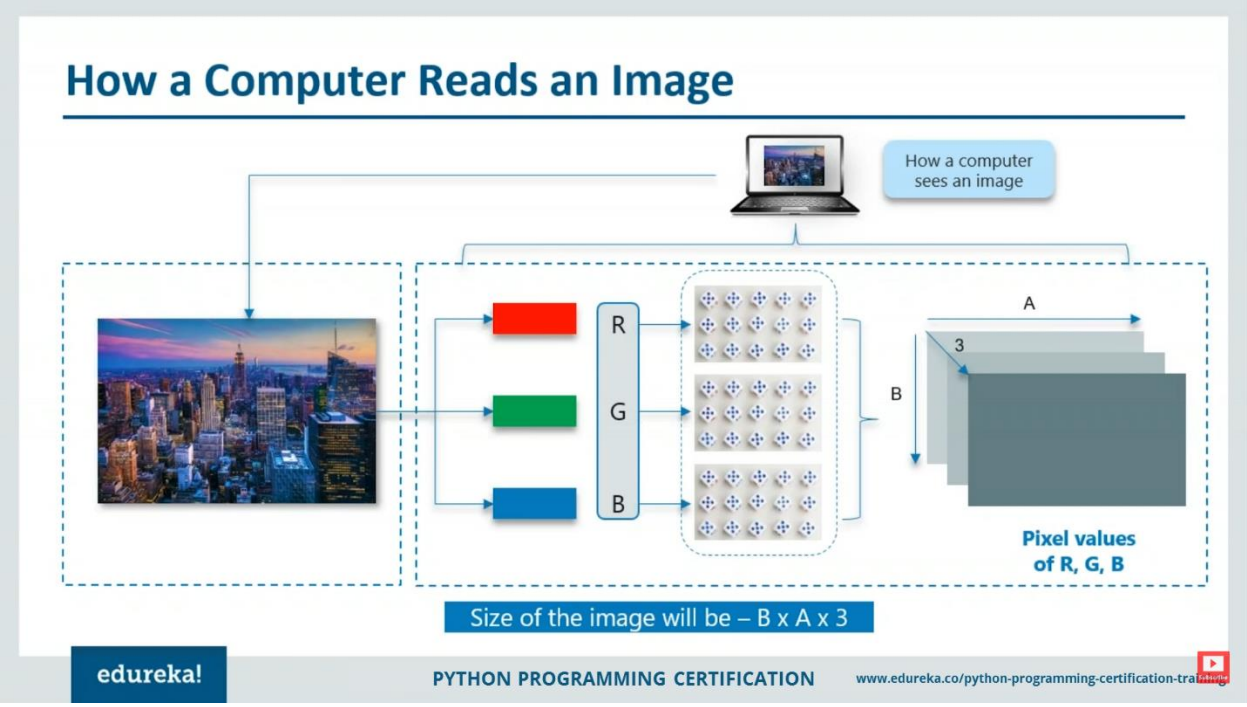
How a Computer Reads an Image?

Computer see a form of matrix numbers between 0 to 255. For Colored images there will be a 3 Channels (*R, G, B; Size of the Image BxAx3, 700(A)x1400(B)*) while Grayscale or Black and White Color there is only 1 channel.



What is OpenCV?

All the OpenCV array structures are converted to and from ***NumPy*** arrays. OpenCV-Phyton is a library of Phyton designed to solve computer vision problems.

Basic Operations with OpenCV

Video Tutorial: OpenCV Python Tutorial | Creating Face Detection System And Motion Detector Using OpenCV | Edureka
link: *https://www.youtube.com/watch?v=-ZrDjwXZGxI*

- Load Images Using OpenCV
- Image Shape / Resolution
- Displaying the Image
- Resizing the Image
- Face Detection
- Capturing Video
- Use Case – Motion Detector
- Bokeh Plot (Motion Graph)

Load Images using OpenCV

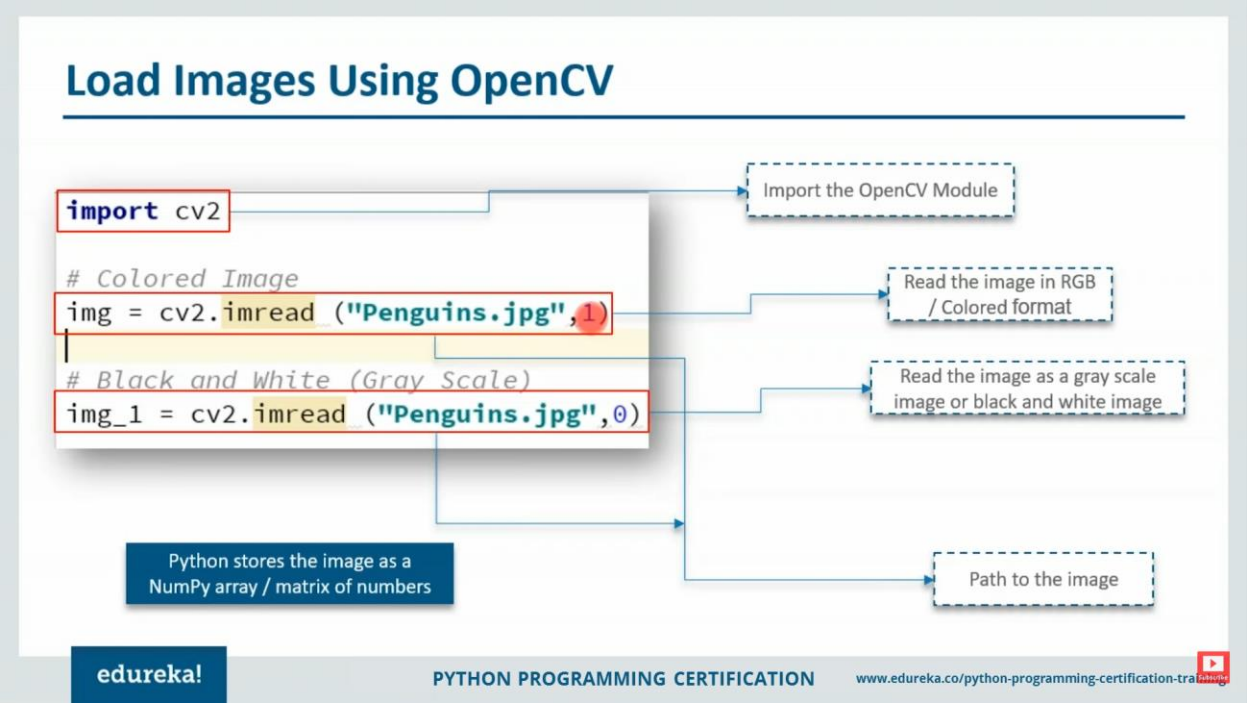
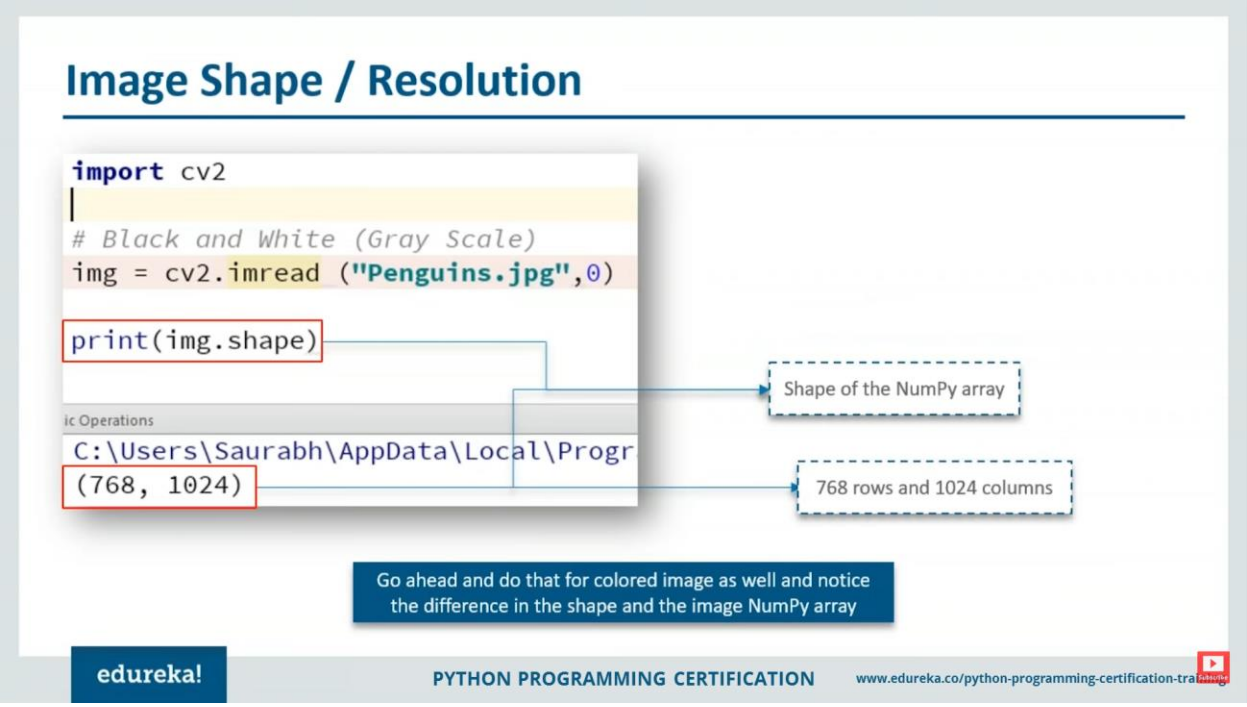
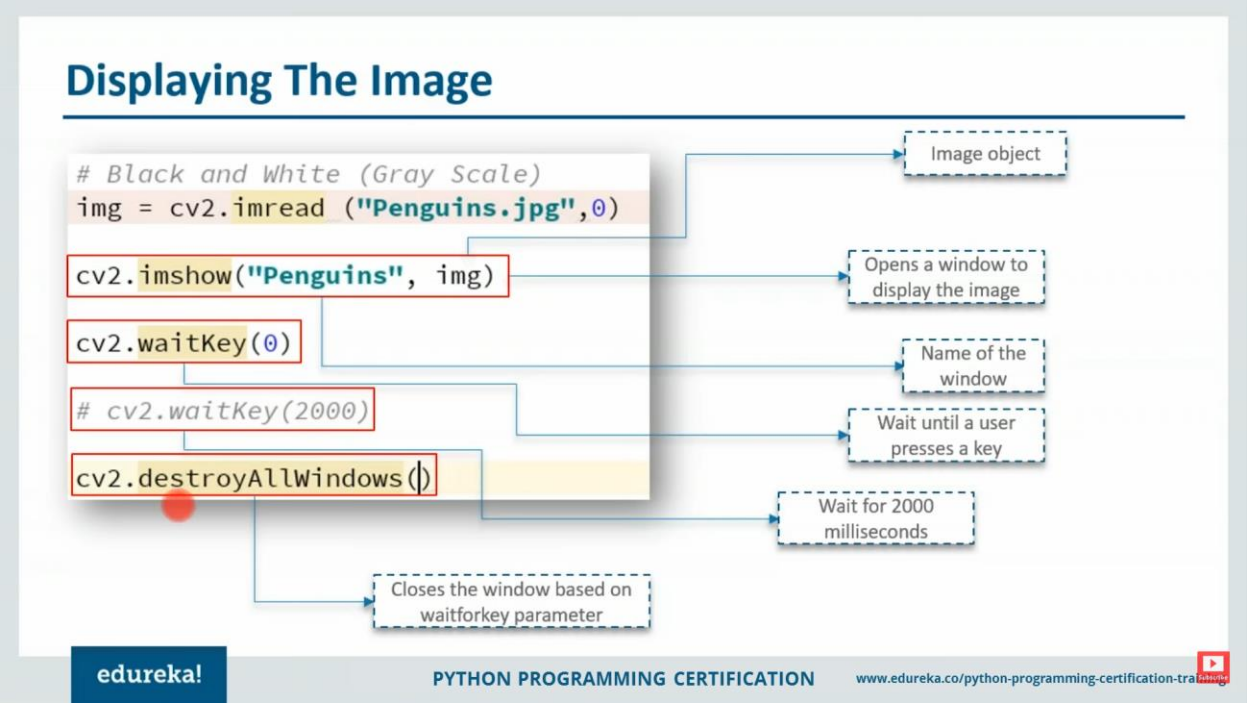


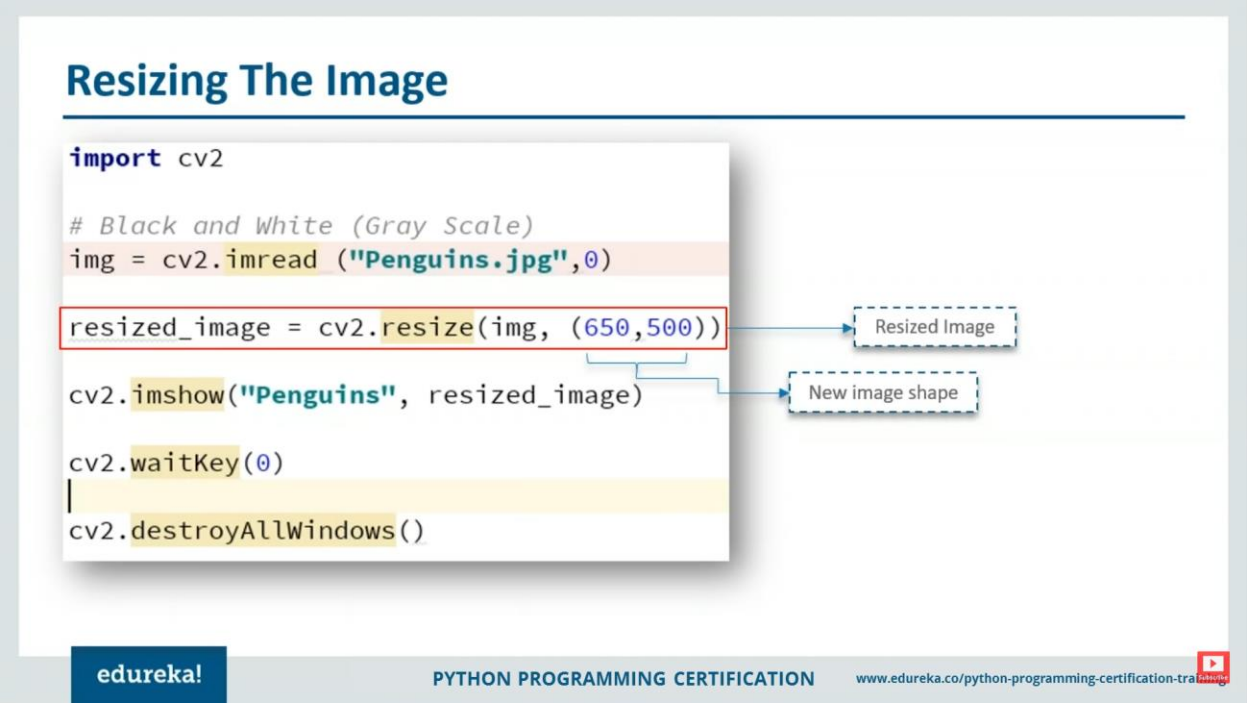
Image Shape / Resolution

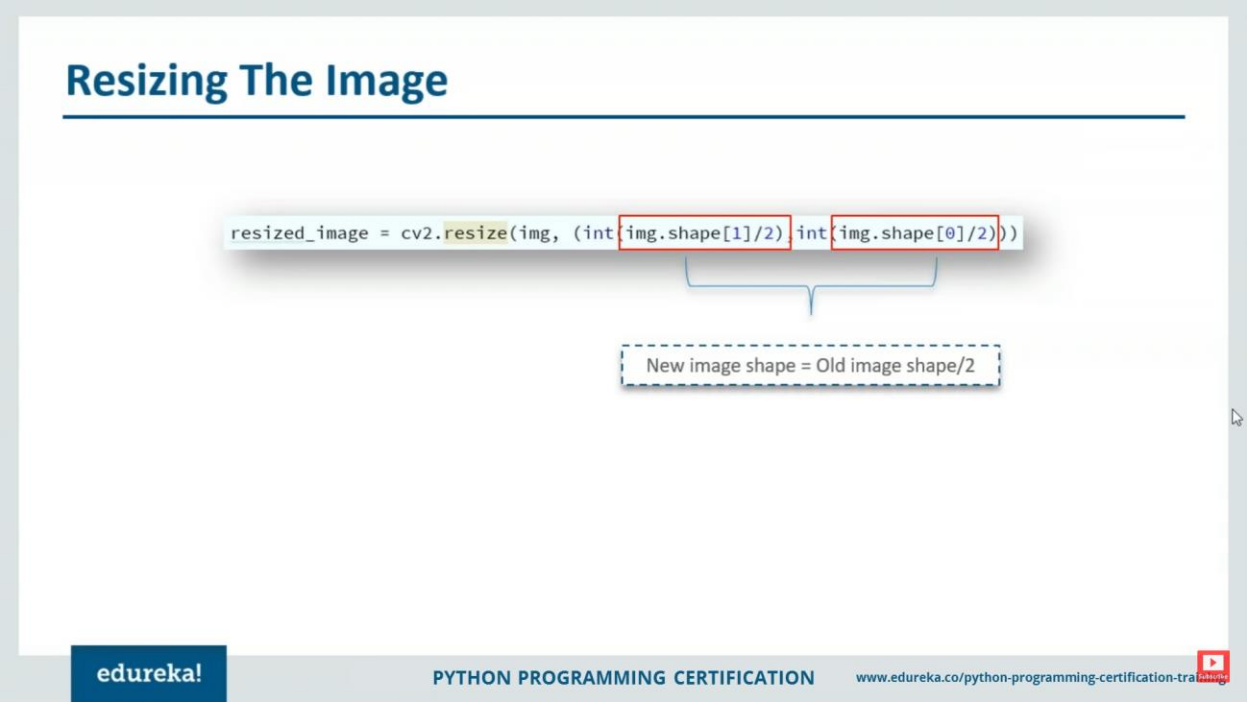


Displaying the Image

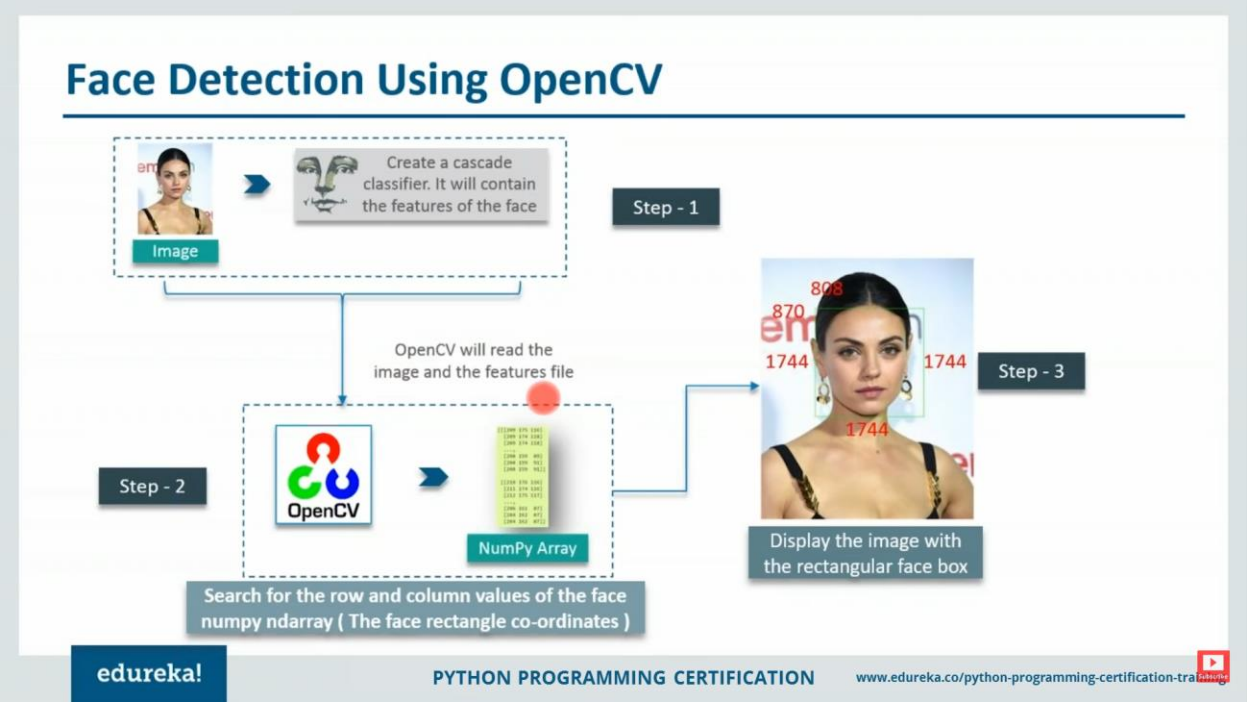


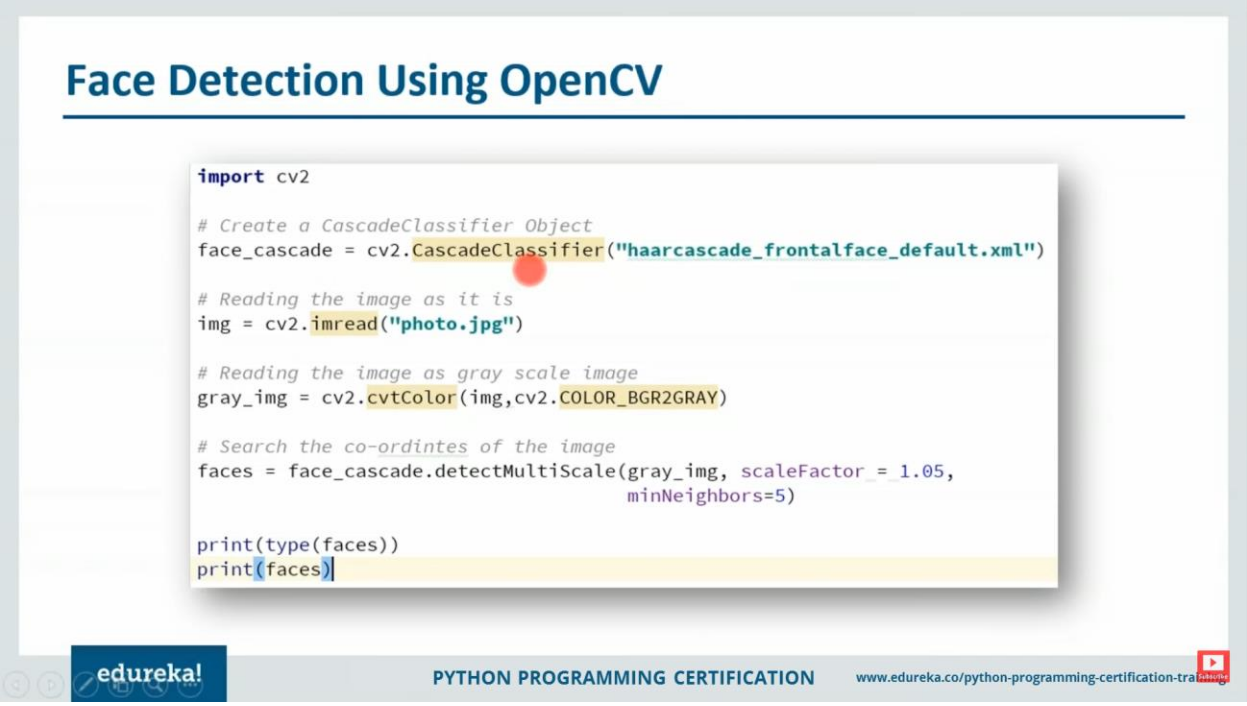
Resizing the Image





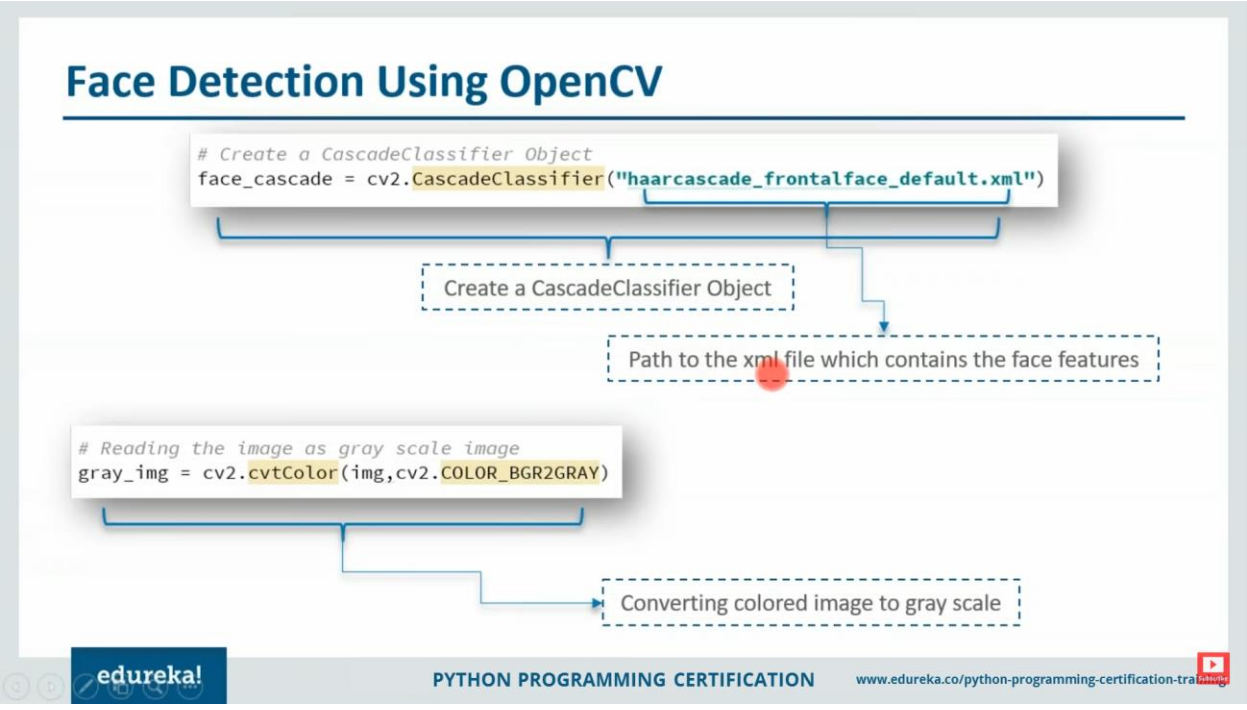
Face Detection





1. Use your PIP pack manager to show the path of packages installed.

run in cmd: *pip show opencv-python*

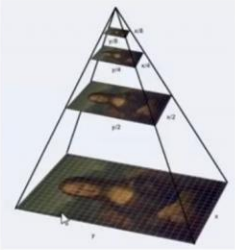


Face Detection Using OpenCV

```
# Search the co-ordintes of the image
faces = face_cascade.detectMultiScale(gray_img, scaleFactor = 1.05,
                                      minNeighbors=5)
```

Method to search for the face rectangle co-ordinates

Decreases the shape value by 5%, until the face is found.
Smaller this value, the greater is the accuracy



Face Detection Using OpenCV - Output

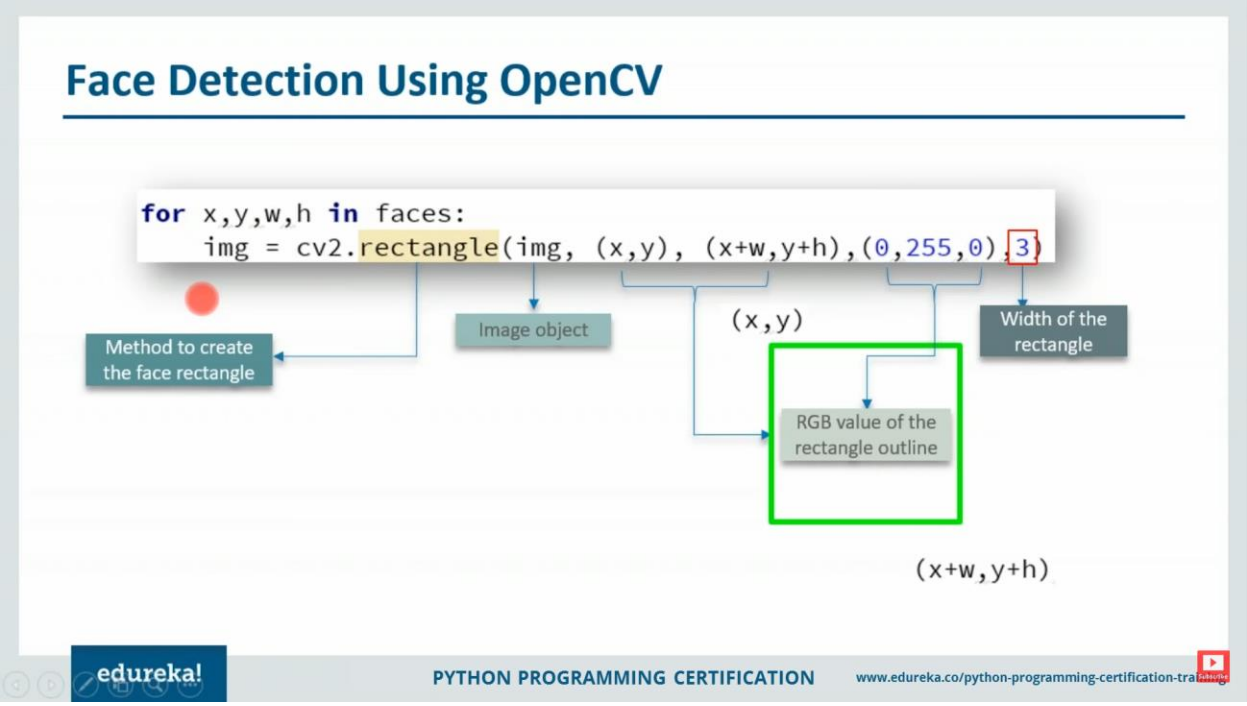
```
print(type(faces))
print(faces)
```

Output

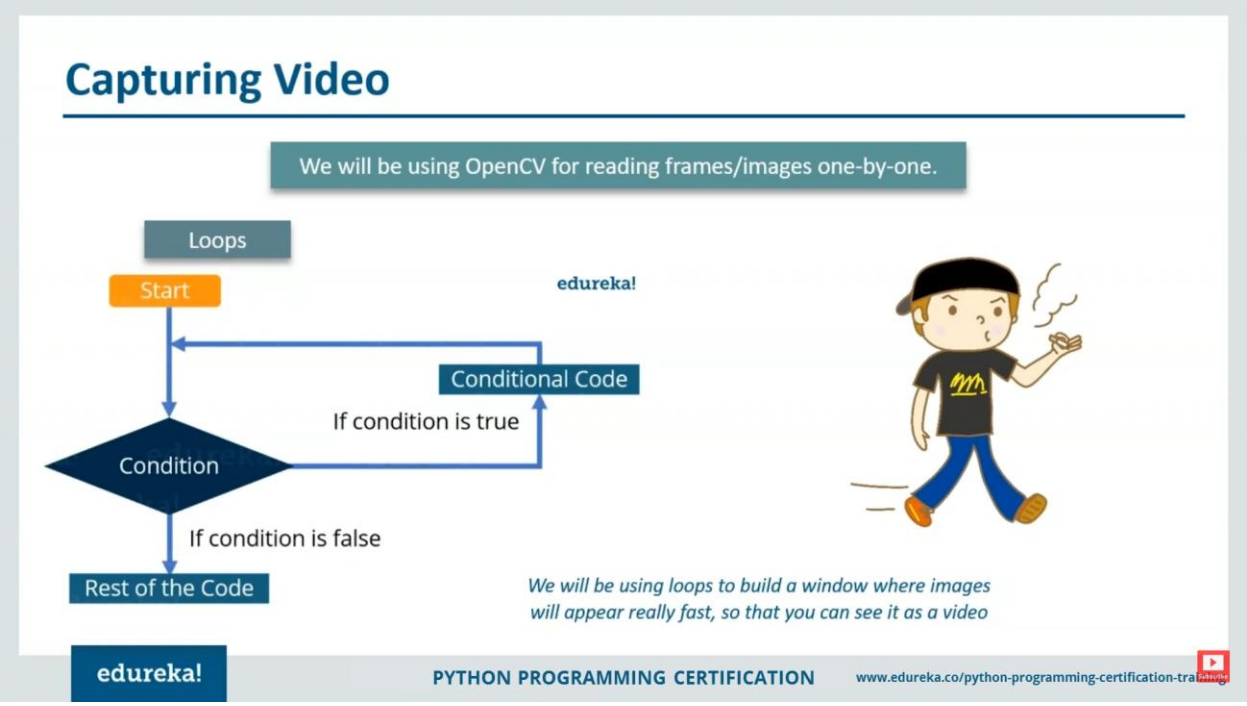
```
<class 'numpy.ndarray'>
[[ 870  808 1744 1744]]
```

Adding The Rectangular Face Box

Let's add the rectangular face box



Capturing a Video



Capturing Video

```
import cv2
video = cv2.VideoCapture(0)
video.release()
```

Either give the path to the video file or use numbers. Numbers specify that you will be using the webcam to capture video

Method to create VideoCapture object. It will trigger the camera

This will release the camera in some milliseconds

'0' is to specify that use built-in camera

Note: If I have an external cam, I can put '1' to use that. Similarly, if I have two external cams and I want to use the third cam I can put '3'.

Capturing Video

When you execute the code, you will notice that your cam light switches on for split seconds, and then it turns off

Let's go ahead and add time delay, using Time module

Capturing Video

```
import cv2,time

video = cv2.VideoCapture(0)

time.sleep(3)

video.release()
```

Import the time module

This will stop the script for 3 seconds

When you execute the above code, the web cam will be on for 3 seconds

Now, Let's Add a Window That Shows The Video

Capturing Video

```
import cv2,time

video = cv2.VideoCapture(0)

check, frame = video.read()

print(check)
print(frame)

time.sleep(3)

video.release()
```

It is a NumPy array, it represents the first image that video captures

It is bool data type, returns true if Python is able to read the VideoCapture object

Capturing Video

- We need to create a frame object, which will read the images of the VideoCapture object.
- We will recessively show each frame of the video being captured.

```
import cv2,time

video = cv2.VideoCapture(0)

check, frame = video.read()

time.sleep(3)

cv2.imshow('Capturing',frame)

cv2.waitKey(0)

video.release()

cv2.destroyAllWindows
```

This will read the first frame/image of the video

imshow method is used to capture the first image/frame of the video

How to Capture the Video, Instead of First Image/Frame of the Video?

edureka!

Capturing Video

In order to capture the video, we will be using 'while' loop. While condition will be such that, until unless 'check' is True, Python will display the frames.

```
import cv2,time

video = cv2.VideoCapture(0)

a = 1

while True:
    a = a + 1
    check, frame = video.read()
    print (frame)

    gray = cv2.cvtColor(frame,cv2.COLOR_BGR2GRAY)

    cv2.imshow('Capturing',gray)

    key = cv2.waitKey(1)

    if key == ord('q'):
        break

print(a) # This will print the number of frames
video.release()
cv2.destroyAllWindows
```

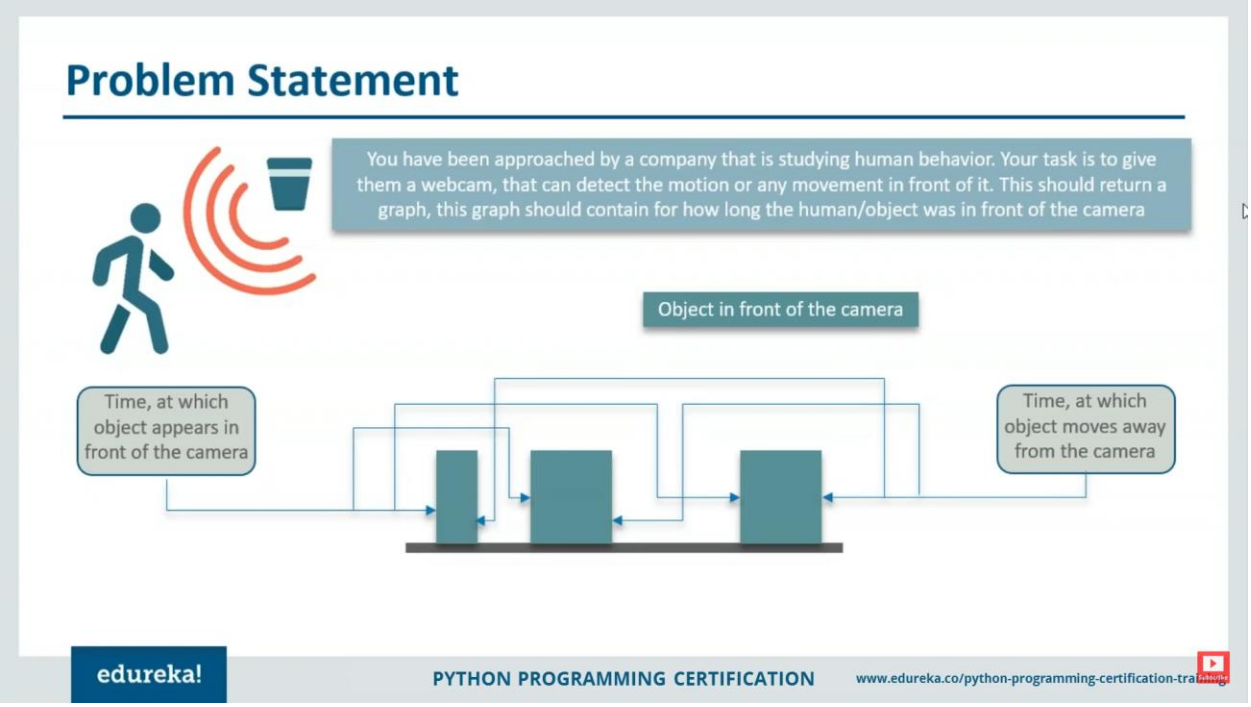
Convert each frame into a gray scale image

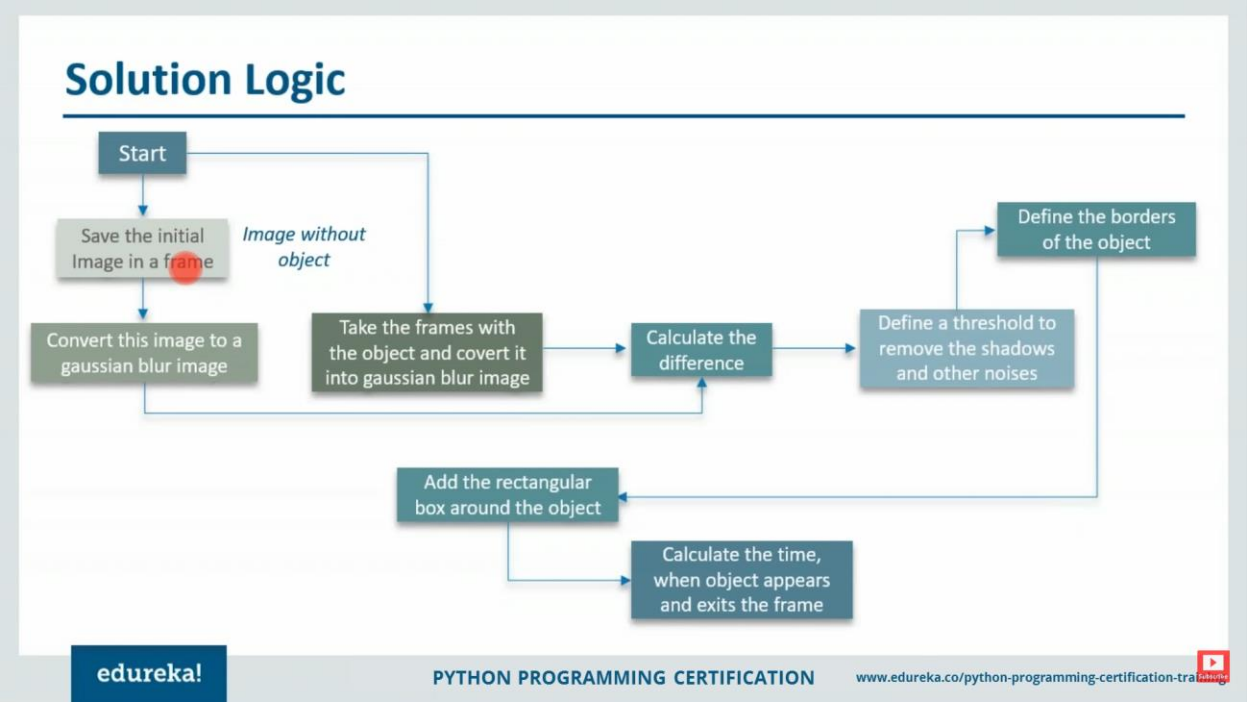
This will iterate through the frames and display the window

This will generate a new frame after every 1 miliseconds

Once you enter 'q' the window will be destroyed

Using Case – Motion Detection





Motion Detector

```
import cv2,time

first_frame = None

video = cv2.VideoCapture(0)

while True:

    check, frame = video.read()

    gray = cv2.cvtColor(frame,cv2.COLOR_BGR2GRAY)

    gray = cv2.GaussianBlur(gray,(21,21),0)

    if first_frame is None:
        first_frame = gray
        continue
```

Create a VideoCapture object to record video using web cam

Convert the frame color to gray scale

Convert the gray scale frame to GaussianBlur

This is used to store the first image/frame of the video

Motion Detector

```
delta_frame = cv2.absdiff(first_frame,gray)

thresh_delta = cv2.threshold(delta_frame, 30, 255, cv2.THRESH_BINARY)[1]

thresh_delta = cv2.dilate(thresh_delta, None, iterations=0 )

(_,cnts,_) = cv2.findContours(thresh_delta.copy(),cv2.RETR_EXTERNAL,
                              cv2.CHAIN_APPROX_SIMPLE)

for contour in cnts:
    if cv2.contourArea(contour) < 1000:
        continue
    (x, y, w, h) = cv2.boundingRect(contour)
    cv2.rectangle(frame, (x,y), (x+w,y+h),(0,255,0), 3)

cv2.imshow('frame',frame)
cv2.imshow('Capturing',gray)
cv2.imshow('delta',delta_frame)
cv2.imshow('thresh',thresh_delta)
```

Calculates the difference between the first frame and other frames

Provides a threshold value, such that it will convert the difference value with less than 30 to black. If the difference is greater than 30 it will convert those pixels to white

Define the contour area. Basically, add the borders

Removes noises and shadows. Basically, it will keep only that part white, which has area greater than 1000 pixels

Creates a rectangular box around the object in the frame

Now, We Can Calculate The Time For Which The Object Was In Front Of The Camera

edureka!

Storing Time Values

```
first_frame=None
status_list=[None,None]
times=[]
df=pandas.DataFrame(columns=["Start","End"])

video=cv2.VideoCapture(0)

while True:
    check, frame = video.read()
    status=0
    gray=cv2.cvtColor(frame,cv2.COLOR_BGR2GRAY)
    gray=cv2.GaussianBlur(gray,(21,21),0)
```

DataFrame to store the time values during which object detection and movement appears

Status at the beginning of the recording is zero as the object is not visible

Storing Time Values

```
(_,cnts,_)=cv2.findContours(thresh_frame.copy(),cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)

for contour in cnts:
    if cv2.contourArea(contour) < 10000:
        continue
    status=1
```

Change in status when the object is being detected

Storing Time Values

```
    (x, y, w, h)=cv2.boundingRect(contour)
    cv2.rectangle(frame, (x, y), (x+w, y+h), (0,255,0), 3)
status_list.append(status)

status_list=status_list[-2:]


if status_list[-1]==1 and status_list[-2]==0:
    times.append(datetime.now())
if status_list[-1]==0 and status_list[-2]==1:
    times.append(datetime.now())
```

List of status for every frame

Record datetime in a list when change occurs

Storing Time Values

```
print(status_list)
print(times)

for i in range(0,len(times),2):
    df=df.append({"Start":times[i],"End":times[i+1]},ignore_index=True)

df.to_csv("Times.csv")

video.release()
cv2.destroyAllWindows
```

Store time values in a DataFrame

Write the DataFrame to a CSV file

Plotting the Motion Detection Graph

```
from motion_detector import df
from bokeh.plotting import figure, show, output_file
from bokeh.models import HoverTool, ColumnDataSource

df["Start_string"]=df["Start"].dt.strftime("%Y-%m-%d %H:%M:%S")
df["End_string"]=df["End"].dt.strftime("%Y-%m-%d %H:%M:%S")


cds=ColumnDataSource(df)

p=figure(x_axis_type='datetime',height=100, width=500, responsive=True,title="Motion Graph")
p.yaxis.minor_tick_line_color=None
p.ygrid[0].ticker.desired_num_ticks=1

hover=HoverTool(tooltips=[("Start","@Start_string"),("End","@End_string")])
p.add_tools(hover)

q=p.quad(left="Start",right="End",bottom=0,top=1,color="red",source=cds)

output_file("Graph1.html")
show(p)
```

Import the DataFrame from the motion_detector.py

Convert time to a string format

The DataFrame of time values is plotted on the browser using Bokeh plots

Tutorials

1. Using OpenCV Episode 1 to 16
https://www.youtube.com/playlist?list=PLQVvvaa0QuDdttJXlLtAJxJetJcqmqlQq

2. Creating your own Haar Cascade OpenCV Python Tutorial Episode 17 to 21
https://www.youtube.com/playlist?list=PLQVvvaa0QuDdttJXlLtAJxJetJcqmqlQq

3. Faster Video FPS
https://www.pyimagesearch.com/2017/02/06/faster-video-file-fps-with-cv2-videocapture-and-opencv/

4. Download Haar Cascades
http://alereimondo.no-ip.org/OpenCV/34

5. Face Recognition and Deep Learning
https://www.pyimagesearch.com/2018/06/18/face-recognition-with-opencv-python-and-deep-learning/

To fully detect a face

1. Viola-Jones Face Detection (At least 3)
    i. Frontal Face
    ii. Left Eye (Optional)
    iii. Right Eye (Optional)
    iv. Nose (Optional)
    v. Mouth (Optional)