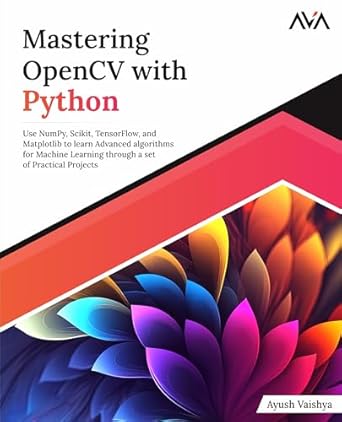
Mastering OpenCV with Python

*Orange Education AVA – 2023*



# 1. Introduction to Computer Vision

## Introduction

## Structure

## Introduction to Computer Vision

## Applications of Computer Vision

## Python

## OpenCV

Brief history of OpenCV

OpenCV 4.7

## Supporting Libraries

NumPy

Matplotlib

SciPy

Scikit-Learn

Scikit-Image

Mahotas

TensorFlow

Keras

Dlib

## Environment Setup

Installing Python

Installing Python on Windows

Installing Python on Ubuntu and Mac

Package Manager

Installing libraries

Installing Mahotas

Installing OpenCV

Verifying our installation

IDE

## Documentation

## Conclusion

## Test Your Understanding

# 2. Getting Started with Images

## Structure

## Introduction to images and pixels

## Loading and displaying images

Imread()

Imshow

Imwrite

WaitKey

DestroyAllWindows

## Manipulating images with pixels

Accessing individual pixels

Accessing a region of interest (ROI)

## Drawing in OpenCV

Line

Rectangle

Circle

Text

## Conclusion

## Points to remember

## Test your understanding

# 3. Image Processing Fundamentals

## Structure

## Geometric transformations

Image translation

Rotation

Scaling

Flipping

Cropping

## Arithmetic Operations

Addition

Subtraction

Multiplication and division

## Bitwise operations

AND

OR

XOR

NOT

## Channels and color spaces

Red Green Blue (RGB) color space

Blue Green Red (BGR) color space

Hue Saturation Value (HSV) color space

Hue Saturation Lightness (HSL) color space

cvtColor() 67 Hue Saturation Lightness (HSL) color space

LAB color space

YCbCr color space

## Conclusion

## Points to Remember

## Test Your Understanding

# 4. Image Operations

Structure

Morphological operations on images

Erosion

cv2.Erode()

Dilation

cv2.Dilate()

Opening

Cv2.morphologyex()

Closing

Morphological gradient

Top hat

Bottom hat

Smoothing and blurring

Average blurring

Cv2.blur()

Median blur

cv2.medianBlur()

Gaussian blur

cv2.gaussianBlur()

Bilateral filter

cv2.bilateralFilter()

Conclusion

Points to remember

Test your understanding

# 5. Image Histograms

Structure

Introduction to histograms

cv2.calcHist()

Matplotlib helper functions

Histogram for colored images

Two-dimensional histograms

Histogram with masks

Histogram equalization

cv2.equalizeHist()

Histogram equalization on colored images

Adaptive histogram equalization

Contrast limited adaptive histogram equalization (CLAHE)

cv2.createCLAHE()

Histograms for feature extraction

Conclusion

Points to remember

Test your understanding

# 6. Image Segmentation

Structure

Introduction to Image Segmentation

Basic Segmentation Techniques

Image thresholding

Simple Thresholding

cv2.threshold()

Adaptive Thresholding

cv2.adaptiveThreshold()

Otsu’s Thresholding

Edge and contour-based segmentation

Advanced Segmentation Techniques

Watershed Algorithm

GrabCut algorithm

cv2.grabCut()

Clustering-based Segmentation

Deep Learning-based Segmentation

Conclusion

Points to Remember

Test your understanding

# 7. Edges and Contours

Structure

Introduction to edges

Image gradients

Filters for image gradients

Sobel Filters

cv2.Sobel()

Scharr Operator

cv2.filter2D

Laplacian Operators

Canny Edge Detector

cv2.Canny()

Introduction to Contours

Contour Hierarchy

Extracting and Visualizing Contours

cv2.findContours()

cv2.drawContours()

Contour Moments

cv2.Moments()

Properties of Contours

Area

cv2.contourArea()

Perimeter

Centroid/Center Of mass

Bounding Rectangle

cv2.boundingRect()

cv2.minAreaRect()

cv2.boxPoints()

Extent

Convex Hull

cv2.convexHull()

cv2.polyLines()

Solidity

Contour Approximation

cv2.approxPolyDP()

Contour Filtering and Selection

Conclusion

Points to Remember

Test your understanding

# 8. Machine Learning with Images

Structure

Introduction to Machine Learning

Overfitting and Underfitting

Evaluation Metrics

Hyperparameters and Tuning

KMeans Clustering

cv2.kmeans()

k-Nearest Neighbors (k-NN)

Feature Scaling

Hyperparameters

Logistic Regression

Hyperparameters

Decision Trees

Hyperparameters

Ensemble Learning

Random Forest

Randomness

Hyperparameters

Support Vector Machines

Conclusion

Points to Remember

Test your understanding

# 9. Advanced Computer Vision Algorithms

Structure

FAST (Features from Accelerated Segment Test)

cv2.FastFeatureDetector\_create

Harris Keypoint Detection

cv2.cornerHarris

BRIEF (Binary Robust Independent Elementary Features)

cv2.ORB\_create

ORB (Oriented FAST and Rotated BRIEF)

SIFT (Scale-Invariant Feature Transform)

cv2.SIFT\_create

RootSIFT (Root Scale-Invariant Feature Transform)

SURF (Speeded-Up Robust Features)

Local Binary Patterns

Histogram of Oriented Gradients

Conclusion

Points to Remember

Test Your Understanding

# 10. Neural Networks

Structure

Introduction to Neural Networks

Design of a Neural Network

Activation Functions

Training a Neural Network

Gradient descent

Convolutional neural networks

Layers in a CNN

Convolutional Layer

Pooling Layer

Fully Connected Layer

Activation Layer

First Neural Network Model

Data Loading

Model Instantiation

Results

Dropout Regularization

Neural network architectures

LeNet

AlexNet

VGGNET

Transfer Learning

Other Network Architectures

GoogleNet

Inception Module

Architecture

ResNet

Conclusion

Points to remember

Test your understanding

# 11. Object Detection Using OpenCV

Structure

Introduction to object detection

Detecting objects using sliding windows

Template matching using OpenCV

cv2.matchTemplate

Haar cascades

Feature extraction for object detection

Image pyramids

Facial landmarks with DLIB

Object tracking using OpenCV

Conclusion

Points to remember

Test your understanding

# 12.Projects Using OpenCV

Structure

Automated book inventory system

Document scanning using OpenCV and OCR

Face recognition

Drowsiness detection

Conclusion