95
	3.7 Ensemble Learning	102
	3.8 AutoML	106
	3.9 PyCaret	109
	3.10 LazyPredict	111
	3.11 Summary	115
	3.12 Chapter Review Questions	116
Chapter 4	Deep Learning	117
	4.1 Introduction	117
		117
	4.2 Artificial Neural Networks	120
	4.2 Artificial Neural Networks4.3 Convolutional Neural Networks	120 125
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 	120 125 129
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 4.3.2 VGG, ResNet, DenseNet, MobileNet, 	120 125 129
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 4.3.2 VGG, ResNet, DenseNet, MobileNet, EffecientNet, and YOLO 	120 125 129 140
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 4.3.2 VGG, ResNet, DenseNet, MobileNet, EffecientNet, and YOLO 4.3.3 U-Net 	120 125 129 140 152
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 4.3.2 VGG, ResNet, DenseNet, MobileNet, EffecientNet, and YOLO 4.3.3 U-Net 4.3.4 AutoEncoder 	120 125 129 140 152 157
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 4.3.2 VGG, ResNet, DenseNet, MobileNet, EffecientNet, and YOLO 4.3.3 U-Net 4.3.4 AutoEncoder 4.3.5 Siamese Neural Networks 	120 125 129 140 152 157 161
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 4.3.2 VGG, ResNet, DenseNet, MobileNet, EffecientNet, and YOLO 4.3.3 U-Net 4.3.4 AutoEncoder 4.3.5 Siamese Neural Networks 4.3.6 Capsule Networks 	120 125 129 140 152 157 161 163
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 4.3.2 VGG, ResNet, DenseNet, MobileNet, EffecientNet, and YOLO 4.3.3 U-Net 4.3.4 AutoEncoder 4.3.5 Siamese Neural Networks 4.3.6 Capsule Networks 4.3.7 CNN Layers Visualization 	120 125 129 140 152 157 161 163 165
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 4.3.2 VGG, ResNet, DenseNet, MobileNet, EffecientNet, and YOLO 4.3.3 U-Net 4.3.4 AutoEncoder 4.3.5 Siamese Neural Networks 4.3.6 Capsule Networks 4.3.7 CNN Layers Visualization 4.4 Recurrent Neural Networks 	120 125 129 140 152 157 161 163 165 173
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 4.3.2 VGG, ResNet, DenseNet, MobileNet, EffecientNet, and YOLO 4.3.3 U-Net 4.3.4 AutoEncoder 4.3.5 Siamese Neural Networks 4.3.6 Capsule Networks 4.3.7 CNN Layers Visualization 4.4 Recurrent Neural Networks 4.4.1 Vanilla RNNs 	120 125 129 140 152 157 161 163 165 173 175
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 4.3.2 VGG, ResNet, DenseNet, MobileNet, EffecientNet, and YOLO 4.3.3 U-Net 4.3.4 AutoEncoder 4.3.5 Siamese Neural Networks 4.3.6 Capsule Networks 4.3.7 CNN Layers Visualization 4.4 Recurrent Neural Networks 4.4.1 Vanilla RNNs 4.4.2 Long-Short Term Memory 	120 125 129 140 152 157 161 163 165 173 175 176
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 4.3.2 VGG, ResNet, DenseNet, MobileNet, EffecientNet, and YOLO 4.3.3 U-Net 4.3.4 AutoEncoder 4.3.5 Siamese Neural Networks 4.3.6 Capsule Networks 4.3.7 CNN Layers Visualization 4.4 Recurrent Neural Networks 4.4.1 Vanilla RNNs 4.4.2 Long-Short Term Memory 4.4.3 Natural Language Processing and Python 	120 125 129 140 152 157 161 163 165 173 175 176
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 4.3.2 VGG, ResNet, DenseNet, MobileNet, EffecientNet, and YOLO 4.3.3 U-Net 4.3.4 AutoEncoder 4.3.5 Siamese Neural Networks 4.3.6 Capsule Networks 4.3.7 CNN Layers Visualization 4.4 Recurrent Neural Networks 4.4.1 Vanilla RNNs 4.4.2 Long-Short Term Memory 4.4.3 Natural Language Processing and Python Natural Language Toolkit 	120 125 129 140 152 157 161 163 165 173 175 176 183
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 4.3.2 VGG, ResNet, DenseNet, MobileNet, EffecientNet, and YOLO 4.3.3 U-Net 4.3.4 AutoEncoder 4.3.5 Siamese Neural Networks 4.3.6 Capsule Networks 4.3.7 CNN Layers Visualization 4.4 Recurrent Neural Networks 4.4.1 Vanilla RNNs 4.4.2 Long-Short Term Memory 4.4.3 Natural Language Processing and Python Natural Language Toolkit 4.5 Transformers 	120 125 129 140 152 157 161 163 165 173 175 176 183 187
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 4.3.2 VGG, ResNet, DenseNet, MobileNet, EffecientNet, and YOLO 4.3.3 U-Net 4.3.4 AutoEncoder 4.3.5 Siamese Neural Networks 4.3.6 Capsule Networks 4.3.7 CNN Layers Visualization 4.4 Recurrent Neural Networks 4.1 Vanilla RNNs 4.4.2 Long-Short Term Memory 4.4.3 Natural Language Processing and Python Natural Language Toolkit 4.5 Transformers 4.5.1 BERT and ALBERT 	120 125 129 140 152 157 161 163 165 173 175 176 183 187 187
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 4.3.2 VGG, ResNet, DenseNet, MobileNet, EffecientNet, and YOLO 4.3.3 U-Net 4.3.4 AutoEncoder 4.3.5 Siamese Neural Networks 4.3.6 Capsule Networks 4.3.7 CNN Layers Visualization 4.4 Recurrent Neural Networks 4.3.1 Vanilla RNNs 4.4.2 Long-Short Term Memory 4.4.3 Natural Language Processing and Python Natural Language Toolkit 4.5 Transformers 4.5.1 BERT and ALBERT 4.5.2 GPT-3 	120 125 129 140 152 157 161 163 165 173 175 176 183 187 187 189
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 4.3.2 VGG, ResNet, DenseNet, MobileNet, EffecientNet, and YOLO 4.3.3 U-Net 4.3.4 AutoEncoder 4.3.5 Siamese Neural Networks 4.3.6 Capsule Networks 4.3.7 CNN Layers Visualization 4.4 Recurrent Neural Networks 4.2 Long-Short Term Memory 4.3 Natural Language Processing and Python Natural Language Toolkit 4.5 Transformers 4.5.1 BERT and ALBERT 4.5.2 GPT-3 4.5.3 Switch Transformers 	120 125 129 140 152 157 161 163 165 173 175 176 183 187 187 189 190
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 4.3.2 VGG, ResNet, DenseNet, MobileNet, EffecientNet, and YOLO 4.3.3 U-Net 4.3.4 AutoEncoder 4.3.5 Siamese Neural Networks 4.3.6 Capsule Networks 4.3.7 CNN Layers Visualization 4.4 Recurrent Neural Networks 4.3.1 Vanilla RNNs 4.4.2 Long-Short Term Memory 4.4.3 Natural Language Processing and Python Natural Language Toolkit 4.5 Transformers 4.5.1 BERT and ALBERT 4.5.2 GPT-3 4.5.3 Switch Transformers 4.6 Graph Neural Networks 	120 125 129 140 152 157 161 163 165 173 175 176 183 187 187 187 189 190 191
	 4.2 Artificial Neural Networks 4.3 Convolutional Neural Networks 4.3 Convolutional Neural Networks 4.3.1 LeNet, AlexNet, GoogLeNet 4.3.2 VGG, ResNet, DenseNet, MobileNet, EffecientNet, and YOLO 4.3.3 U-Net 4.3.4 AutoEncoder 4.3.5 Siamese Neural Networks 4.3.6 Capsule Networks 4.3.7 CNN Layers Visualization 4.4 Recurrent Neural Networks 4.3.7 CNN Layers Visualization 4.4 Recurrent Neural Networks 4.4.1 Vanilla RNNs 4.4.2 Long-Short Term Memory 4.4.3 Natural Language Processing and Python Natural Language Toolkit 4.5 Transformers 4.5.1 BERT and ALBERT 4.5.2 GPT-3 4.5.3 Switch Transformers 4.6 Graph Neural Networks 4.6.1 SuperGLUE 	120 125 129 140 152 157 161 163 165 173 175 176 183 187 187 187 187 189 190 191 192

	4.8 Meta Learning	195
	4.9 Summary	197
	4.10 Chapter Review Questions	197
Part III	AI Applications	
Chapter 5	Image Classification	201
	5.1 Introduction	201
	5.2 Classification with Pre-trained Models	203
	5.3 Classification with Custom Trained Models:	
	Transfer Learning	209
	5.4 Cancer/Disease Detection	227
	5.4.1 Skin Cancer Image Classification	227
	5.4.2 Retinopathy Classification	229
	5.4.3 Chest X-Ray Classification	230
	5.4.5 Brain Tumor MRI Image Classification	231
	5.4.5 RSNA Intracranial Hemorrhage Detection	231
	5.5 Federated Learning for Image Classification	232
	5.6 Web-Based Image Classification	233
	5.6.1 Streamlit Image File Classification	234
	5.6.2 Streamlit Webcam Image Classification	242
	5.6.3 Streamlit from GitHub	248
	5.6.4 Streamlit Deployment	249
	5.7 Image Processing	250
	5.7.1 Image Stitching	250
	5.7.2 Image Inpainting	253
	5.7.3 Image Coloring	255
	5.7.4 Image Super Resolution	256
	5.7.5 Gabor Filter	257
	5.0 Chapter Porvious Oscietions	262
e l	3.9 Chapter Review Questions	203
Chapter 6	Face Detection and Face Recognition	265
	6.2 Eaco Detection and Eaco Landmarks	203
	6.3 Face Recognition	200
	6.3.1 Face Recognition with Face Recognition	279
	6.3.2 Face Recognition with OpenCV	285
	6.3.3 GUI-Based Face Recognition System	288
	Other GUI Development Libraries	300
	6.3.4 Google FaceNet	301
	6.4 Age, Gender, and Emotion Detection	301
	6.4.1 DeepFace	302
	6.4.2 TCS-HumAIn-2019	305
	6.5 Face Swap	309
	6.5.1 Face_Recognition and OpenCV	310
	6.5.2 Simple_Faceswap	315
	6.5.3 DeepFaceLab	322
	-	

	6.6 Face Detection Web Apps	322
	6.7 How to Defeat Face Recognition	334
	6.8 Summary	335
	6.9 Chapter Review Questions	336
Chapter 7	Object Detections and Image Segmentations	337
	7.1 Introduction	337
	R-CNN Family	338
	YOLO	339
	SSD	340
	7.2 Object Detections with Pretrained Models	341
	7.2.1 Object Detection with OpenCV	341
	7.2.2 Object Detection with YOLO	346
	7.2.3 Object Detection with OpenCV and Deep Learning	351
	7.2.4 Object Detection with TensorFlow, ImageAI, Mask KINN,	254
	PixelLib, Gluon	354 254
	TensorFlow Object Detection	334 255
	MackRCNN Object Detection	357
	Chuon Object Detection	363
	725 Object Detection with Colab OpenCV	364
	7.3 Object Detections with Custom Trained Models	369
	7.3.1 OpenCV	369
	Step 1	369
	Step 2	369
	Step 3	369
	Step 4	370
	Step 5	371
	7.3.2 YOLO	372
	Step 1	372
	Step 2	372
	Step 3	373
	Step 4	375
	Step 5	375
	7.3.3 TensorFlow, Gluon, and ImageAl	376
	lensorFlow	376
	Gluon	376
	74 Object Tracking	370 377
	7.4 Object Hacking 7.4.1 Object Size and Distance Detection	377
	7.4.2 Object Tracking with OpenCV	387
	Sinole Ohiect Tracking with OpenCV	382
	Multinle Ohject Tracking with OpenCV	384
	7.4.2 Object Tracking with YOLOV4 and DeepSORT	386
	7.4.3 Object Tracking with Gluon	389
	, 0	

	7.5 Image Segmentation	389
	7.5.1 Image Semantic Segmentation and Image Instance	
	Segmentation	390
	PexelLib	390
	Detectron2	394
	Gluon CV	394
	7.5.2 K-means Clustering Image Segmentation	394
	7.5.3 Watershed Image Segmentation	396
	7.6 Background Removal	405
	7.6.1 Background Removal with OpenCV	405
	7.6.2 Background Removal with PaddlePaddle	423
	7.6.3 Background Removal with PixelLib	425
	7.7 Depth Estimation	426
	7.7.1 Depth Estimation from a Single Image	426
	7.7.2 Depth Estimation from Stereo Images	428
	7.8 Augmented Reality	430
	7.9 Summary	431
	7.10 Chapter Review Questions	431
Chapter 8	Pose Detection	433
•	8.1 Introduction	433
	8.2 Hand Gesture Detection	434
	8.2.1 OpenCV	434
	8.2.2 TensorFlow.js	452
	8.3 Sign Language Detection	453
	8.4 Body Pose Detection	454
	8.4.1 OpenPose	454
	8.4.2 OpenCV	455
	8.4.3 Gluon	455
	8.4.4 PoseNet	456
	8.4.5 ML5JS	457
	8.4.6 MediaPipe	459
	8.5 Human Activity Recognition	461
	ActionAI	461
	Gluon Action Detection	461
	Accelerometer Data HAR	461
	8.6 Summary	464
	8.7 Chapter Review Questions	464
Chapter 9	GAN and Neural-Style Transfer	465
	9.1 Introduction	465
	9.2 Generative Adversarial Network	466
	9.2.1 CycleGAN	467
	9.2.2 StyleGAN	469
	9.2.3 Pix2Pix	474
	9.2.4 PULSE	475
	9.2.5 Image Super-Resolution	475
	9.2.6 2D to 3D	478

	9.4 Adversarial Machine Learning	
		484
	9.5 Music Generation	486
	9.6 Summary	489
	9.7 Chapter Review Questions	489
Chapter 10	Natural Language Processing	491
	10.1 Introduction	491
	10.1.1 Natural Language Toolkit	492
	10.1.2 spaCy	493
	10.1.3 Gensim	493
	10.1.4 TextBlob	494
	10.2 Text Summarization	494
	10.3 Text Sentiment Analysis	508
	10.4 Text/Poem Generation	510
	10.5.1 Text to Speech	515
	10.5.2 Speech to lext	517
	10.6 Machine Translation	522
	10.7 Optical Character Recognition	523
	10.0 QK Code	524 527
	10.9 FDF and DOCA Files	527
	10.10 Chatbois and Question Answering	530
	10.10.1 Challerbot	530
	10.10.2 IARVIS	534
	10.10.5 J.A.K. V.I.S. 10.10.4 Chathot Resources and Examples	540
	10.10.4 Charbot Resources and Examples	540
		741
	10.11 Summary 10.12 Chapter Review Questions	541 542
Chanter 11	10.11 Summary 10.12 Chapter Review Questions	541 542
Chapter 11	10.11 Summary 10.12 Chapter Review Questions Data Analysis	541 542 543
Chapter 11	10.11 Summary 10.12 Chapter Review Questions Data Analysis 11.1 Introduction 11.2 Represeive	541 542 543 543
Chapter 11	10.11 Summary 10.12 Chapter Review Questions Data Analysis 11.1 Introduction 11.2 Regression 11.2 Linear Pegression	541 542 543 543 544
Chapter 11	10.11 Summary 10.12 Chapter Review Questions Data Analysis 11.1 Introduction 11.2 Regression 11.2.1 Linear Regression 11.2.2 Support Vector Regression	541 542 543 543 544 545 547
Chapter 11	10.11 Summary 10.12 Chapter Review Questions Data Analysis 11.1 Introduction 11.2 Regression 11.2.1 Linear Regression 11.2.2 Support Vector Regression 11.2.3 Partial Least Squares Regression	541 542 543 543 544 545 547 554
Chapter 11	 10.11 Summary 10.12 Chapter Review Questions Data Analysis 11.1 Introduction 11.2 Regression 11.2.1 Linear Regression 11.2.2 Support Vector Regression 11.2.3 Partial Least Squares Regression 11.3 Time-Series Analysis 	541 542 543 543 543 544 545 547 554 563
Chapter 11	 10.11 Summary 10.12 Chapter Review Questions Data Analysis 11.1 Introduction 11.2 Regression 11.2.1 Linear Regression 11.2.2 Support Vector Regression 11.2.3 Partial Least Squares Regression 11.3 Time-Series Analysis 11.3 1 Stock Price Data 	541 542 543 543 544 545 547 554 563 563
Chapter 11	 10.11 Summary 10.12 Chapter Review Questions Data Analysis 11.1 Introduction 11.2 Regression 11.2.1 Linear Regression 11.2.2 Support Vector Regression 11.2.3 Partial Least Squares Regression 11.3 Time-Series Analysis 11.3.1 Stock Price Data 11.3.2 Stock Price Prediction 	541 542 543 543 544 545 547 554 563 563 563
Chapter 11	 10.11 Summary 10.12 Chapter Review Questions Data Analysis 11.1 Introduction 11.2 Regression 11.2.1 Linear Regression 11.2.2 Support Vector Regression 11.2.3 Partial Least Squares Regression 11.3 Time-Series Analysis 11.3.1 Stock Price Data 11.3.2 Stock Price Prediction Streamlit Stock Price Web Ann 	541 542 543 543 544 545 547 554 563 563 563 565 569
Chapter 11	 10.11 Summary 10.12 Chapter Review Questions Data Analysis 11.1 Introduction 11.2 Regression 11.2.1 Linear Regression 11.2.2 Support Vector Regression 11.2.3 Partial Least Squares Regression 11.3 Time-Series Analysis 11.3.1 Stock Price Data 11.3.2 Stock Price Prediction Streamlit Stock Price Web App 11.3.4 Seasonal Trend Analysis 	541 542 543 543 544 545 547 554 563 563 563 565 569 573
Chapter 11	 10.11 Summary 10.12 Chapter Review Questions Data Analysis 11.1 Introduction 11.2 Regression 11.2.1 Linear Regression 11.2.2 Support Vector Regression 11.2.3 Partial Least Squares Regression 11.3 Time-Series Analysis 11.3.1 Stock Price Data 11.3.2 Stock Price Prediction Streamlit Stock Price Web App 11.3.4 Seasonal Trend Analysis 11.3.5 Sound Analysis 	541 542 543 543 544 545 547 554 563 563 563 563 565 569 573 576
Chapter 11	 10.11 Summary 10.12 Chapter Review Questions Data Analysis 11.1 Introduction 11.2 Regression 11.2.1 Linear Regression 11.2.2 Support Vector Regression 11.2.3 Partial Least Squares Regression 11.3 Time-Series Analysis 11.3.1 Stock Price Data 11.3.2 Stock Price Prediction Streamlit Stock Price Web App 11.3.4 Seasonal Trend Analysis 11.3.5 Sound Analysis 11.4 Predictive Maintenance Analysis 	541 542 543 543 544 545 547 554 563 563 563 563 565 569 573 576 580
Chapter 11	 10.11 Summary 10.12 Chapter Review Questions Data Analysis 11.1 Introduction 11.2 Regression 11.2.1 Linear Regression 11.2.2 Support Vector Regression 11.2.3 Partial Least Squares Regression 11.3 Time-Series Analysis 11.3.1 Stock Price Data 11.3.2 Stock Price Prediction <i>Streamlit Stock Price Web App</i> 11.3.4 Seasonal Trend Analysis 11.3.5 Sound Analysis 11.4 Predictive Maintenance Analysis 11.5 Anomaly Detection and Fraud Detection 	541 542 543 543 544 545 547 554 563 563 563 565 569 573 576 580 580 584
Chapter 11	 10.11 Summary 10.12 Chapter Review Questions Data Analysis 11.1 Introduction 11.2 Regression 11.2.1 Linear Regression 11.2.2 Support Vector Regression 11.2.3 Partial Least Squares Regression 11.3 Time-Series Analysis 11.3.1 Stock Price Data 11.3.2 Stock Price Prediction <i>Streamlit Stock Price Web App</i> 11.3.4 Seasonal Trend Analysis 11.3.5 Sound Analysis 11.4 Predictive Maintenance Analysis 11.5 Anomaly Detection and Fraud Detection 	541 542 543 543 544 545 547 554 563 563 563 563 565 569 573 576 580 584 584
Chapter 11	 10.11 Summary 10.12 Chapter Review Questions Data Analysis 11.1 Introduction 11.2 Regression 11.2.1 Linear Regression 11.2.2 Support Vector Regression 11.2.3 Partial Least Squares Regression 11.3 Time-Series Analysis 11.3.1 Stock Price Data 11.3.2 Stock Price Prediction <i>Streamlit Stock Price Web App</i> 11.3.4 Seasonal Trend Analysis 11.3.5 Sound Analysis 11.4 Predictive Maintenance Analysis 11.5 Anomaly Detection and Fraud Detection 11.5.1 Numenta Anomaly Detection 11.5.2 Textile Defect Detection 	541 542 543 543 544 545 547 554 563 563 563 563 565 569 573 576 580 584 584 584
Chapter 11	 10.11 Summary 10.12 Chapter Review Questions Data Analysis 11.1 Introduction 11.2 Regression 11.2.1 Linear Regression 11.2.2 Support Vector Regression 11.2.3 Partial Least Squares Regression 11.3 Time-Series Analysis 11.3.1 Stock Price Data 11.3.2 Stock Price Prediction Streamlit Stock Price Web App 11.3.4 Seasonal Trend Analysis 11.3.5 Sound Analysis 11.4 Predictive Maintenance Analysis 11.5 Anomaly Detection and Fraud Detection 11.5.1 Numenta Anomaly Detection 11.5.3 Healthcare Fraud Detection 	541 542 543 543 544 545 547 554 563 563 563 563 563 565 569 573 576 580 584 584 584 584

	11.6 COVID-19 Data Visualization and Analysis	585
	11.7 KerasClassifier and KerasRegressor	588
	11.7.1 KerasClassifier	589
	11.7.2 KerasRegressor	593
	11.8 SQL and NoSQL Databases	599
	11.9 Immutable Database	608
	11.9.1 Immudb	608
	11.9.2 Amazon Quantum Ledger Database	609
	11.10 Summary	610
	11.11 Chapter Review Questions	610
Chapter 12	Advanced AI Computing	613
-	12.1 Introduction	613
	12.2 AI with Graphics Processing Unit	614
	12.3 AI with Tensor Processing Unit	618
	12.4 AI with Intelligence Processing Unit	621
	12.5 AI with Cloud Computing	622
	12.5.1 Amazon AWS	623
	12.5.2 Microsoft Azure	624
	12.5.3 Google Cloud Platform	625
	12.5.4 Comparison of AWS, Azure, and GCP	625
	12.6 Web-Based AI	629
	12.6.1 Django	629
	12.6.2 Flask	629
	12.6.3 Streamlit	634
	12.6.4 Other Libraries	634
	12.7 Packaging the Code	635
	Pyinstaller	635
	Nbconvert	635
	Py2Exe	636
	Py2app	636
	Auto-Py-To-Exe	636
	cx_Freeze	637
	Cython	638
	Kubernetes	639
	Docker	642
	PIP 12.9 Alexith Educ Commuting	647
	12.8 Al with Edge Computing	647
	12.8.1 Google Coral	647
	12.0.2 HILYIVIL 12.8.2 Decemberry Di	04ð
	12.0.5 Kaspberry M 12.0 Greate a Mobile ALApp	649 651
	12.7 Create a Woolle AI App	651
	12.10 Quantum AI	633
	12.11 Summary	63/
	12.12 Chapter Review Questions	657

Index

This book is accompanied by bonus content! The following extra elements can be downloaded from www.wiley.com/go/aiwithpython:

- MATLAB for AI Cheat Sheets
- Python for AI Cheat Sheets
- Python Deep Learning Cheat Sheet
- Python Virtual Environment
- Jupyter Notebook, Google Colab, and Kaggle

Preface

The year 2020 was a year of turmoil, conflicts, and division. The most significant event was no doubt the COVID-19 pandemic, which was, and still is, raging in more than 200 countries and affecting the lives of hundreds of millions of people. I spent a good part of the year working from home. There are many disadvantages of remote working; however, it does have at least one advantage: it saved me at least two hours a day traveling to and from work. This gave me more time to think about, to plan, and to propose this book.

I am absolutely fascinated with artificial intelligence, and I have read many artificial intelligence books. But most of the books are heavily focused on the mathematics of artificial intelligence, which makes them difficult to understand for people without mathematics or computer science backgrounds. I have always wanted to write a book that could make it easier to get into the artificial intelligence field for beginners—people from all different disciplines. Thanks to the countless researchers and developers around the world and their open source code, particularly Python-based open source code, it is much easier to use artificial intelligence now than 10 years ago. Through this book, you will find that you can do amazing things with just a few lines of code, and in some cases, you don't need to code at all.

I am a big fan of open source, and for a research field as controversial as artificial intelligence, it is better for everyone to work together. So, I want to express my ultimate gratitude to those who made their work available for the benefit of others.

We are living in an era of digital revolutions and digital technologies such as artificial intelligence, the Internet of Things, Industry 4.0, 5G technologies, digital twin, cybersecurity, big data, cloud computing, blockchains, and, on the horizon, quantum computing. They are all being developed at a breathtaking speed. In the future, the Internet of Things will provide a means to connect all things around us and to use sensors to collect data. The industry version of the Internet of Things is called Industry 4.0, which will connect all sorts of things for manufacturers. Digital twin is a digital representation of a process, product, or service updated from real-time data. With digital twin, we can predict problems before they even occur, prevent downtime, develop new opportunities for the future through simulations. 5G technologies will provide a means for fast and low-latency communications for the data. Cybersecurity will provide a means to protect the data. Big data will provide a means to analyze the data in large quantity. Cloud computing will provide the storage, display, and analysis of the data remotely, in the cloud. Blockchains will provide traceability to the data through distributed ledgers. Quantum computing will make some of the computation faster, in fact, many orders of magnitude faster. Artificial intelligence will be right at the heart of all the technologies, which allows us to analyze the data intelligently. As you can see, all these digital technologies are going to become intertwined to make us work better and live smarter.

That is why I have always said to my students, you can change your future. Your future is in your hands. The key is learning, even after graduation. Learning is a lifelong mission. In today's ever-evolving world, with all the quickly developing digital technologies, you need to constantly reinvent yourself; you will need to learn everything and learn anything. The disadvantage of fast-changing technologies is that you will need to learn all the time, but the advantage is no one has any more advantages than you; you are on the same starting line as everyone else. The rest is up to you!

I believe artificial intelligence will be just a tool for everyone in the future, just like software coding is today. Artificial intelligence will no doubt affect every aspect of our lives and will fundamentally change the way we live, how we work, and how we socialize. The more you know about artificial intelligence and the more involved you are in artificial intelligence, the better you can transform your life.

Many successful people are lifelong learners. American entrepreneur and business magnate Elon Musk is a classic example. As the world's richest man, he learned many things by himself, from computer programming, Internet, finance, to building cars and rockets. British comedian Lee Evans once said that by the end of the day, if you have learned something new, then it is a good day. I hope you will have a good day every day and enjoy reading this book!

Professor Perry Xiao

July 2021, London

Why Buy This Book

Artificial intelligence (AI) is no doubt one of the hottest buzzwords at the moment. AI has penetrated into many aspects of our lives. Knowing AI and being able to use AI will bring enormous benefits to our work and lives. However, learning AI is a daunting task for many people, largely due to the complex mathematics and sophisticated coding behind it. This book aims to demystify AI and teach readers about AI from scratch, by using plain language and simple, illustrative code examples. It is divided into three parts.

In Part I, the book gives an easy-to-read introduction about AI, including the history, the types of AI, the current status, and the possible future trends. It then introduces AI development tools and Python, the most widely used programming language for AI.

In Part II, the book introduces the machine learning and deep learning aspects of AI. Machine learning topics include classifications, regressions, and clustering. It also includes the most popular reinforcement learning. Deep learning topics include convolutional neural networks (CNNs) and long short-term memory networks (LSTMs).

In Part III, the book introduces AI case studies; topics include image classifications, transfer learning, recurrent neural networks, and the latest generative adversarial networks. It also includes the state of the art of GPUs, TPUs, cloud computing, and edge computing. This book is packed with interesting and exciting examples such as pattern recognitions, image classifications, face recognition (most controversial), age and gender detection, voice/speech recognition, chatbot, natural language processing, translation, sentiment analysis, predictive maintenance, finance and stock price analysis, sales prediction, customer segmentation, biomedical data analysis, and much more.

How This Book Is Organized

This book is divided into three parts. Part I introduces AI. Part II covers machine learning and deep learning. Part III covers the case studies, or the AI application projects. R&D developers as well as students will be interested in Part III.

Part I

Chapter 1: Introduction to AI

Chapter 2: AI Development Tools

Part II Chapter 3: Machine Learning Chapter 4: Deep Learning Part III Chapter 5: Image Classifications Chapter 5: Image Classifications Chapter 6: Face Detection and Recognition Chapter 7: Object Detections and Image Segmentations Chapter 8: Pose Detection Chapter 8: Pose Detection Chapter 9: GAN and Neural-Style Transfer Chapter 10: Natural Language Processing Chapter 11: Data Analysis Chapter 12: Advanced AI Computing

Example Code

All the example source code is available on the website that accompanies this book.

Who This Book Is For

This book is intended for university/college students, as well as software and electronic hobbyists, researchers, developers, and R&D engineers. It assumes readers understand the basic concepts of computers and their main components such as CPUs, RAM, hard drives, network interfaces, and so forth. Readers should be able to use a computer competently, for example, can switch on and off the computer, log in and log out, run some programs, copy/move/delete files, and use terminal software such as Microsoft Windows command prompt.

It also assumes that readers have some basic programming experience, ideally in Python, but it could also be in other languages such as Java, C/C++, Fortran, MATLAB, C#, BASIC, R, and so on. Readers should know the basic syntax, the different types of variables, standard inputs and outputs, the conditional selections, and the loops and subroutines.

Finally, it assumes readers have a basic understanding of computer networks and the Internet and are familiar with some of the most commonly used Internet services such as the Web, email, file download/upload, online banking/ shopping, etc.

This book can be used as a core textbook as well as for background reading.

What This Book Is Not For

This book is not for readers to purely learn the Python programming language; there are already a lot of good Python programming books on the market. However, to appeal to a wider audience, Chapter 2 provides a basic introduction to Python and how to get started with Python programming, so even if you have never programmed Python before, you can still use the book.

If you want to learn all the technical details of Python, please refer to the following suggested prerequisite reading list and resources.

Suggested Prerequisite Readings

Computer Basics

Absolute Beginner's Guide to Computer Basics (Absolute Beginner's Guides (Que)), 5th Edition, Michael Miller, QUE, 1 Sept. 2009.

ISBN-10: 0789742535

ISBN-13: 978-0789742537

Computers for Beginners (Wikibooks)

https://en.wikibooks.org/wiki/Computers_for_Beginners

Python Programming

Python Crash Course (2nd Edition): A Hands-On, Project-Based Introduction to Programming, Eric Matthes, No Starch Press, 9 May 2019.

ISBN-10:1593279280

ISBN-13:978-1593279288

Learn Python 3 the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code, 3rd Edition, Zed A. Shaw, Addison-Wesley Professional; 10 Oct. 2013.

ISBN-10:0321884914

ISBN-13:978-0321884916

- Head First Python 2e: A Brain-Friendly Guide, 2nd Edition, Paul Barry, O'Reilly; 16 Dec. 2016.
- ISBN-10:1491919531

ISBN-13:978-1491919538

Think Python: How to Think Like a Computer Scientist, 2nd Edition, Allen B. Downey, O'Reilly, 25 Dec. 2015.

ISBN-10:1491939362

ISBN-13:978-1491939369

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Python Pocket Reference: Python in Your Pocket, 5th edition, Mark Lutz, O'Reilly Media, 9 Feb. 2014.
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ISBN-10:1449357016

ISBN-13:978-1449357016

A Beginner's Python Tutorial (Wikibooks) https://en.wikibooks.org/wiki/A_Beginner%27s_Python_Tutorial

Python Programming (Wikibooks)
https://en.wikibooks.org/wiki/Python Programming

Suggested Readings to Accompany the Book

Introduction to Machine Learning with Python: A Guide for Data Scientists, Sarah Guido, O'Reilly Media; 25 May 2016.

ISBN-10:1449369413

ISBN-13:978-1449369415

Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd Edition, Aurelien Geron, OReilly, 14 Oct. 2019.

ISBN-10:1492032646

ISBN-13:978-1492032649

Deep Learning with Python, Francois Chollet, Manning Publications, 30 Nov. 2017.

ISBN-10:9781617294433

ISBN-13:978-1617294433

Deep Learning (Adaptive Computation and Machine Learning Series), Illustrated edition, Ian Goodfellow, MIT Press, 3 Jan. 2017

ISBN-10:0262035618

ISBN-13:978-0262035613

Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2, 3rd Edition, Sebastian Raschka, Vahid Mirjalili, Packt Publishing, 12 Dec. 2019.

ISBN-10:1789955750

ISBN-13:978-1789955750

Machine Learning Yearning (Andrew Ng's free ebook) https://www.deeplearning.ai/machine-learning-yearning/

Dive into Deep Learning (Free ebook) https://d2l.ai/