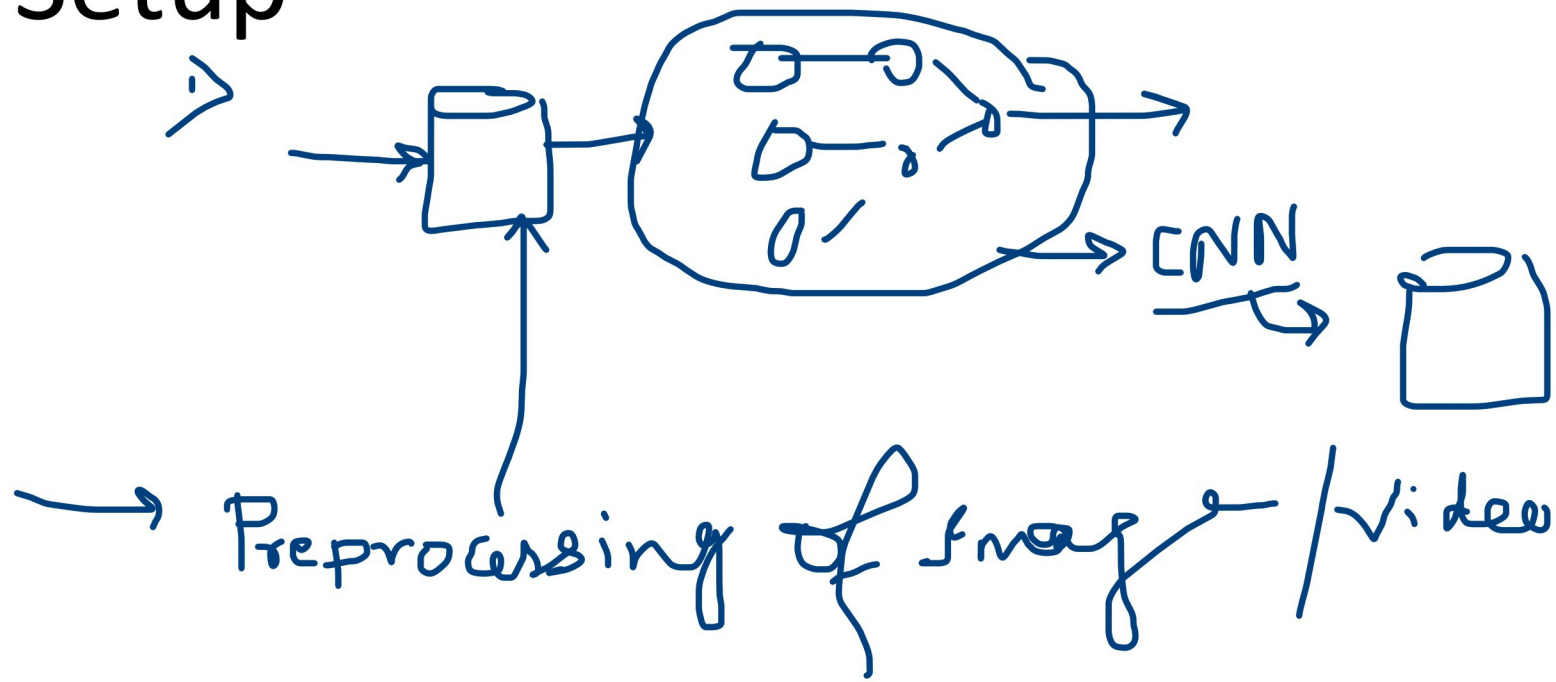
Source: pyimagesearch

Environment Setup

- Anaconda
- Open CV
- Tensorflow

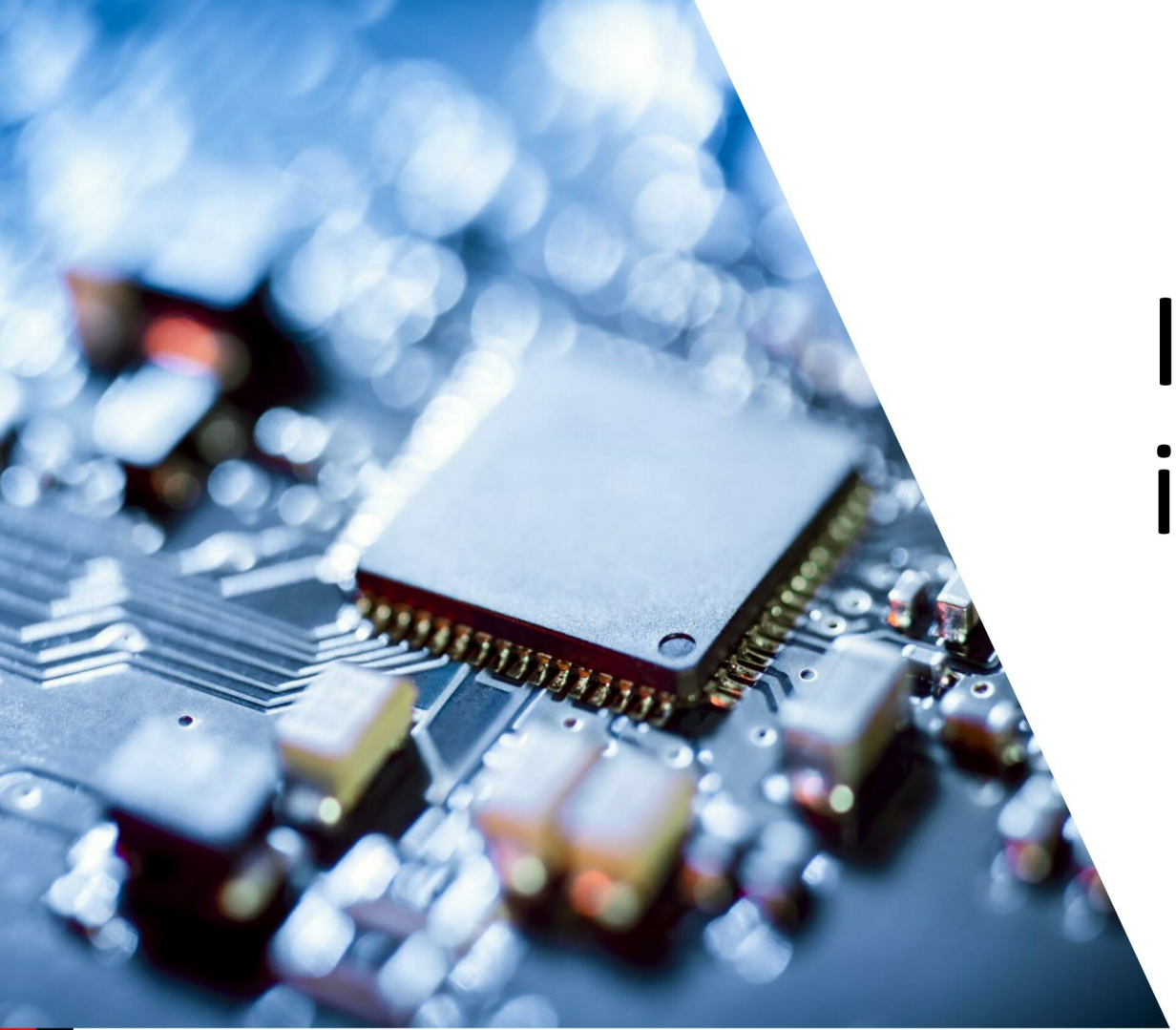


Install anaconda

- Anaconda.org (appropriate python version and OS version)
- Open anaconda prompt
- Type *conda install – c conda-forge opencv*

Virtual environment

- Type *conda create—n environment_name python =version*
- environment_name is your env name and version is 3.6 or 3.7
- Type *source activate environment_name*
- Type *source deactivate*



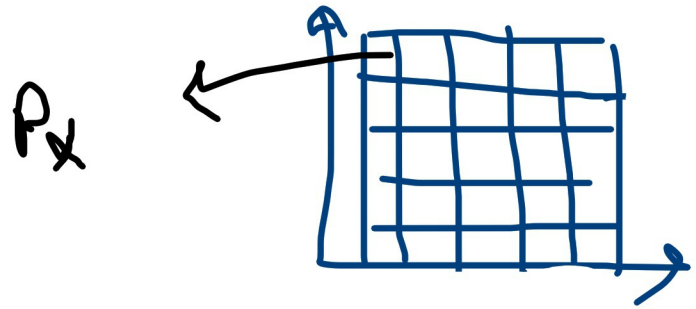
INNOMATICS RESEARCH LABS

Introduction to image processing

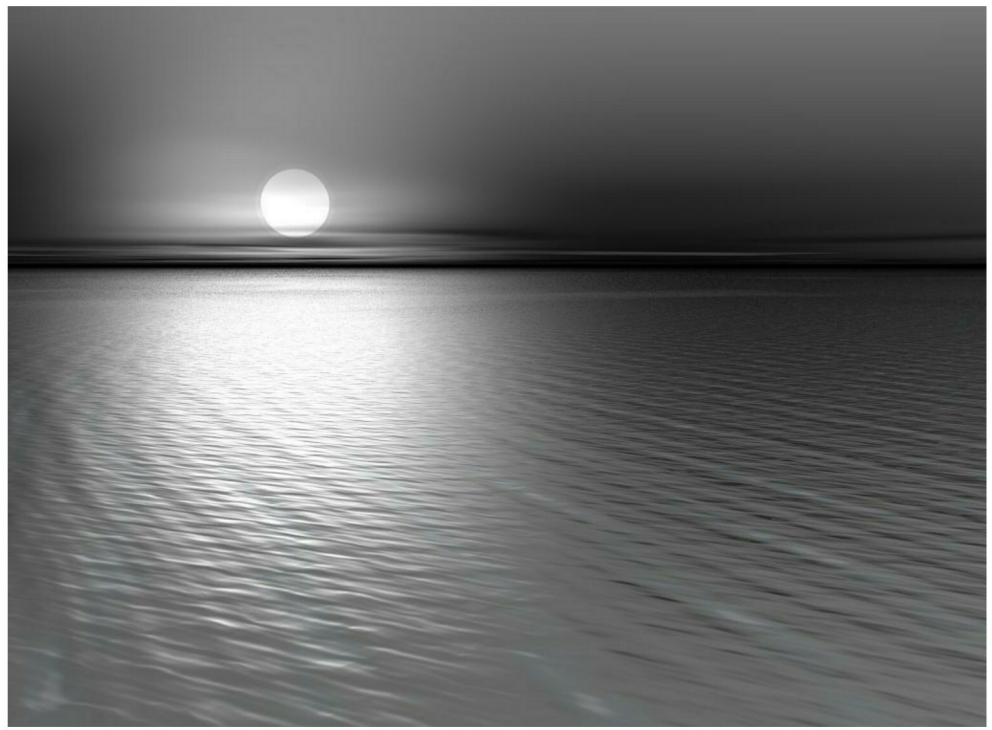
Agenda

- Images and pixels
- Resolution
- Bitmap Images
- Lossless and lossy compression
- File formats
- Color spaces

Images



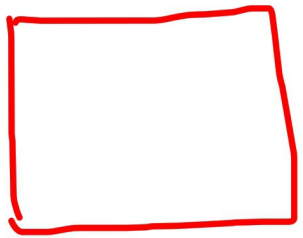
θx → 0 – 255

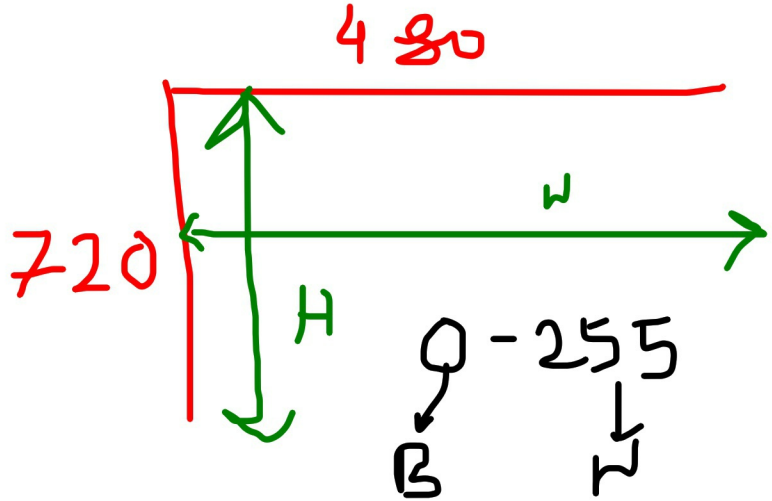


Visual representation in a 2 dimensional form is called Image.

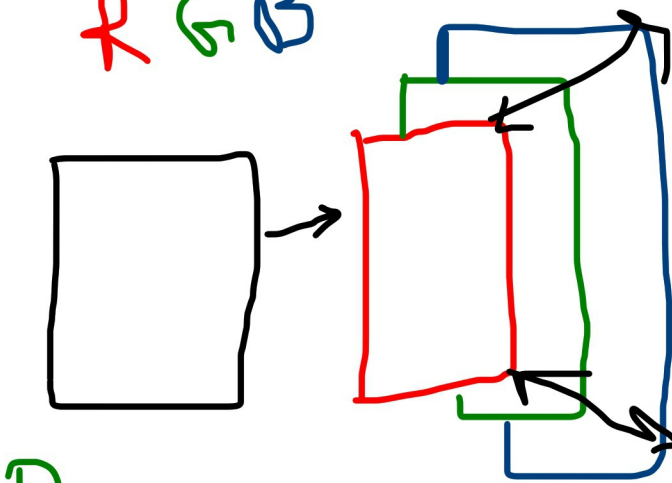
Images are collection of pixels

Source: www.deviantart.com

Px =  ⇒ 720x480 Px



R G B



P[_], G[_], B[_]

⇒ 720 x 480 = 345600

⇒ 3.4MP

Source: www.freeimages.co.uk

- The samples here are pixels, smallest elements in any digital space.
- Like you zoom any photograph.

Image resolution

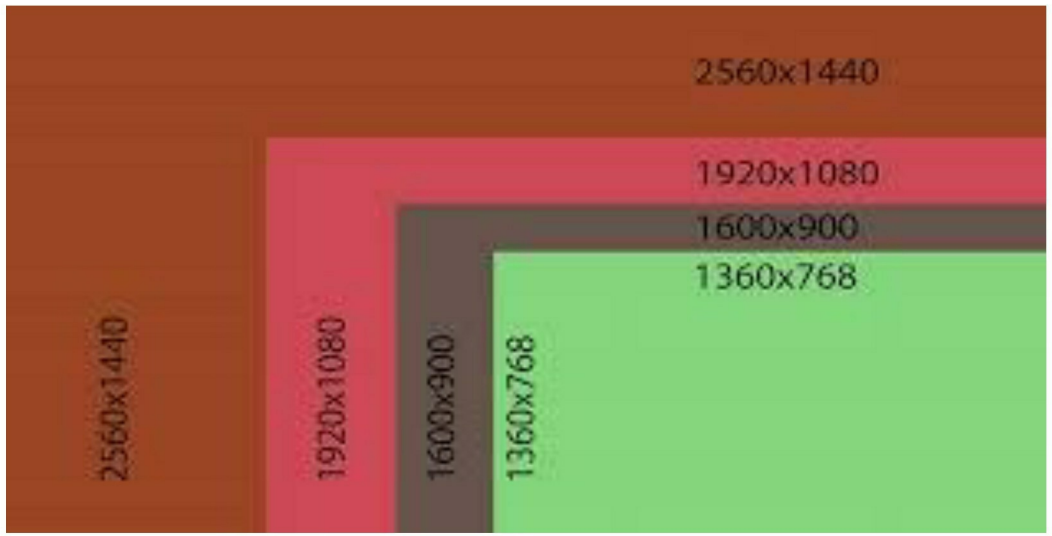
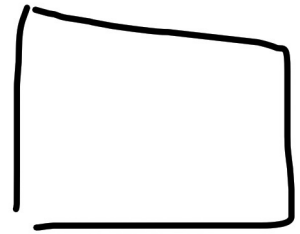


Image resolution comparison

- Image resolution is number of pixels present in an image.
- More pixels == more quality
- For example if you take 1024 X 768 , that means you have 1024 pixel columns and 768 pixel rows total is 786,432 pix

Bitmap Images



- Ideally pixel values are integers, if we convert range of integers to 0s and 1s like bytes it's called a Bitmap image.
- To convert we make white as 1 and black as zero to represent the image.
- Loss less compression:
  - Reducing the size without losing quality is lossless compression
- Lossy compression:
  - In lossy compression some data would be lost.

BpP = Bit per pixel

1bpp = 2 colors

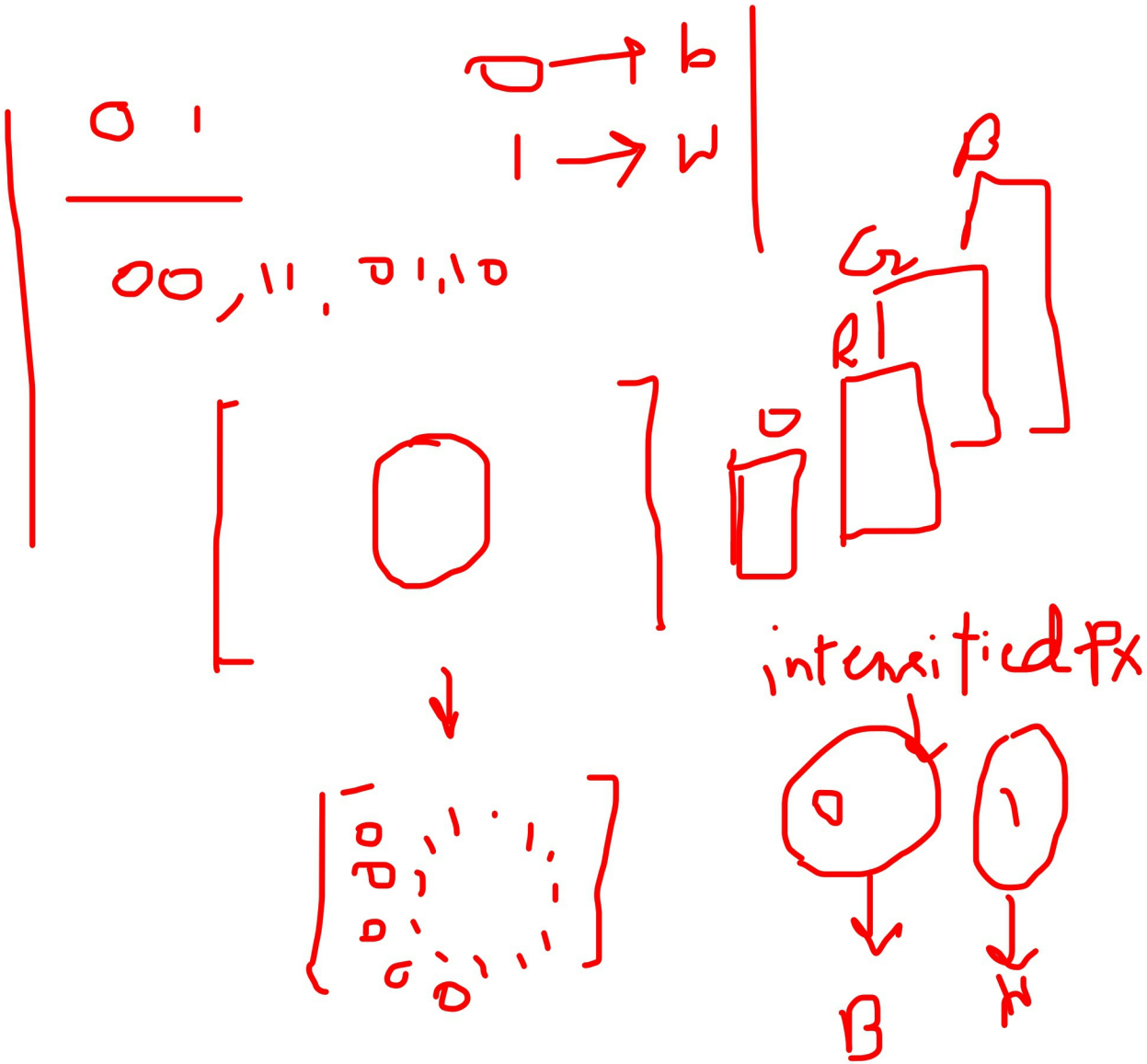
$2^K = 2^1$

$2^2 = 4c$

$2^3 = 8c$

$2^4 = 16c$

$2^5 = 32e$



R = 255, 0, 0

G = 0, 255, 0

B = 0, 0, 255

Gray = 128, 128, 128

W = 255, 255, 255

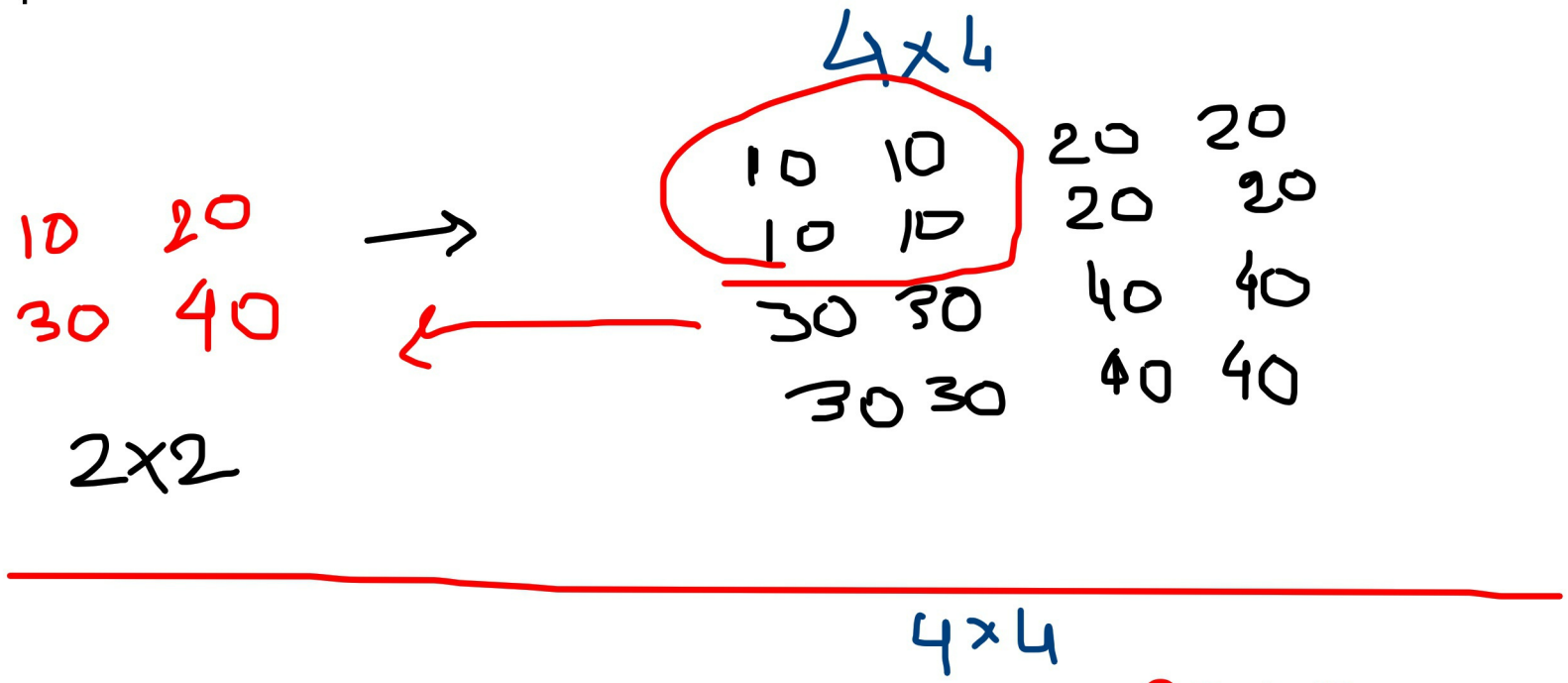
B = 0, 0, 0

$\frac{255}{2} = 128$

Y = 255, 255, 0

Cyan = (0, 255, 255)

Interpolation

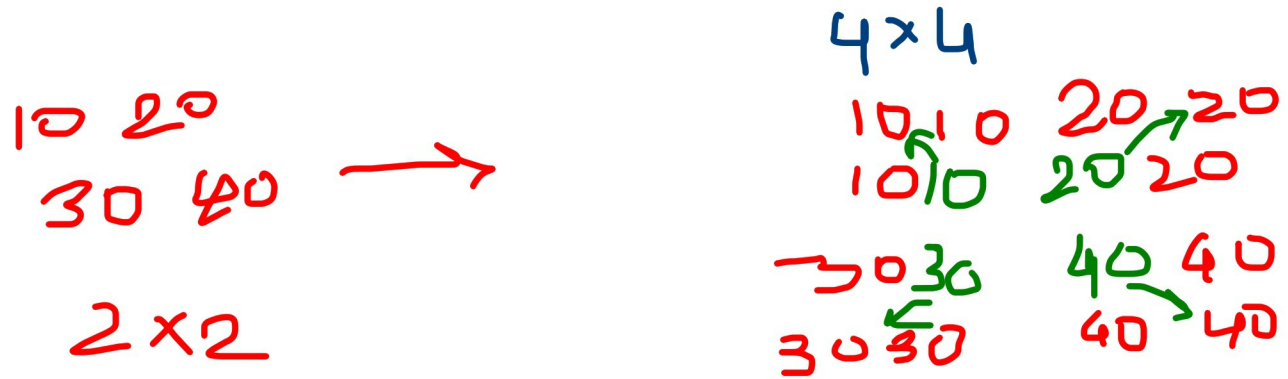


Inter-nearest: nearest neighbour

inter-bilinear: bilinear transformation

inter cubic : cubic transformation

inter Area: computes the area and then fit the pixels



Takes care of sharpness of image.

1. calculates the coeffiecient from the 2X2 and then multiply with pixels

Image file formats

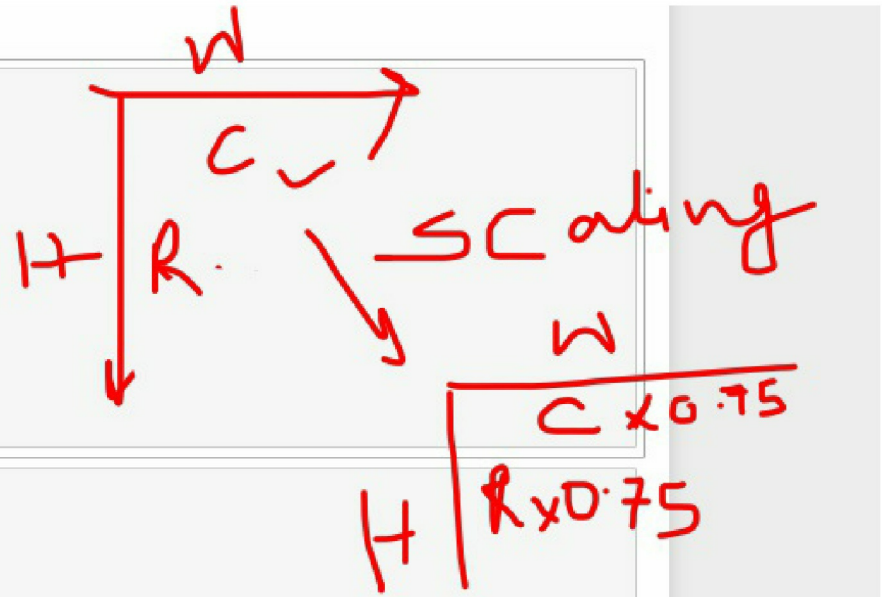
Image Format	Description	Use
JPEG	Lossy compression of raw images	Photos and paints
JPEG2000	Optimized form of JPEG, better compression ratio. (lossless and lossy)	Surveillance
TIFF	lossless compression	Document storage
GIF	bitmap image , animations can be done and lossless compression	gaming and animaition
BMP	independent of display device	windows
PNG	Lossless compression	image transfer over internet
WebP	comparable quality with JPEG	stickers in messaging apps
SVG	for interativity and animation	website development

0 50 100 150 200 250

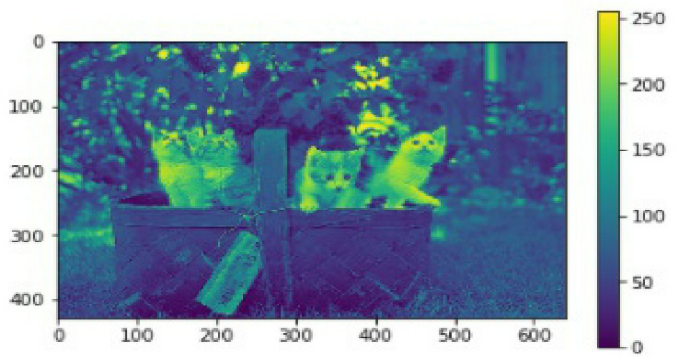
[2]:
```
import cv2 as cv2
vid = cv2.VideoCapture('Resources/Videos/dog.mp4')
while(vid.isOpened()):
    ret, frame = vid.read()
    if ret:
        frameresize = Rescale_Frames(frame)
        cv2.imshow('frame', frame)
        cv2.imshow('resized frame', frameresize)
        if cv2.waitKey(1) & 0xFF == ord('q'):
            break
    else:
        break
vid.release()
cv2.destroyAllWindows()
```

[3]:
```
def Rescale_Frames(frame, scale=0.75):
    width = int(frame.shape[1]*scale)
    height = int(frame.shape[0]*scale)
    dimensions = (width, height)
    return cv2.resize(frame, dimensions, interpolation = cv2.INTER_AREA)
```

[ ]:



Out[7]: <matplotlib.colorbar.Colorbar at 0x1f36cce56d8>



Kernel

Smoothing Images

```
vals = np.random.rand(5,5)
# print(vals.shape)
# print(vals)
vals_ = vals*(1/5)
print(vals_)
```

```
[[0.11203741 0.02947612 0.02540384 0.0532086  0.17745157]
 [0.17831626 0.01569529 0.00773126 0.12064265 0.08676238]
 [0.03530667 0.10236724 0.0399299  0.03946516 0.10060309]
 [0.11848442 0.11154662 0.17313083 0.11182556 0.07051929]
 [0.1808257  0.05371926 0.08990013 0.1049047  0.18698858]]
```

$K = \left(\frac{1}{5}\right)\begin{bmatrix} 5 & 8 & 1 \\ 6 & 9 & 3 \\ 7 & 2 & 4 \end{bmatrix}$

$k = [3 \times 3]$

jupyter Untitled Last Checkpoint: 7 hours ago (autosaved)

Logout

File Edit View Insert Cell Kernel Widgets Help

Trusted | Python 3

Run Code

Out[32]: -1

Smoothing Images

In [35]:
```
vals = np.random.rand(5,5)
# print(vals.shape)
# print(vals)
vals_ = vals*(1/5)
print(vals_)
```

```
[[0.11203741 0.02947612 0.02540384 0.0532086  0.17745157]
 [0.17831626 0.01569529 0.00773126 0.12064265 0.08676238]
 [0.03530667 0.10236724 0.0399299  0.03946516 0.10060309]
 [0.11848442 0.11154662 0.17313083 0.11182556 0.07051929]
 [0.1808257  0.05371926 0.08990013 0.1049047  0.18698858]]
```

In [36]:
```
kernel = np.ones((5,5))/25
print(kernel)
```

```
[[0.04 0.04 0.04 0.04 0.04]
 [0.04 0.04 0.04 0.04 0.04]
 [0.04 0.04 0.04 0.04 0.04]
 [0.04 0.04 0.04 0.04 0.04]
 [0.04 0.04 0.04 0.04 0.04]]
```

$k = \frac{2^{n+1}}{3}$

$k = (3)\ 3$

$k = 3 \rightarrow 3 \times 3$

$k = \text{odd } n/o$

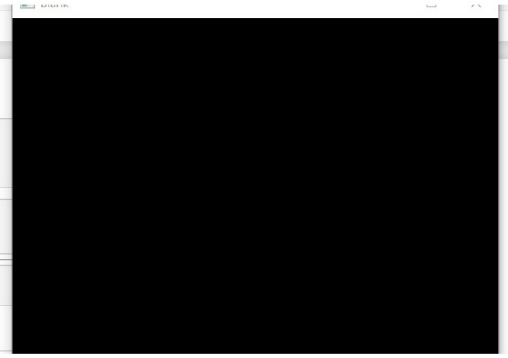
$\begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ \vdots & & & & \end{bmatrix} \times \frac{1}{25} = 0.04 \times 1 = 0.04$

Drawing -

blank Drawing

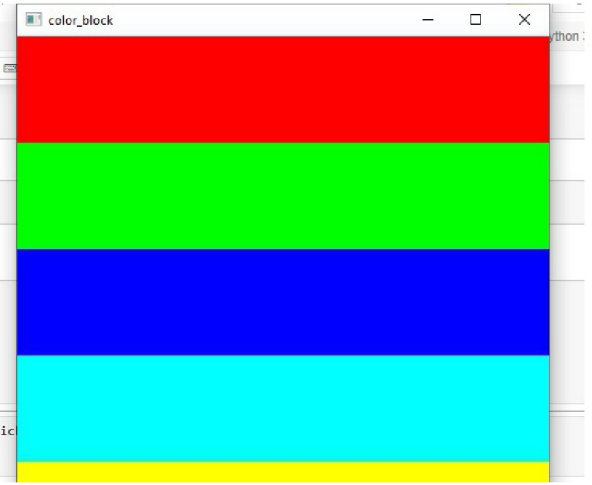
Drawing the images

```
In [1]: %matplotlib inline
        import cv2 as cv2
        import numpy as np
        from matplotlib import pyplot as plt

In [*]: blank = np.zeros((500, 500,3), np.uint8)
        cv2.imshow('blank',blank)
        cv2.waitKey(0)

In [13]: print(blank.shape)
         print(blank.shape[0:2])

         (500, 500, 3)
         (500, 500)
```

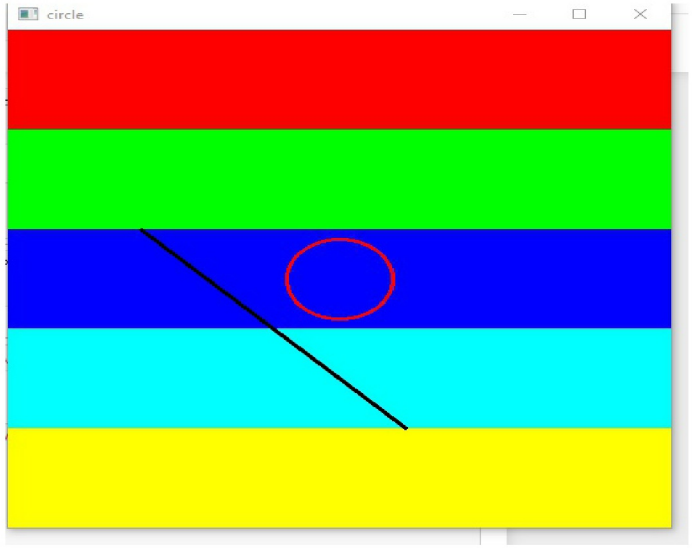


colouring pixel

```
7]: blank = np.zeros((500, 500,3), np.uint8)
    cv2.imshow('blank',blank)
    cv2.waitKey(0)

7]: -1

3]: print(blank.shape)
    print(blank.shape[0:2])

    (500, 500, 3)
    (500, 500)

*]: blank[0:100, 0:500] = (0,0,255)
    blank[100:200, 0:500] = (0,255,0)
    blank[200:300, 0:500] = (255,0,0)
    blank[300:400, 0:500] = (255,255,0)
    blank[400:500, 0:500] = (0,255,255)
    cv2.imshow('color_block', blank)
    cv2.waitKey(0)

1]: cv2.rectangle(blank, (0,0), (250,250),(0,0,0), thic
    cv2.imshow('rect', blank)
    cv2.waitKey(0)
```



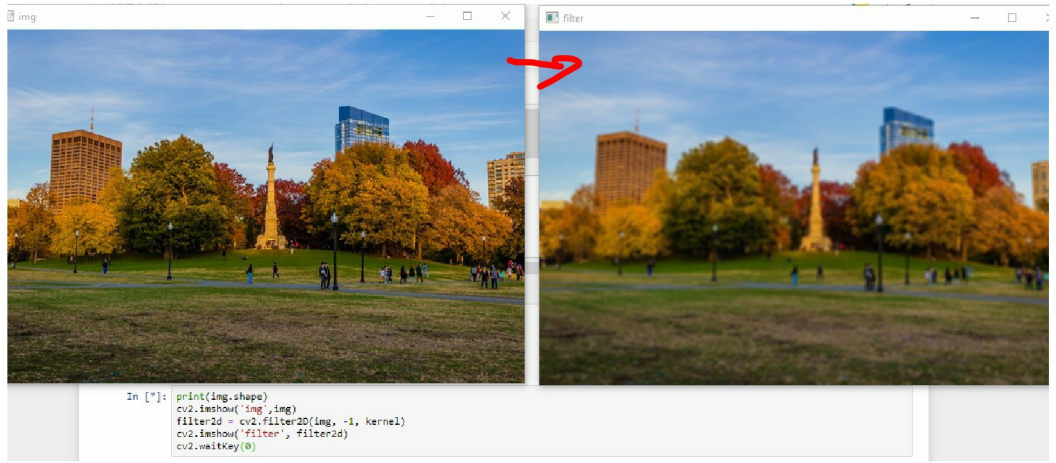
Drawing Lines, cicle



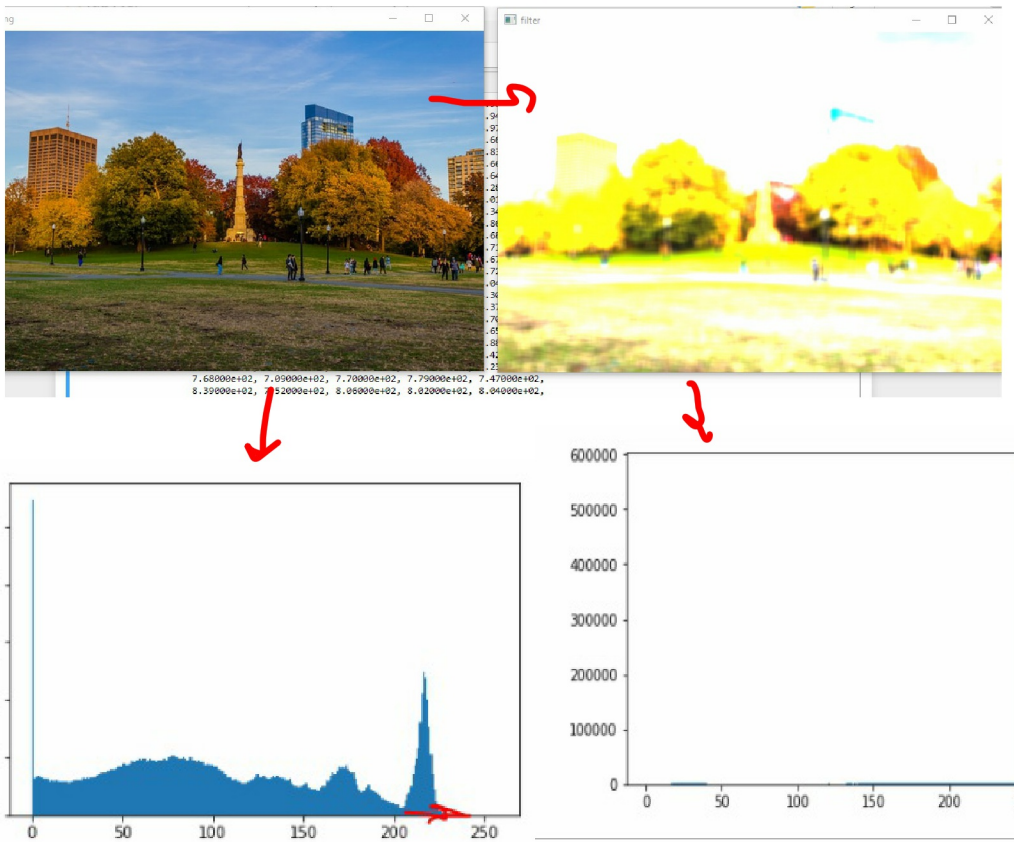
Text applications

Smoothing of images

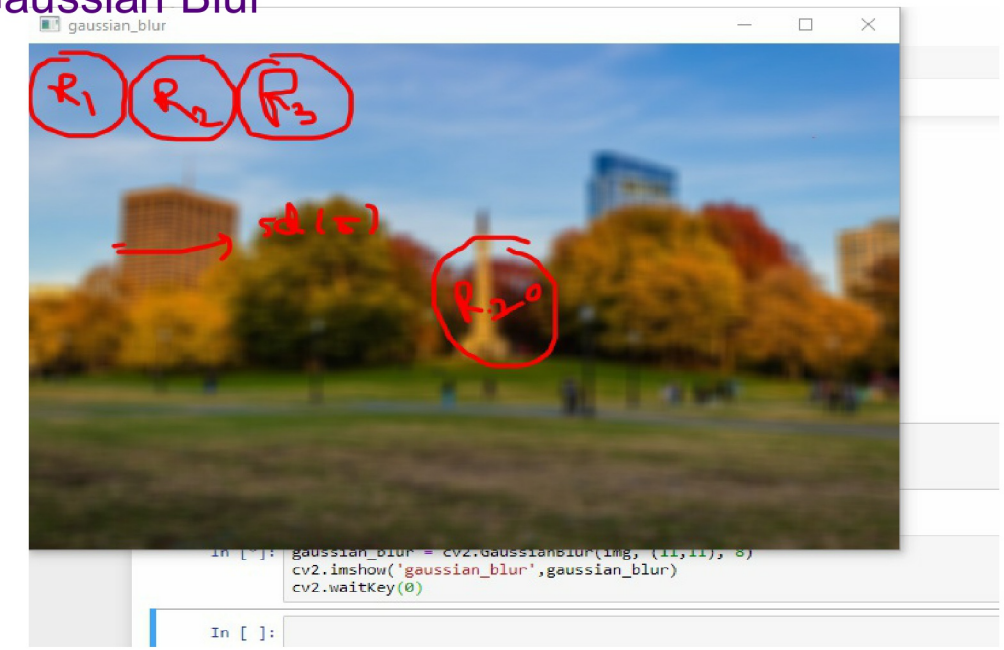
1.Filter2d - small kernel



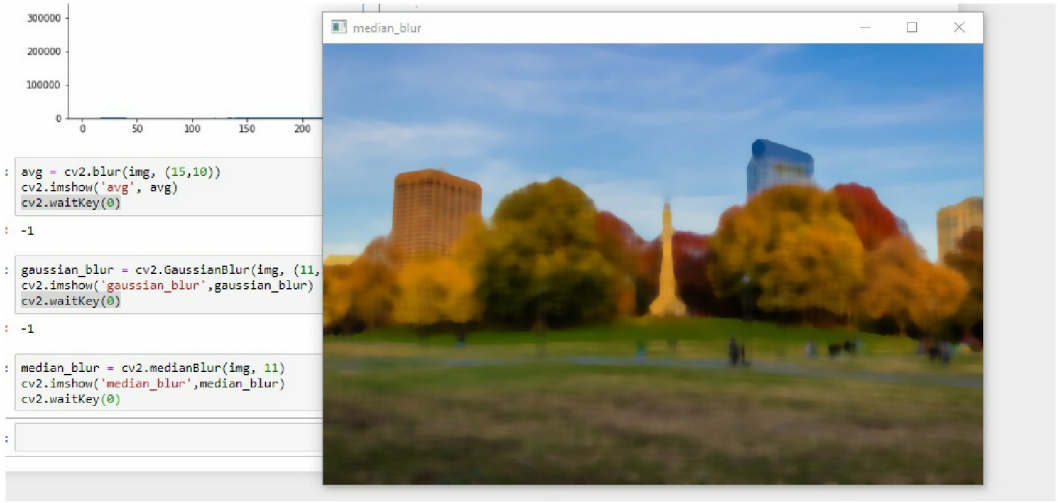
Filter2D Technique- large kernel



Gaussian Blur



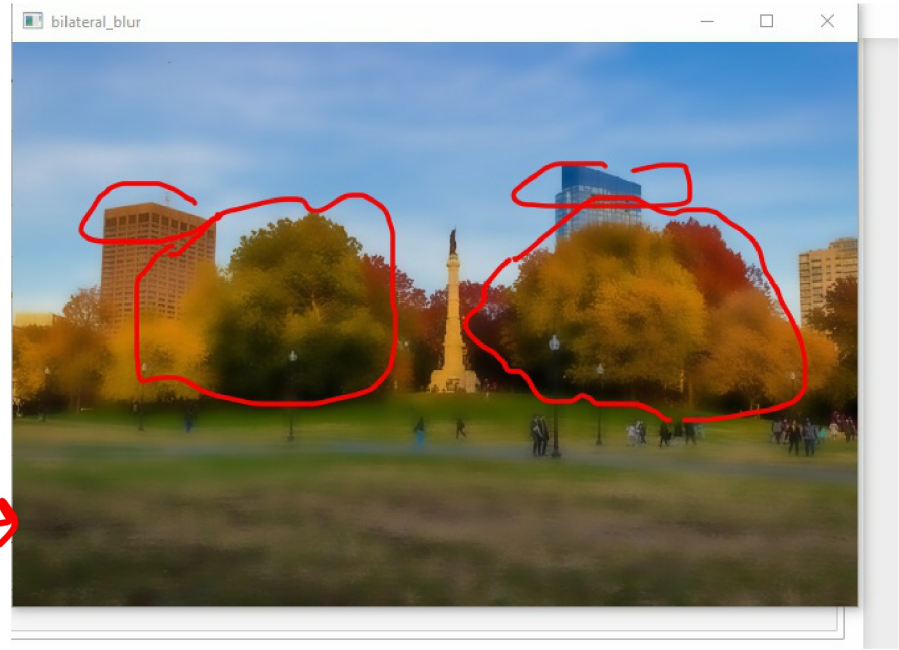
Median blur

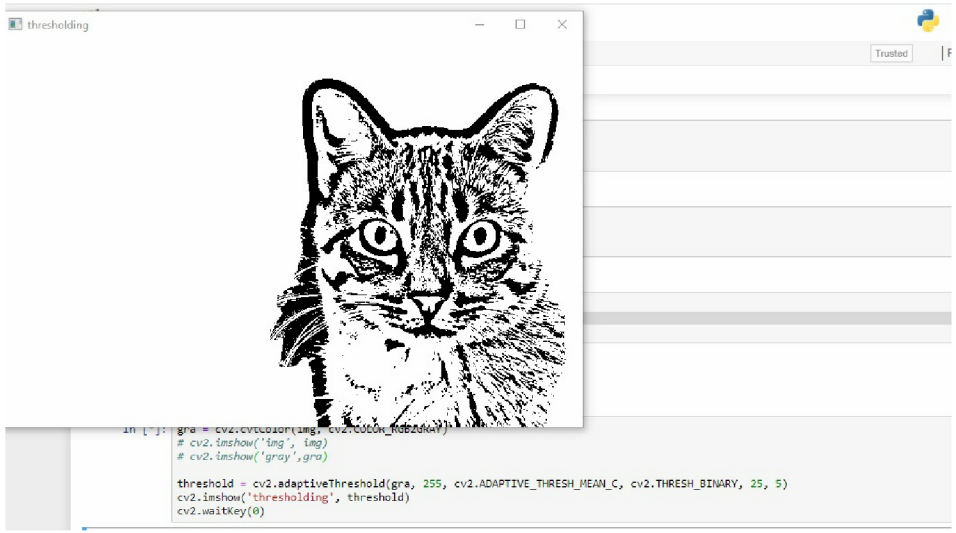


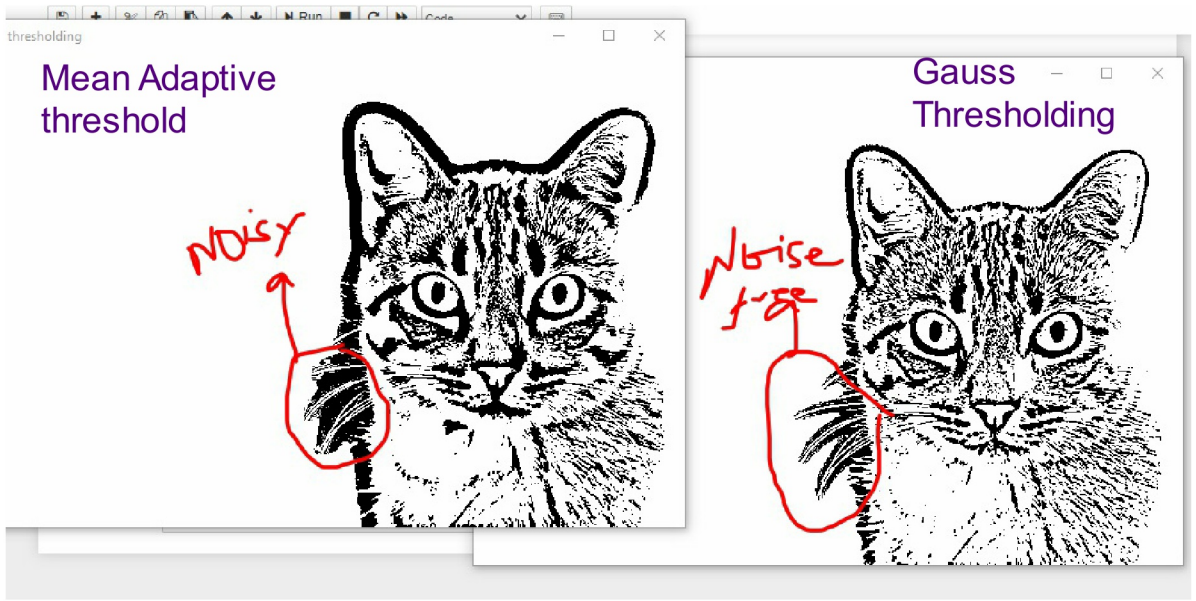
bilateral filter:

Gaussian blur module

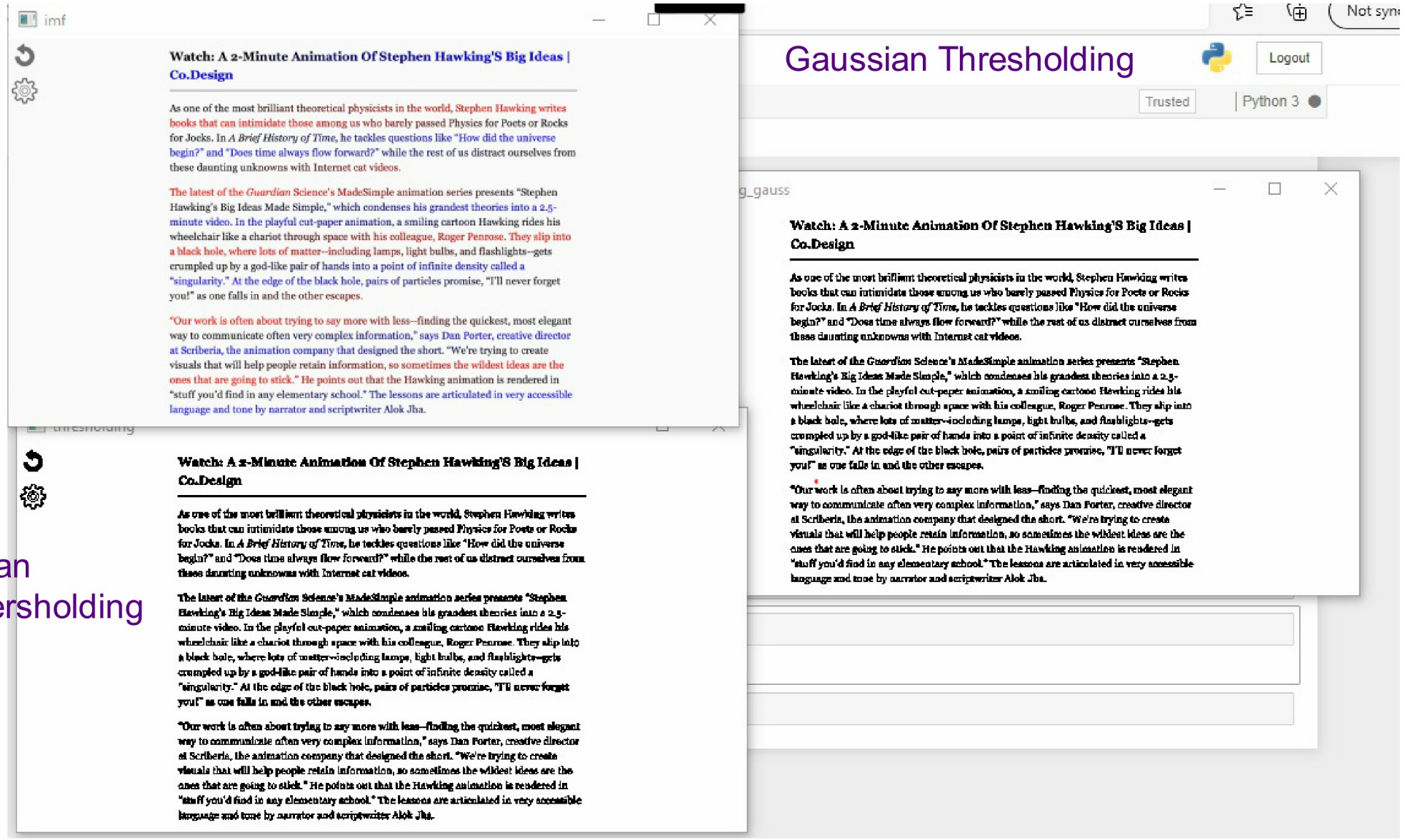
pointy edges module



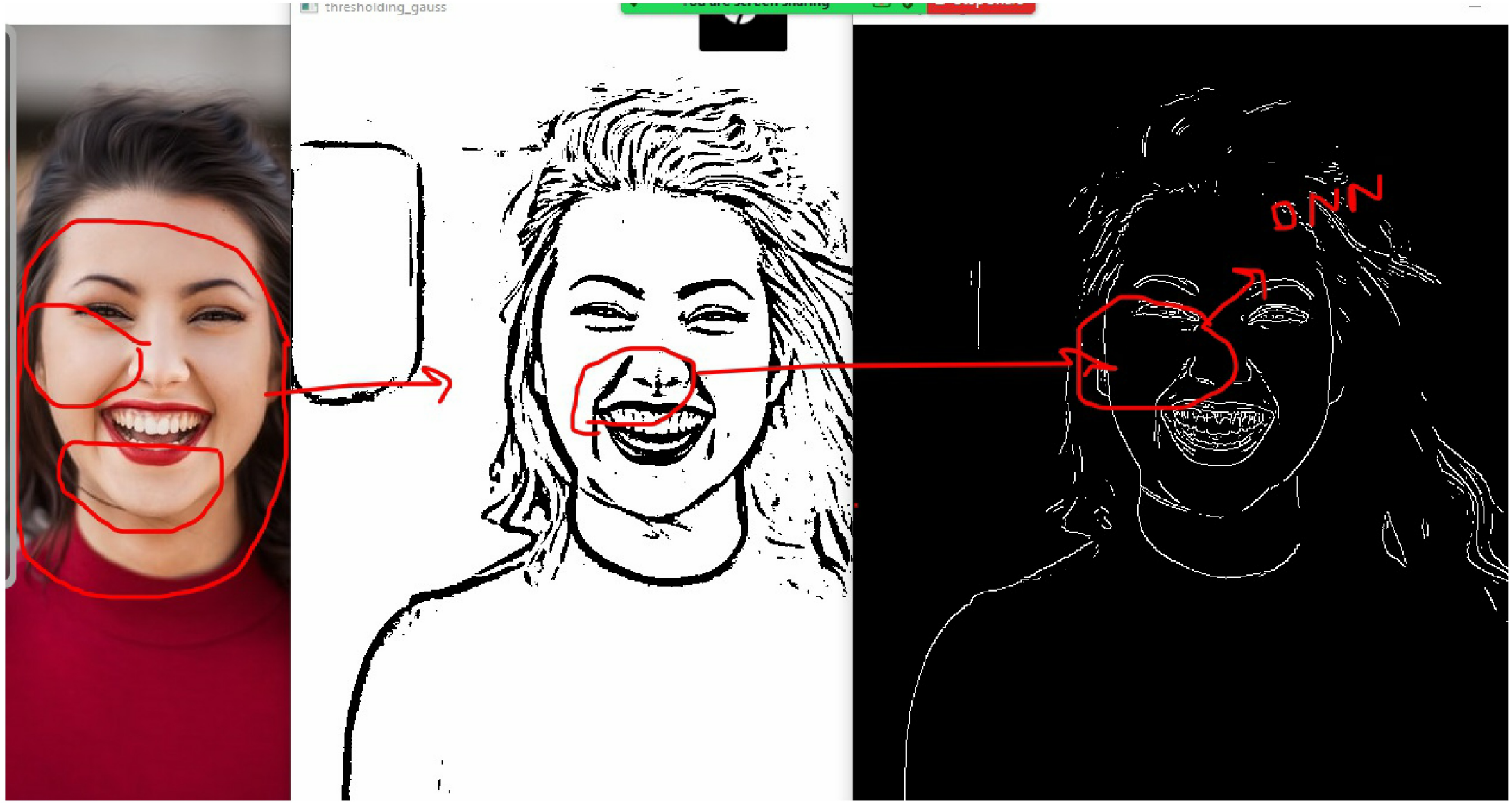




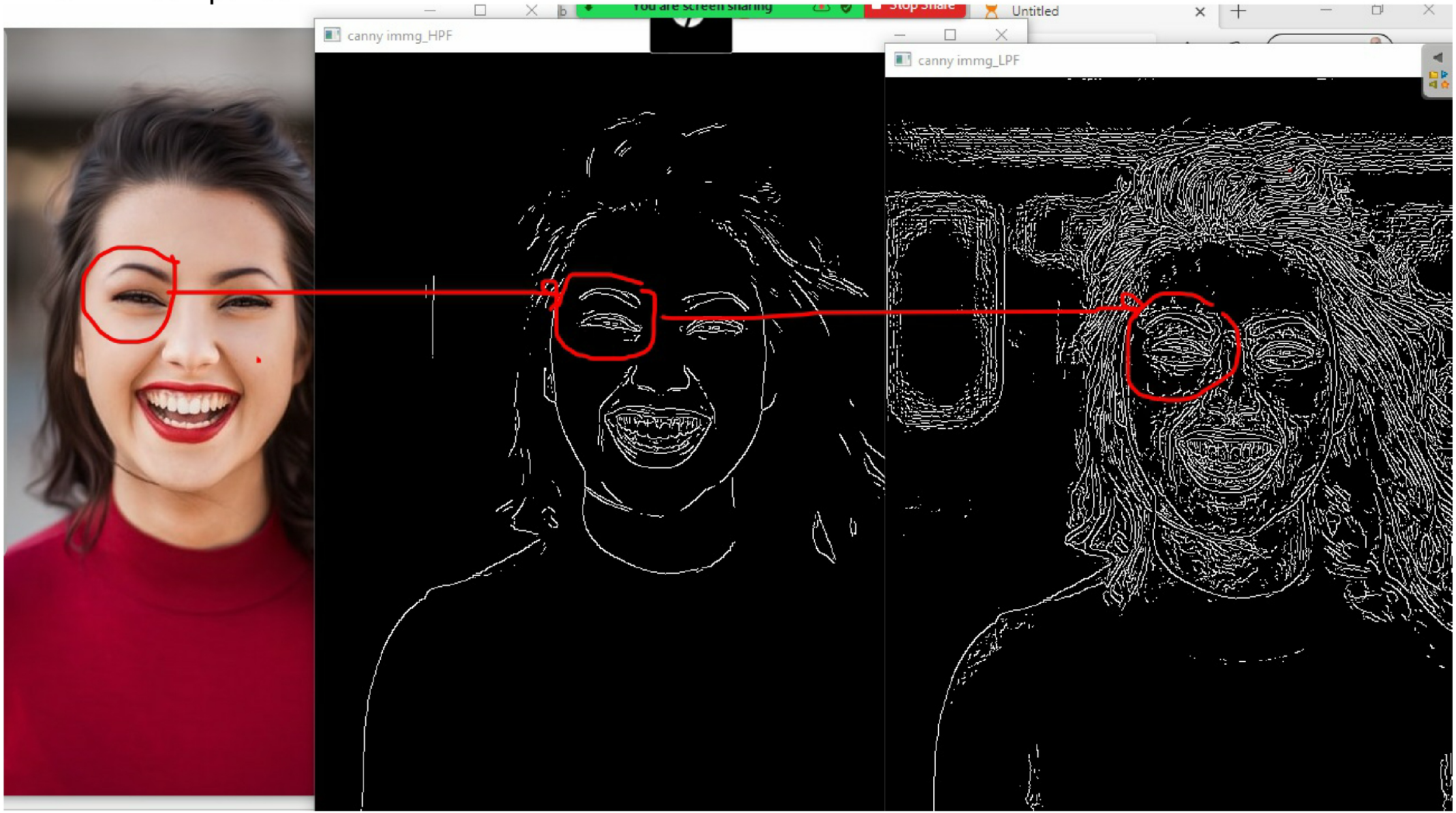
Thresholding

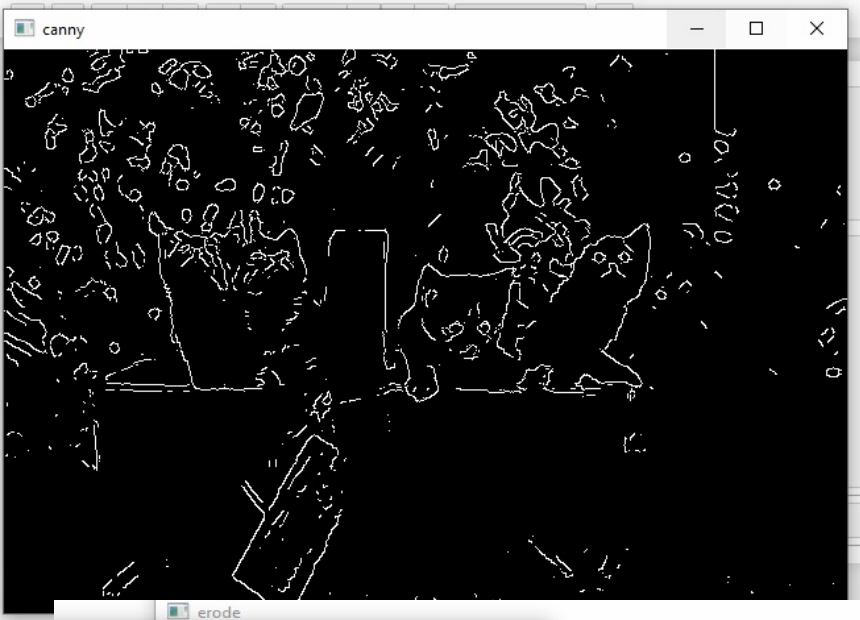


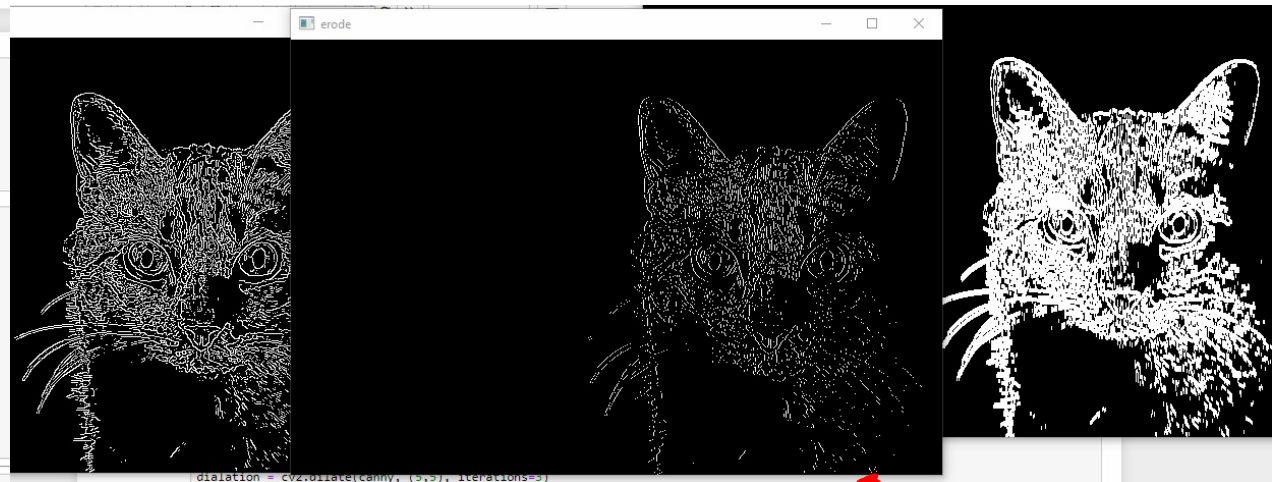
Gaussian Filter - canny edges

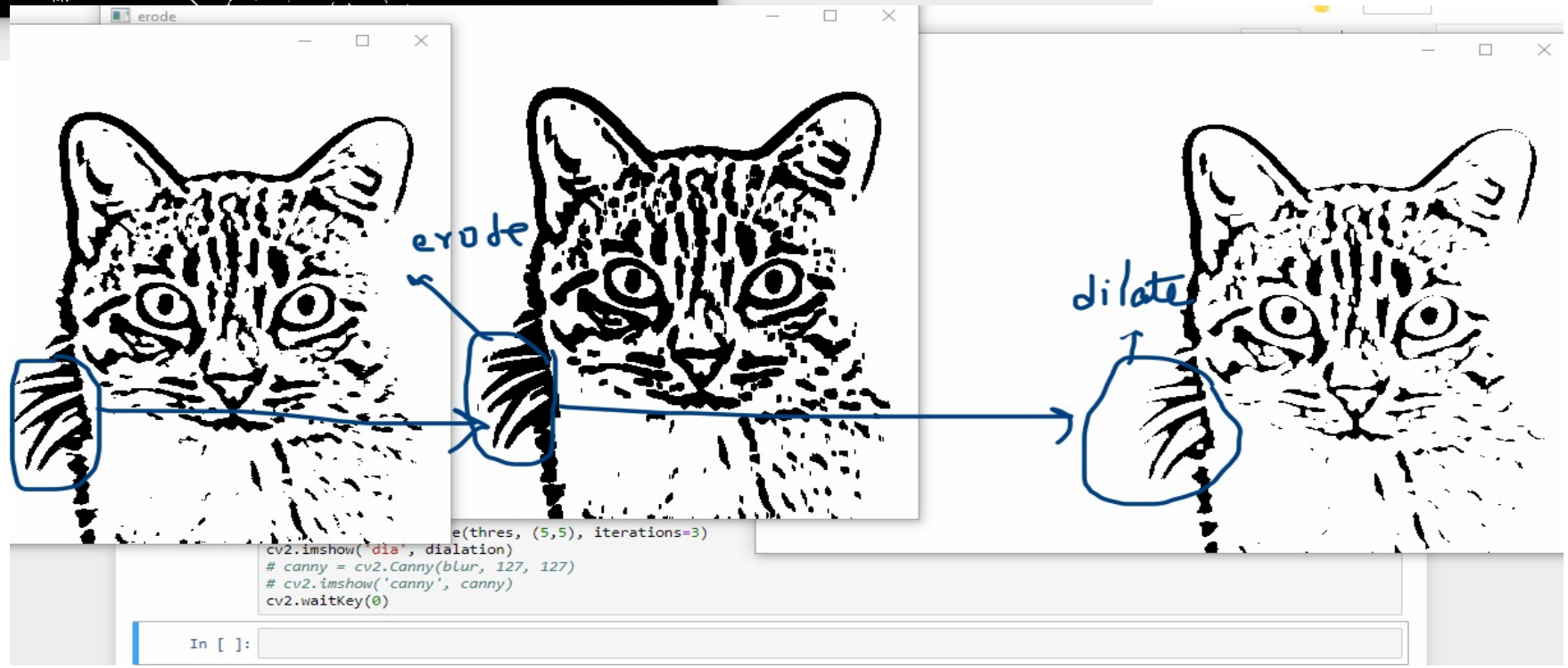


canny HPF & LPF comparison

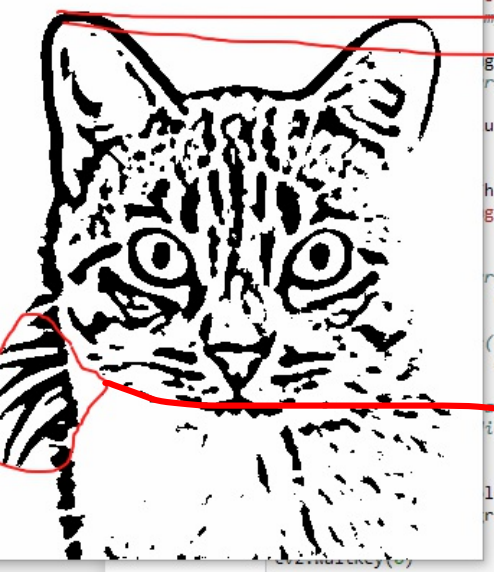




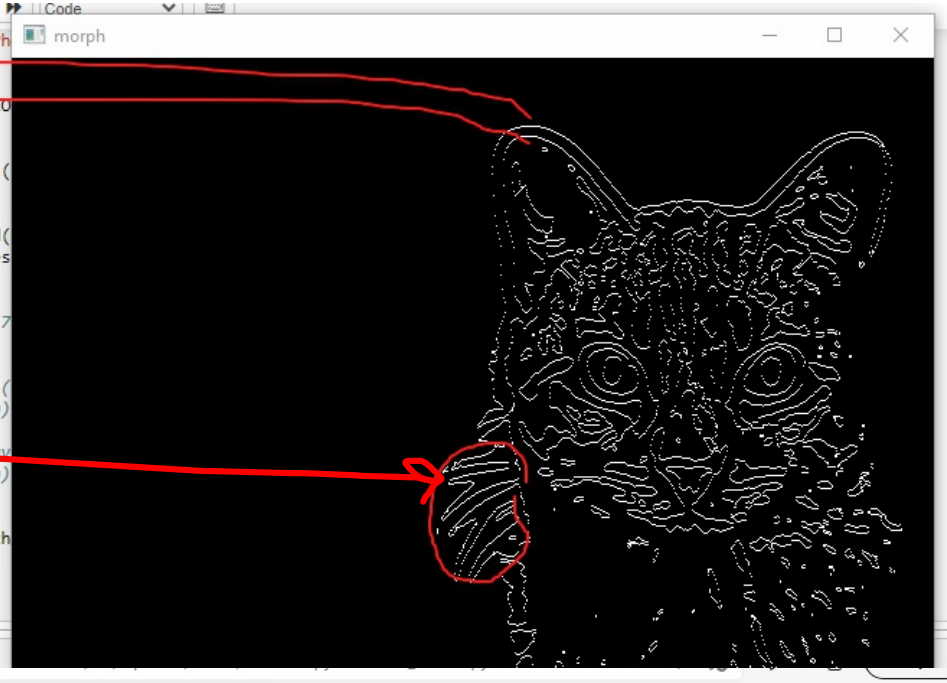




Erosion works better when there are too many thick edges are present. It is usefull to remove the noise and erodes the edges hence we can use dilate to improve prominance over erroded outcomes



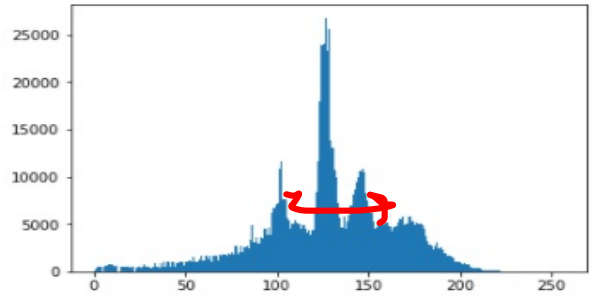
morph



```
ources\Ph
mg)
g, cv2.CO
ra)
ur(gra, (
hreshold(
g', thres
ra, 77, 7
 canny)
(canny, (
 erosion)
ialation)
logyEx(th
radient)
```

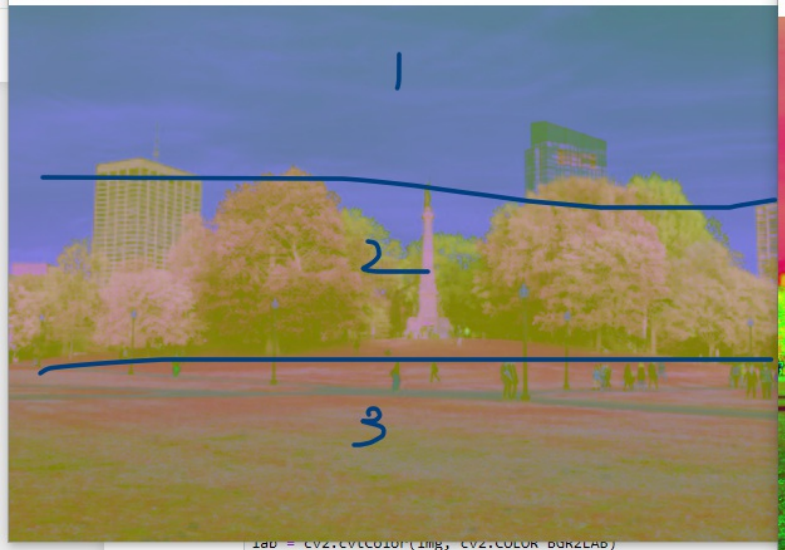
In [ ]:

```
        165., 166., 167., 168., 169., 170., 171., 172., 173., 17
        176., 177., 178., 179., 180., 181., 182., 183., 184., 18
        187., 188., 189., 190., 191., 192., 193., 194., 195., 19
        198., 199., 200., 201., 202., 203., 204., 205., 206., 20
        209., 210., 211., 212., 213., 214., 215., 216., 217., 21
        220., 221., 222., 223., 224., 225., 226., 227., 228., 22
        231., 232., 233., 234., 235., 236., 237., 238., 239., 24
        242., 243., 244., 245., 246., 247., 248., 249., 250., 25
        253., 254., 255., 256.]),
<a list of 256 Patch objects>)
```

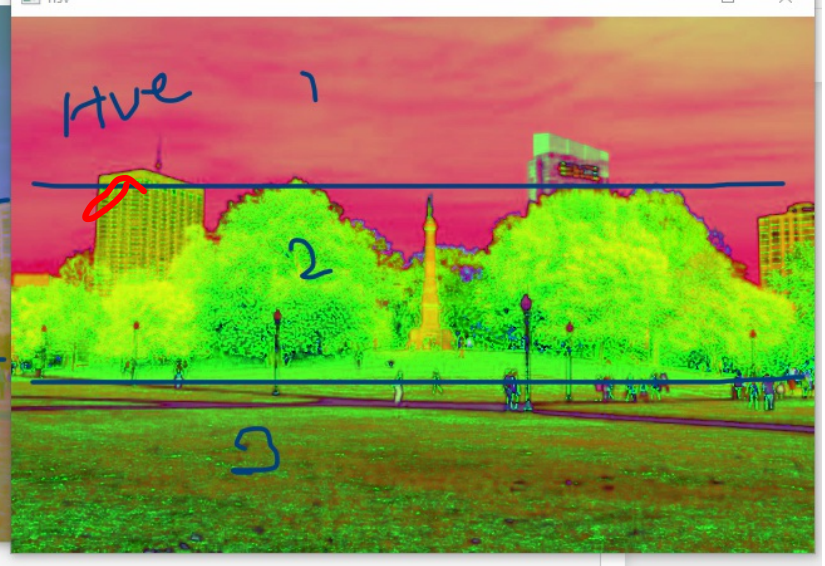


Lab

lab



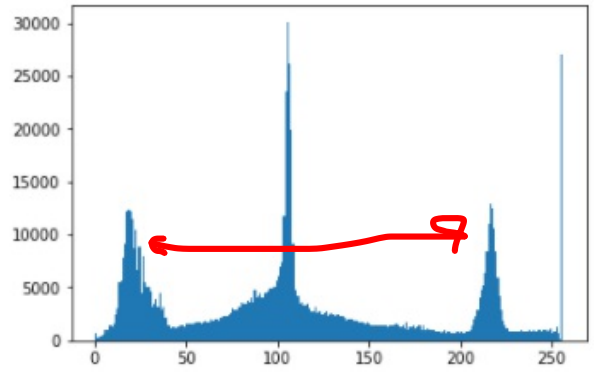
hsv



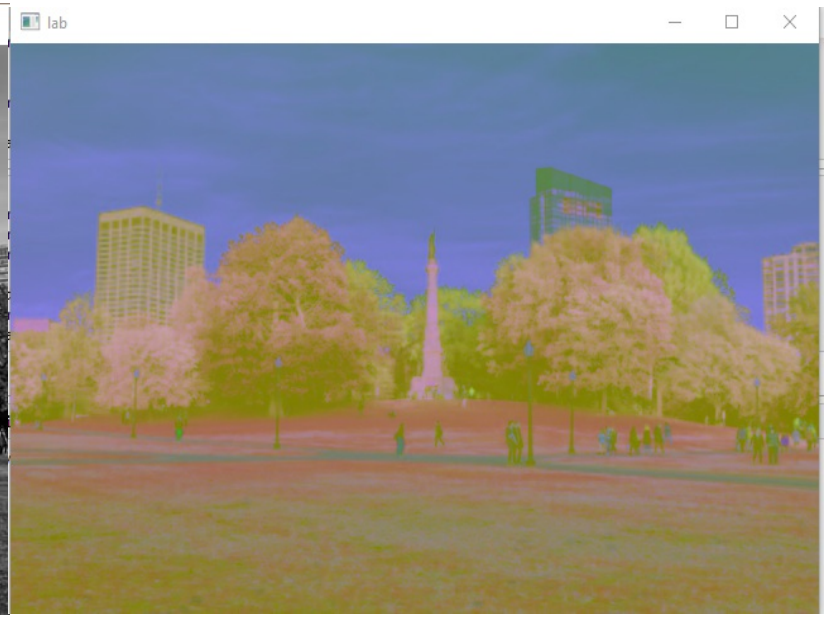

```
lab = cv2.cvtColor(img, cv2.COLOR_BGR2LAB)
cv2.imshow('lab', lab)
cv2.waitKey(0)
```

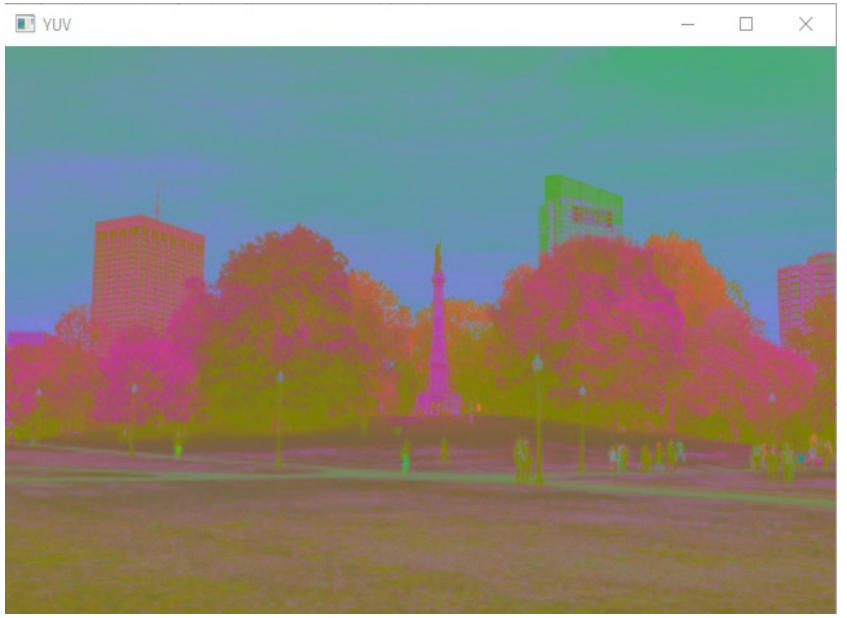
HSV

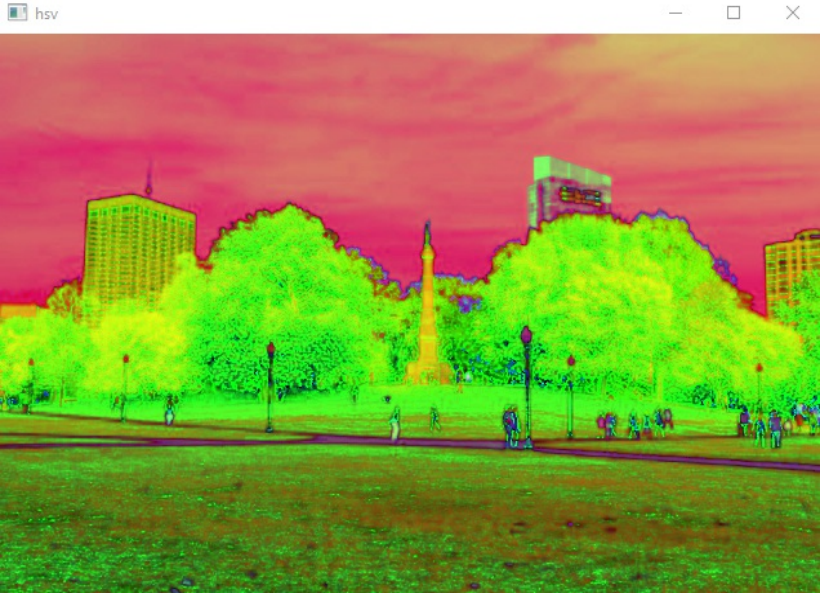
```
        154., 155., 156., 157., 158., 159., 160., 161., 162., 163.,
        165., 166., 167., 168., 169., 170., 171., 172., 173., 174.,
        176., 177., 178., 179., 180., 181., 182., 183., 184., 185.,
        187., 188., 189., 190., 191., 192., 193., 194., 195., 196.,
        198., 199., 200., 201., 202., 203., 204., 205., 206., 207.,
        209., 210., 211., 212., 213., 214., 215., 216., 217., 218.,
        220., 221., 222., 223., 224., 225., 226., 227., 228., 229.,
        231., 232., 233., 234., 235., 236., 237., 238., 239., 240.,
        242., 243., 244., 245., 246., 247., 248., 249., 250., 251.,
        253., 254., 255., 256.]),
<a list of 256 Patch objects>)
```

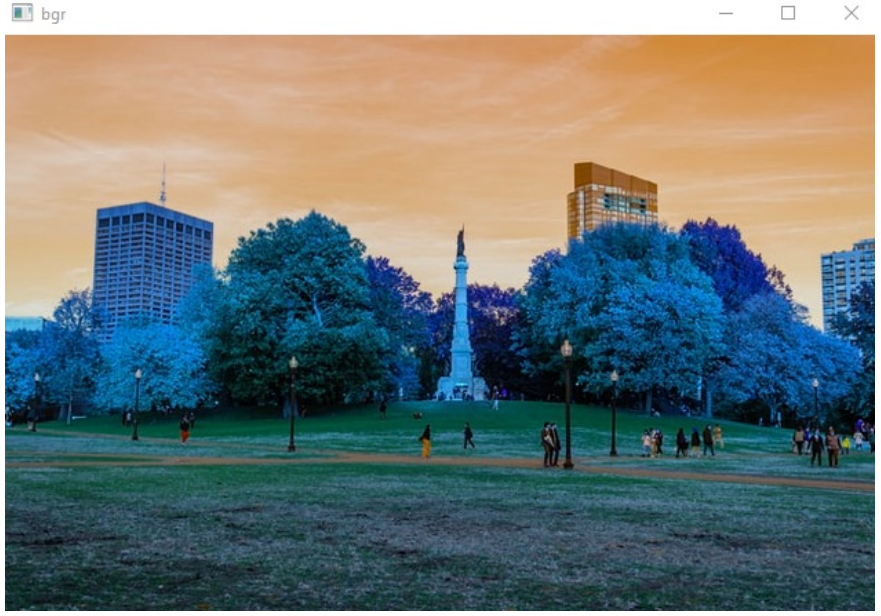



gry


lab

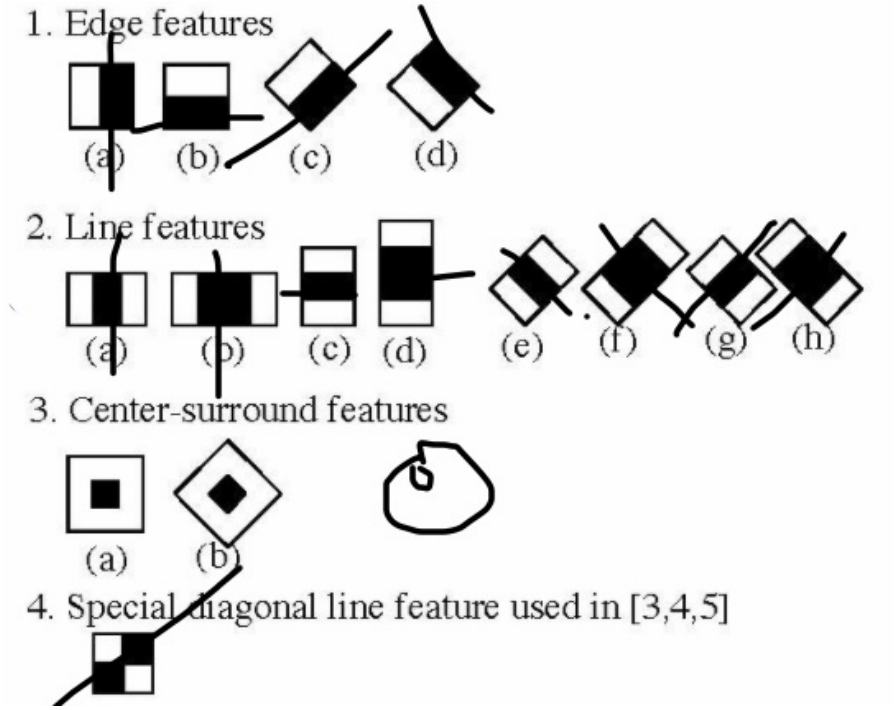

YUV

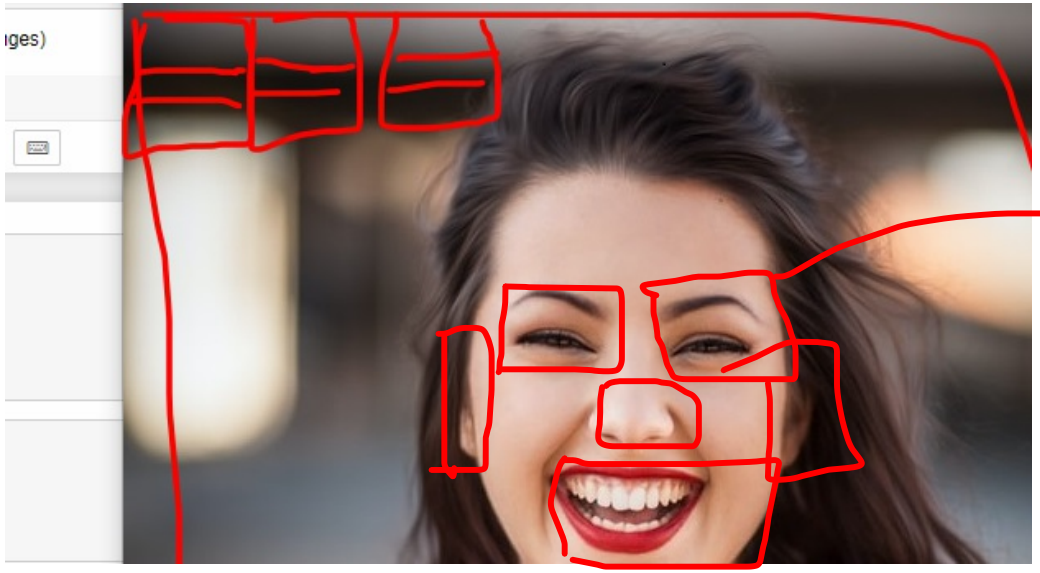

hsv


bgr

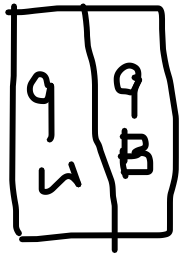

gry

Haar Cascade





Haar: sum of dark pixel /no of dark pixel



$$= \frac{0.8 + 0.7 \cdot 0.2}{9} = 0.02$$

Cascading : combining the haar features = 0.7

jupyter Untitled1 Last Checkpoint: 32 minutes ago (autosaved)

File Edit View Insert Cell Kernel Widgets Help

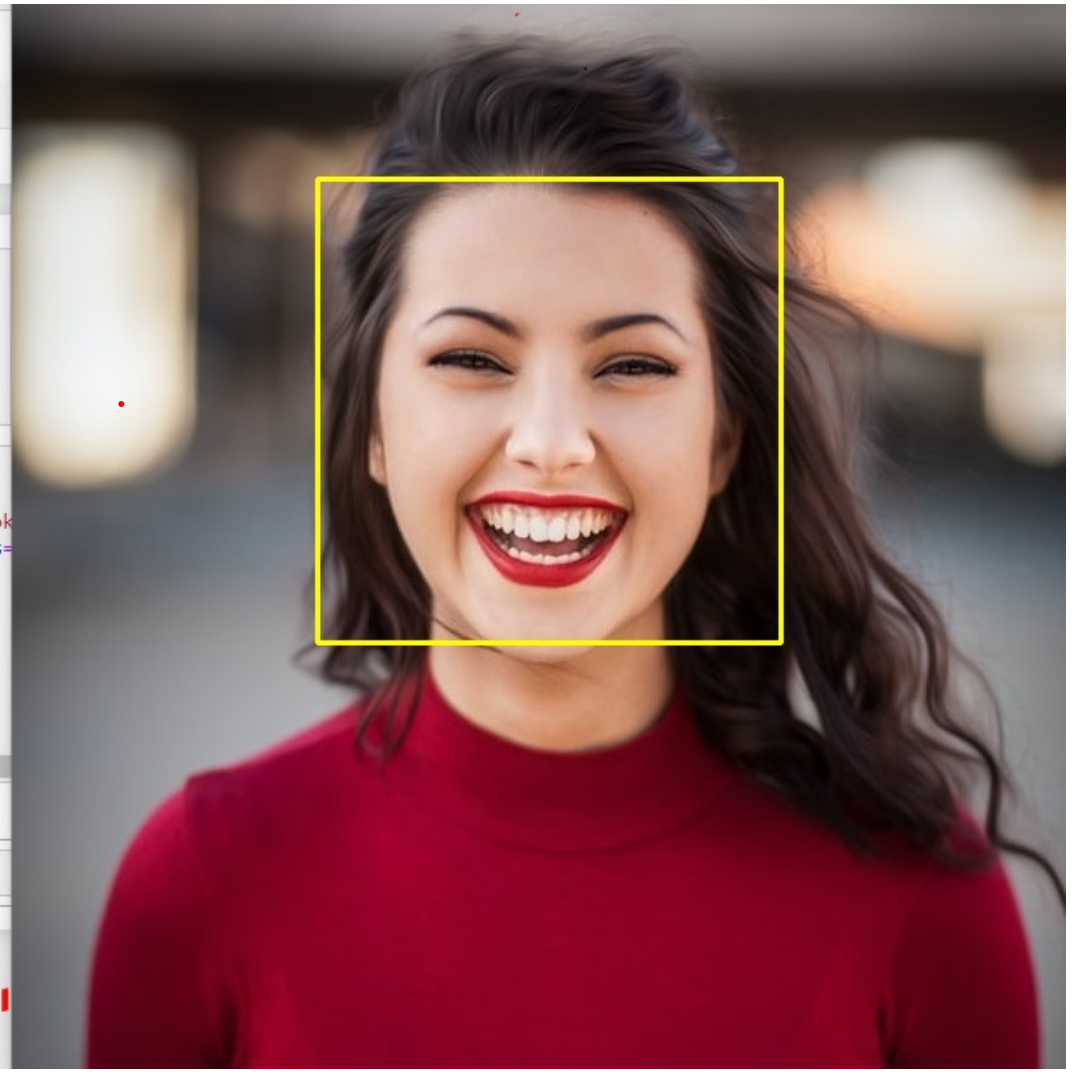
Run Code

In [1]:
```
import cv2 as cv2
import numpy as np
import pandas as pd
import math as math
from matplotlib import pyplot as plt
```

In [*]:
```
imread('Resources\Photo\lady.jpg')
cvtColor(img, cv2.COLOR_BGR2GRAY)
de = cv2.CascadeClassifier('C:\\Users\\R1007398\\Downloads\\Book
aarcascade.detectMultiScale(img, scaleFactor=1.1, minNeighbors=
 of faces : {len(detect)}')

,h) in detect:
ctangle(img,  (x,y), (x+w, y+h), (0,255,255), thickness=2)

('img', img)
y(0)
```

```
no of faces : 1
```

In [ ]:



Color spaces

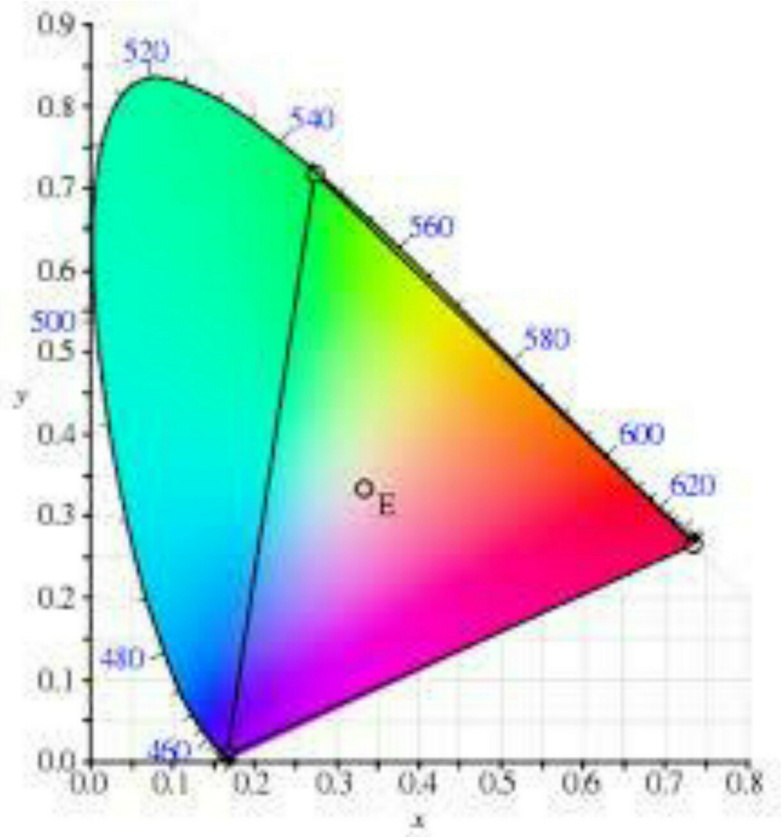
- The organization of the colors in an image in a specific format is called color space.
- Each and every image uses one of the following color spaces:
  - RGB : Red, Green , Blue
  - XYZ : color in the x ,y and z dimensions
  - HSV/HSL : hue , saturation and value/hue saturation and lightness
  - LAB : luminance, and green – red and blue – yellow color components
  - LCH : lightness, chroma and hue
  - YPbPr : green ,blue and red cables
  - YUV : brightness or chroma or color
  - YIQ : luminance, in-phase parameter and quadrature

RGB Color Space

- Using RGB, the colors are mixed in different ways to make different color combinations.
- Theoretically, we can form any color from these colors. Each intensity is from 0 to 255. (color depth)
- RGB has two more components:
  - White point chromaticity
  - Gamma correction curve

XYZ

-



https://en.wikipedia.org/wiki/CIE_1931_color_space

HSV/HSL

- This is alternate representation of RGB color space.
  - Hue
  - Saturation
  - Value
  - Lightness
- Hue explains green, red and magenta or two pure colors red and yellow
- Saturation &Lightness measures intensity of image with respect to Gray and white respectively.
- Value does the same from black.

LAB & LCH

- Luminance
- a which is a green and red color component
- b blue and yellow color component
- This is used for printing textiles
- This uses cylindrical coordinates
- LCH is also similar but this uses rectangular coordinates

YPbPr

- Y – Green cable
- Pb – blue cable
- Pr – red cable

https://en.wikipedia.org/wiki/YPbPr

YUV

- YUV is similar to the previous one , but this works for black and white television as well.
- Y – Represents brightness 0 to 255
- U and V represents color , if they are zeros we get a grayscale image.
- YIQ:
- NTSC television uses this.

INNOMATICS RESEARCH LABS

THANK YOU