# **OpenCV with Python**

**OpenCV** is a huge open-source library for computer vision, machine learning, and image processing. OpenCV supports a wide variety of programming languages like Python, C++, Java, etc. It can process images and videos to identify objects, faces, or even the handwriting of a human. When it is integrated with various libraries, such as [Numpy](https://www.geeksforgeeks.org/python-numpy/" \t "_blank) which is a highly optimized library for numerical operations, then the number of weapons increases in your Arsenal i.e whatever operations one can do in Numpy can be combined with OpenCV.

Getting started with OpenCV's Python bindings is actually much easier than many people make it out to be initially. You will need two main libraries, with an optional third: **python-OpenCV**, **Numpy**, and **Matplotlib**.

**Windows Users:**

[***python-OpenCV***](https://www.lfd.uci.edu/~gohlke/pythonlibs/#opencv) - There are alternative methods, but this is the easiest. Download the appropriate wheel (.whl) file, and install using pip. See video for help.

*pip install numpy*

*pip install matplotlib*

**Linux / Mac Users:**

*pip3 install numpy*or *apt-get install python3-numpy*. You may need to *apt-get install python3-pip*.

*pip3 install matplotlib* or *apt-get install python3-matplotlib*.

*apt-get install python3-OpenCV*

[**Matplotlib**](https://pythonprogramming.net/matplotlib-intro-tutorial/) is an optional choice for displaying frames from video or images.

[**Numpy**](https://www.numpy.org/) is used for all things "numbers and Python." We are mainly making use of Numpy's array functionality.

Finally, we are using the python-specific bindings for OpenCV called **python-OpenCV**.

There are some operations for OpenCV that you will not be able to do without a full installation of OpenCV (about 3GB in size), but you can actually do quite a bit with the fairly minimal installation of python-OpenCV. We will wind up using the full installation of OpenCV later in this series, so you can feel free to get it if you like, but these 3 modules will keep us busy for a while!

Make sure your installations were successful by running Python, and doing:

*import cv2*

*import matplotlib*

*import numpy*

## [Working with Images](https://www.geeksforgeeks.org/opencv-python-tutorial/#images)

### **[Getting Started](https://www.geeksforgeeks.org/opencv-python-tutorial/" \l "imagesstart)**

* [Reading an image in OpenCV using Python](https://www.geeksforgeeks.org/reading-image-opencv-using-python/" \t "_blank)
* [Display an image in OpenCV using Python](https://www.geeksforgeeks.org/python-opencv-cv2-imshow-method/)
* [Writing an image in OpenCV using Python](https://www.geeksforgeeks.org/python-opencv-cv2-imwrite-method/)
* [OpenCV | Saving an Image](https://www.geeksforgeeks.org/opencv-saving-an-image/)
* [Color Spaces](https://www.geeksforgeeks.org/color-spaces-in-opencv-python/)
* [Arithmetic operations on Images](https://www.geeksforgeeks.org/arithmetic-operations-on-images-using-opencv-set-1-addition-and-subtraction/)
* [Bitwise Operations on Binary Images](https://www.geeksforgeeks.org/arithmetic-operations-on-images-using-opencv-set-2-bitwise-operations-on-binary-images/)

### [**Image Processing**](https://www.geeksforgeeks.org/opencv-python-tutorial/#processing)

* [Image Resizing](https://www.geeksforgeeks.org/image-resizing-using-opencv-python/)
* [Eroding an Image](https://www.geeksforgeeks.org/python-opencv-cv2-erode-method/)
* [Blurring an Image](https://www.geeksforgeeks.org/python-image-blurring-using-opencv/)
* [Create Border around Images](https://www.geeksforgeeks.org/python-opencv-cv2-copymakeborder-method/)
* [Grayscaling of Images](https://www.geeksforgeeks.org/python-grayscaling-of-images-using-opencv/)
* [Scaling, Rotating, Shifting and Edge Detection](https://www.geeksforgeeks.org/image-processing-in-python-scaling-rotating-shifting-and-edge-detection/)
* [Erosion and Dilation of images](https://www.geeksforgeeks.org/erosion-dilation-images-using-opencv-python/)
* [Analyze an image using Histogram](https://www.geeksforgeeks.org/opencv-python-program-analyze-image-using-histogram/)
* [Histograms Equalization](https://www.geeksforgeeks.org/histograms-equalization-opencv/)
* [Simple Thresholding](https://www.geeksforgeeks.org/python-thresholding-techniques-using-opencv-set-1-simple-thresholding/)
* [Adaptive Thresholding](https://www.geeksforgeeks.org/python-thresholding-techniques-using-opencv-set-2-adaptive-thresholding/)
* [Otsu Thresholding](https://www.geeksforgeeks.org/python-thresholding-techniques-using-opencv-set-3-otsu-thresholding/)
* [Segmentation using Thresholding](https://www.geeksforgeeks.org/opencv-segmentation-using-thresholding/)
* [Convert an image from one color space to another](https://www.geeksforgeeks.org/python-opencv-cv2-cvtcolor-method/)
* [Filter Color with OpenCV](https://www.geeksforgeeks.org/filter-color-with-opencv/)
* [Denoising of colored images](https://www.geeksforgeeks.org/python-denoising-of-colored-images-using-opencv/)
* [Visualizing image in different color spaces](https://www.geeksforgeeks.org/python-visualizing-image-in-different-color-spaces/)
* [Find Co-ordinates of Contours](https://www.geeksforgeeks.org/find-co-ordinates-of-contours-using-opencv-python/)
* [Bilateral Filtering](https://www.geeksforgeeks.org/python-bilateral-filtering/)
* [Image Inpainting using OpenCV](https://www.geeksforgeeks.org/image-inpainting-using-opencv/)
* [Intensity Transformation Operations on Images](https://www.geeksforgeeks.org/python-intensity-transformation-operations-on-images/)
* [Image Registration](https://www.geeksforgeeks.org/image-registration-using-opencv-python/)
* [Background subtraction](https://www.geeksforgeeks.org/python-background-subtraction-using-opencv/)
* [Background Subtraction in an Image using Concept of Running Average](https://www.geeksforgeeks.org/background-subtraction-in-an-image-using-concept-of-running-average/)
* [Foreground Extraction in an Image using Grabcut Algorithm](https://www.geeksforgeeks.org/python-foreground-extraction-in-an-image-using-grabcut-algorithm/)
* [Morphological Operations in Image Processing (Opening)](https://www.geeksforgeeks.org/python-morphological-operations-in-image-processing-opening-set-1/)
* [Morphological Operations in Image Processing (Closing)](https://www.geeksforgeeks.org/python-morphological-operations-in-image-processing-closing-set-2/)
* [Morphological Operations in Image Processing (Gradient)](https://www.geeksforgeeks.org/python-morphological-operations-in-image-processing-gradient-set-3/)
* [Image segmentation using Morphological operations](https://www.geeksforgeeks.org/image-segmentation-using-morphological-operation/)
* [Image Translation](https://www.geeksforgeeks.org/image-translation-using-opencv-python/)
* [Image Pyramid](https://www.geeksforgeeks.org/image-pyramid-using-opencv-python/)

### [**Feature Detection and Description**](https://www.geeksforgeeks.org/opencv-python-tutorial/#feature)

* [Line detection using Houghline method](https://www.geeksforgeeks.org/line-detection-python-opencv-houghline-method/)
* [Circle Detection](https://www.geeksforgeeks.org/circle-detection-using-opencv-python/)
* [Detect corner of an image](https://www.geeksforgeeks.org/python-detect-corner-of-an-image-using-opencv/)
* [Corner Detection with Shi-Tomasi method](https://www.geeksforgeeks.org/python-corner-detection-with-shi-tomasi-corner-detection-method-using-opencv/)
* [Corner detection with Harris Corner Detection](https://www.geeksforgeeks.org/python-corner-detection-with-harris-corner-detection-method-using-opencv/)
* [Find Circles and Ellipses in an Image](https://www.geeksforgeeks.org/find-circles-and-ellipses-in-an-image-using-opencv-python/)
* [Document field detection](https://www.geeksforgeeks.org/python-document-field-detection-using-template-matching/)
* [Smile detection](https://www.geeksforgeeks.org/python-smile-detection-using-opencv/)

### [**Drawing Functions**](https://www.geeksforgeeks.org/opencv-python-tutorial/#drawing)

* [Draw a line](https://www.geeksforgeeks.org/python-opencv-cv2-line-method/)
* [Draw arrow segment](https://www.geeksforgeeks.org/python-opencv-cv2-arrowedline-method/)
* [Draw an ellipse](https://www.geeksforgeeks.org/python-opencv-cv2-ellipse-method/)
* [Draw a circle](https://www.geeksforgeeks.org/python-opencv-cv2-circle-method/)
* [Draw a rectangle](https://www.geeksforgeeks.org/python-opencv-cv2-rectangle-method/)
* [Draw a text string](https://www.geeksforgeeks.org/python-opencv-cv2-puttext-method/)
* [Find and Draw Contours](https://www.geeksforgeeks.org/find-and-draw-contours-using-opencv-python/)
* [Draw a triangle with centroid](https://www.geeksforgeeks.org/draw-a-triangle-with-centroid-using-opencv/)

## [Working with Videos](https://www.geeksforgeeks.org/opencv-python-tutorial/#videos)

### **Getting Started**

* [Play a video using OpenCV](https://www.geeksforgeeks.org/python-play-a-video-using-opencv/)

### **Video Processing**

* [Create video using multiple images](https://www.geeksforgeeks.org/python-create-video-using-multiple-images-using-opencv/)
* [Extract images from video](https://www.geeksforgeeks.org/extract-images-from-video-in-python/)

## Applications and Projects

* [Extract frames using OpenCV](https://www.geeksforgeeks.org/python-program-extract-frames-using-opencv/)
* [White and black dot detection](https://www.geeksforgeeks.org/white-and-black-dot-detection-using-opencv-python/)
* [OpenCV BGR color palette with trackbars](https://www.geeksforgeeks.org/python-opencv-bgr-color-palette-with-trackbars/)
* [Draw rectangular shape and extract objects](https://www.geeksforgeeks.org/python-draw-rectangular-shape-and-extract-objects-using-opencv/)
* [Invisible Cloak using OpenCV](https://www.geeksforgeeks.org/invisible-cloak-using-opencv-python-project/)
* [Unsupervised Face Clustering Pipeline](https://www.geeksforgeeks.org/ml-unsupervised-face-clustering-pipeline/)
* [Saving Operated Video from a webcam](https://www.geeksforgeeks.org/saving-operated-video-from-a-webcam-using-opencv/)
* [Face Detection using Python and OpenCV with webcam](https://www.geeksforgeeks.org/face-detection-using-python-and-opencv-with-webcam/)
* [Opening multiple color windows](https://www.geeksforgeeks.org/opening-multiple-color-windows-to-capture-using-opencv-in-python/)
* [Play a video in reverse mode](https://www.geeksforgeeks.org/python-play-video-reverse-mode-using-opencv/)
* [Template matching using OpenCV in Python](https://www.geeksforgeeks.org/template-matching-using-opencv-in-python/)

## Reference

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3. <https://arboook.com/kompyuternoe-zrenie/osnovnye-operatsii-s-izobrazheniyami-v-opencv-3-python/>
4. <https://www.geeksforgeeks.org/opencv-python-tutorial/#images>