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FIIT04 Computer Vision Batch

In [ ]:
```
import numpy as np
import matplotlib.pyplot as plt
# %matplotlib inline
import PIL.Image as images
from skimage import io
import cv2 as cv
```

Histogram Equalisation

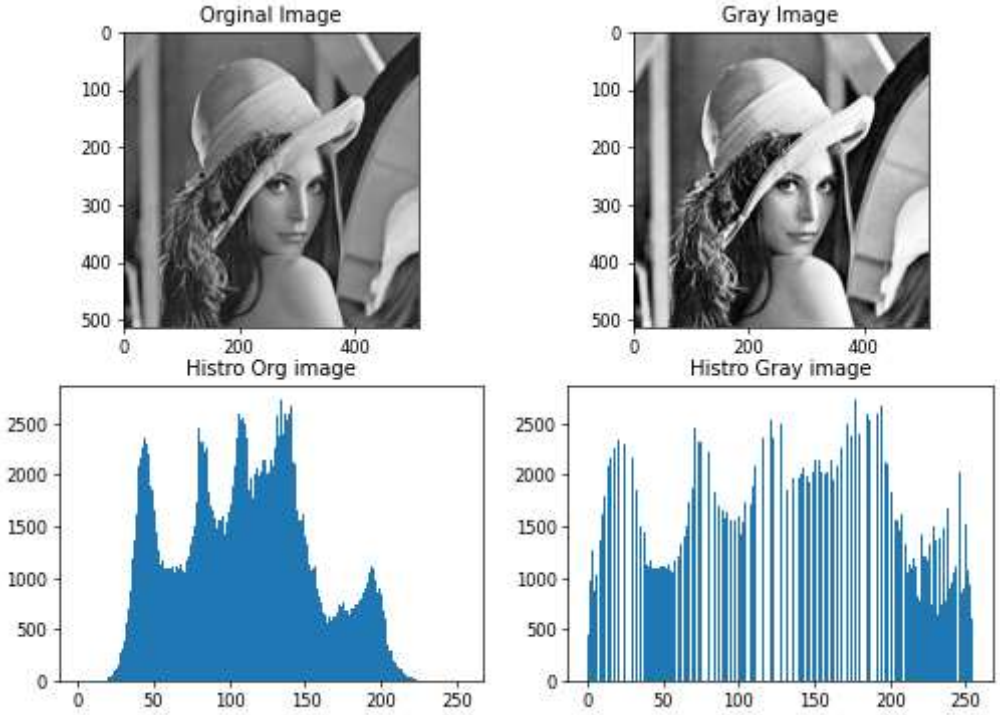
In [ ]:
```
image_path = './images/lenna.png'
gaussian_image = io.imread(image_path)

# Convert the image to grayscale using OpenCV
gray_lena_image = cv.cvtColor(gaussian_image, cv.COLOR_BGR2GRAY)

# Ensure the grayscale image is of data type np.uint8
gray_lena_image = gray_lena_image.astype(np.uint8)

hist_equalis_img = cv.equalizeHist(gray_lena_image)

fig = plt.figure(figsize=(10,7))

fig.add_subplot(2,2,1)
plt.imshow(gray_lena_image,cmap=plt.get_cmap('gray'))
plt.title("Orginal Image")

fig.add_subplot(2,2,2)
plt.title("Gray Image")
plt.imshow(hist_equalis_img,cmap='gray')

fig.add_subplot(2,2,3)
```

```
plt.title("Histro Org image")
plt.hist(gray_lena_image.ravel(),bins=256,range=[0,255])


fig.add_subplot(2,2,4)
plt.title("Histro Gray image")
plt.hist(hist_equalis_img.ravel(),bins=256,range=[0,255])

# plt.imshow(np.hstack([gray_image,hist_equalis]))
```

Out[ ]:
```
(array([ 457.,  978.,  852., 1263.,  872., 1038., 1186.,    0., 1367.,
        1629.,    0., 1794.,    0., 2079.,    0., 2170.,    0., 2264.,
           0.,    0., 2334.,    0., 2364.,    0., 2301.,    0., 2197.,
           0.,    0., 2162., 1902.,    0., 1863.,    0., 1668., 1509.,
           0., 1438., 1267., 1136., 1122., 1168., 1098., 1095., 1094.,
        1093.,    0., 1097., 1117., 1109., 1061., 1114., 1092., 1126.,
        1125., 1075., 1063., 1174., 1177.,    0., 1214., 1319., 1363.,
           0., 1398., 1505.,    0., 1737.,    0., 1868.,    0., 2451.,
           0., 2320.,    0., 2327.,    0.,    0., 2466.,    0., 2229.,
           0., 2272.,    0., 1843.,    0., 1736., 1707.,    0., 1655.,
           0., 1590., 1647.,    0., 1488., 1555.,    0., 1559., 1615.,
           0., 1601., 1432.,    0., 1539., 1728.,    0., 1630.,    0.,
        1724., 1889.,    0., 2094.,    0.,    0., 2144.,    0., 2360.,
           0., 2586.,    0.,    0., 2539.,    0., 2369.,    0.,    0.,
        2561.,    0., 2488.,    0., 2368.,    0., 1854.,    0., 1855.,
           0., 1965.,    0., 1783.,    0., 1966., 2014.,    0., 2061.,
           0., 1986.,    0., 1922.,    0., 2026.,    0., 2149.,    0.,
        2142.,    0., 2031.,    0., 2018.,    0., 2025.,    0., 2150.,
           0., 1950.,    0., 2088.,    0.,    0., 2254.,    0., 2567.,
           0., 2490.,    0.,    0., 2378.,    0., 2727.,    0.,    0.,
        2393.,    0., 2379.,    0.,    0., 2600.,    0., 2527.,    0.,
           0., 2598.,    0., 2600.,    0.,    0., 2679.,    0., 2135.,
           0., 2100.,    0., 1840., 1666.,    0., 1571., 1559.,    0.,
        1461., 1629.,    0., 1400., 1322., 1052., 1134., 1083., 1096.,
        1183., 1119.,  904.,  823.,  786., 1419.,  651., 1209., 1203.,
        1179.,  619., 1331.,  742., 1495.,  716., 1360.,  638., 1389.,
         695.,  752., 1483.,  782.,  802., 1680.,  898.,  951., 1097.,
        1046., 1118.,    0., 1102., 2023.,  870.,  903.,  756., 1523.,
        1074.,  943., 1050.,  599.]),
 array([  0.        ,   0.99609375,   1.9921875 ,   2.98828125,
          3.984375  ,   4.98046875,   5.9765625 ,   6.97265625,
          7.96875   ,   8.96484375,   9.9609375 ,  10.95703125,
         11.953125  ,  12.94921875,  13.9453125 ,  14.94140625,
         15.9375    ,  16.93359375,  17.9296875 ,  18.92578125,
         19.921875  ,  20.91796875,  21.9140625 ,  22.91015625,
         23.90625   ,  24.90234375,  25.8984375 ,  26.89453125,
         27.890625  ,  28.88671875,  29.8828125 ,  30.87890625,
         31.875     ,  32.87109375,  33.8671875 ,  34.86328125,
         35.859375  ,  36.85546875,  37.8515625 ,  38.84765625,
         39.84375   ,  40.83984375,  41.8359375 ,  42.83203125,
         43.828125  ,  44.82421875,  45.8203125 ,  46.81640625,
         47.8125    ,  48.80859375,  49.8046875 ,  50.80078125,
```

```
 51.796875  ,  52.79296875,  53.7890625 ,  54.78515625,
 55.78125   ,  56.77734375,  57.7734375 ,  58.76953125,
 59.765625  ,  60.76171875,  61.7578125 ,  62.75390625,
 63.75      ,  64.74609375,  65.7421875 ,  66.73828125,
 67.734375  ,  68.73046875,  69.7265625 ,  70.72265625,
 71.71875   ,  72.71484375,  73.7109375 ,  74.70703125,
 75.703125  ,  76.69921875,  77.6953125 ,  78.69140625,
 79.6875    ,  80.68359375,  81.6796875 ,  82.67578125,
 83.671875  ,  84.66796875,  85.6640625 ,  86.66015625,
 87.65625   ,  88.65234375,  89.6484375 ,  90.64453125,
 91.640625  ,  92.63671875,  93.6328125 ,  94.62890625,
 95.625     ,  96.62109375,  97.6171875 ,  98.61328125,
 99.609375  , 100.60546875, 101.6015625 , 102.59765625,
103.59375   , 104.58984375, 105.5859375 , 106.58203125,
107.578125  , 108.57421875, 109.5703125 , 110.56640625,
111.5625    , 112.55859375, 113.5546875 , 114.55078125,
115.546875  , 116.54296875, 117.5390625 , 118.53515625,
119.53125   , 120.52734375, 121.5234375 , 122.51953125,
123.515625  , 124.51171875, 125.5078125 , 126.50390625,
127.5       , 128.49609375, 129.4921875 , 130.48828125,
131.484375  , 132.48046875, 133.4765625 , 134.47265625,
135.46875   , 136.46484375, 137.4609375 , 138.45703125,
139.453125  , 140.44921875, 141.4453125 , 142.44140625,
143.4375    , 144.43359375, 145.4296875 , 146.42578125,
147.421875  , 148.41796875, 149.4140625 , 150.41015625,
151.40625   , 152.40234375, 153.3984375 , 154.39453125,
155.390625  , 156.38671875, 157.3828125 , 158.37890625,
159.375     , 160.37109375, 161.3671875 , 162.36328125,
163.359375  , 164.35546875, 165.3515625 , 166.34765625,
167.34375   , 168.33984375, 169.3359375 , 170.33203125,
171.328125  , 172.32421875, 173.3203125 , 174.31640625,
175.3125    , 176.30859375, 177.3046875 , 178.30078125,
179.296875  , 180.29296875, 181.2890625 , 182.28515625,
183.28125   , 184.27734375, 185.2734375 , 186.26953125,
187.265625  , 188.26171875, 189.2578125 , 190.25390625,
191.25      , 192.24609375, 193.2421875 , 194.23828125,
195.234375  , 196.23046875, 197.2265625 , 198.22265625,
199.21875   , 200.21484375, 201.2109375 , 202.20703125,
203.203125  , 204.19921875, 205.1953125 , 206.19140625,
207.1875    , 208.18359375, 209.1796875 , 210.17578125,
211.171875  , 212.16796875, 213.1640625 , 214.16015625,
215.15625   , 216.15234375, 217.1484375 , 218.14453125,
```

```
        219.140625  , 220.13671875, 221.1328125 , 222.12890625,
        223.125     , 224.12109375, 225.1171875 , 226.11328125,
        227.109375  , 228.10546875, 229.1015625 , 230.09765625,
        231.09375   , 232.08984375, 233.0859375 , 234.08203125,
        235.078125  , 236.07421875, 237.0703125 , 238.06640625,
        239.0625    , 240.05859375, 241.0546875 , 242.05078125,
        243.046875  , 244.04296875, 245.0390625 , 246.03515625,
        247.03125   , 248.02734375, 249.0234375 , 250.01953125,
        251.015625  , 252.01171875, 253.0078125 , 254.00390625,
        255.        ]),
<BarContainer object of 256 artists>)
```



Practice question

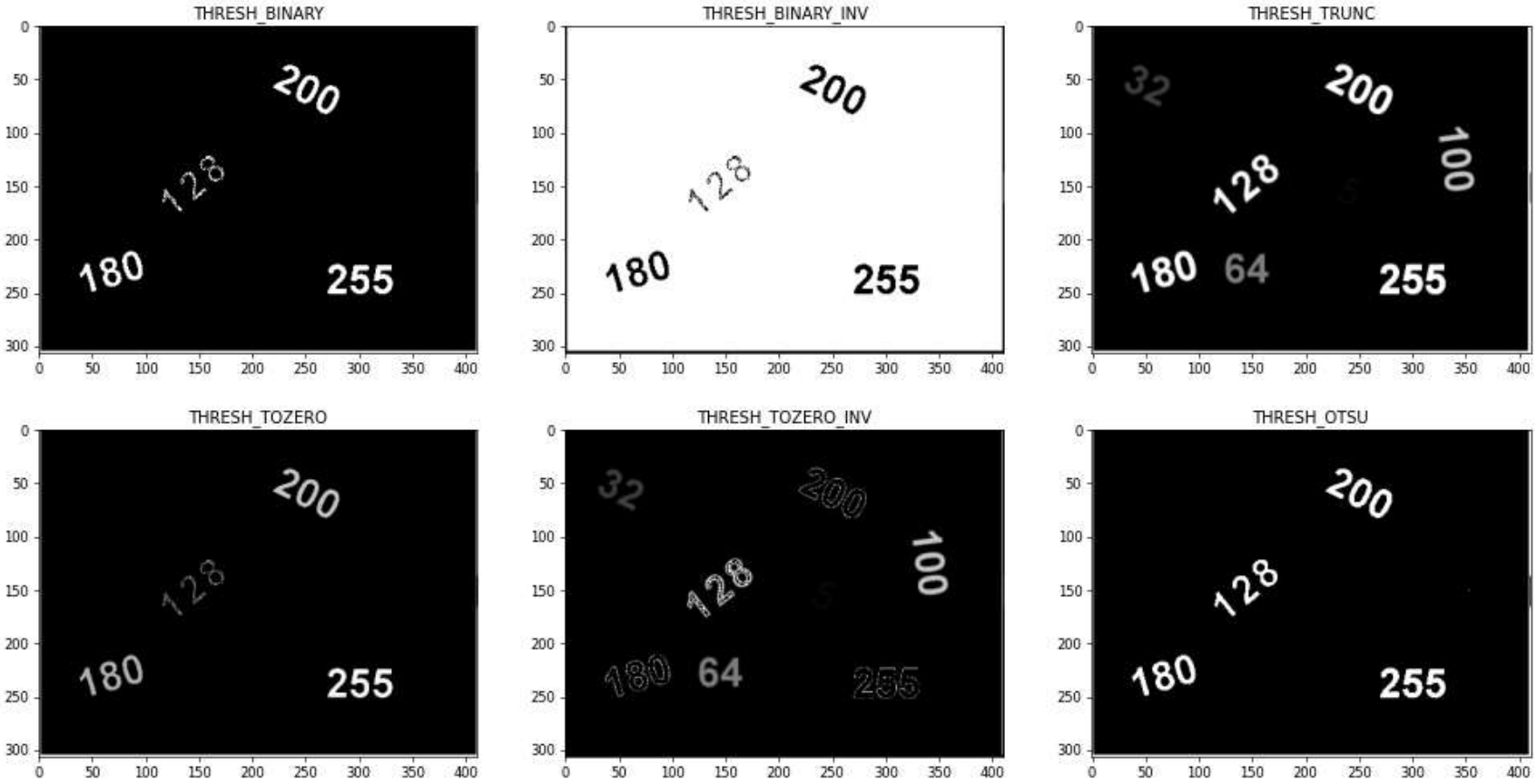
1. Use differnt threshold and try thresholding
2. Try various thresholding techniques like OTSU, Kapur
3. Try Multithresholding(one or more thresholds)

1. Use differnt threshold and try thresholding

In [ ]:
```
image_path = './images/ostuExample.png'
gaussian_image = cv.imread(image_path)

# Convert the image to grayscale using OpenCV
gray_image = cv.cvtColor(gaussian_image, cv.COLOR_BGR2GRAY)

# Ensure the grayscale image is of data type np.uint8
# gray_image = gray_image.astype(np.uint8)
ret, thresh1 = cv.threshold(gray_image, 127,255,cv.THRESH_BINARY)
ret, thresh2 = cv.threshold(gray_image, 127,255,cv.THRESH_BINARY_INV)
ret, thresh3 = cv.threshold(gray_image, 127,255,cv.THRESH_TRUNC)
ret, thresh4 = cv.threshold(gray_image, 127,255,cv.THRESH_TOZERO)
ret, thresh5 = cv.threshold(gray_image, 127,255,cv.THRESH_TOZERO_INV)
ret, threshOstu = cv.threshold(gray_image, 127,255,cv.THRESH_OTSU)
# ret, thresh5 = cv.threshold(gray_image, 127,255,cv.)


# plt.imshow(np.hstack([gray_image,thresh1]))
fig = plt.figure(figsize=(20,10))
col, row = 2,3
fig.add_subplot(col,row,1)

plt.imshow(thresh1,cmap='gray')
plt.title("THRESH_BINARY")

fig.add_subplot(col,row,2)
plt.title("THRESH_BINARY_INV")
```

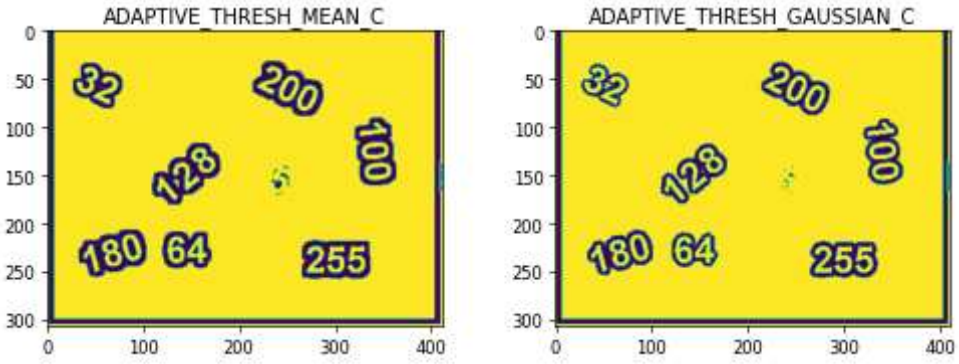
```
plt.imshow(thresh2,cmap='gray')

fig.add_subplot(col,row,3)
plt.title("THRESH_TRUNC")
plt.imshow(thresh3,cmap='gray')
fig.add_subplot(col,row,4)
plt.title("THRESH_TOZERO")
plt.imshow(thresh4,cmap='gray')
fig.add_subplot(col,row,5)
plt.title("THRESH_TOZERO_INV")
plt.imshow(thresh5,cmap='gray')
fig.add_subplot(col,row,6)
plt.title("THRESH_OTSU")
plt.imshow(threshOstu,cmap='gray')
```

Out[ ]: <matplotlib.image.AxesImage at 0x279b73a16d0>



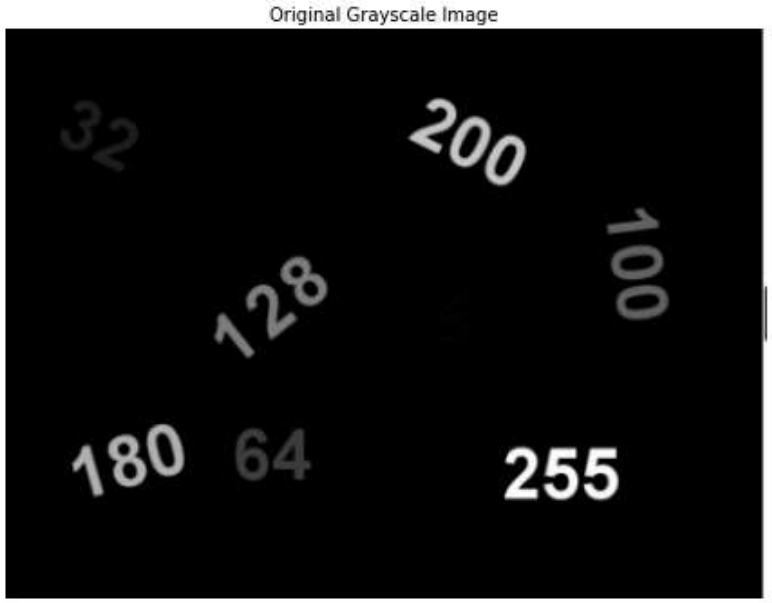
In [ ]:
```
adaptive_thresh1 = cv.adaptiveThreshold(gray_image,255,cv.ADAPTIVE_THRESH_MEAN_C,
                                        cv.THRESH_BINARY,11,2)
adaptive_thresh2 = cv.adaptiveThreshold(gray_image,255,cv.ADAPTIVE_THRESH_GAUSSIAN_C,
                                        cv.THRESH_BINARY,11,2)

fig =plt.figure(figsize=(10,7))
fig.add_subplot(2,2,1)
plt.title("ADAPTIVE_THRESH_MEAN_C")
plt.imshow(adaptive_thresh1)

fig.add_subplot(2,2,2)
plt.title("ADAPTIVE_THRESH_GAUSSIAN_C")
plt.imshow(adaptive_thresh2)
```

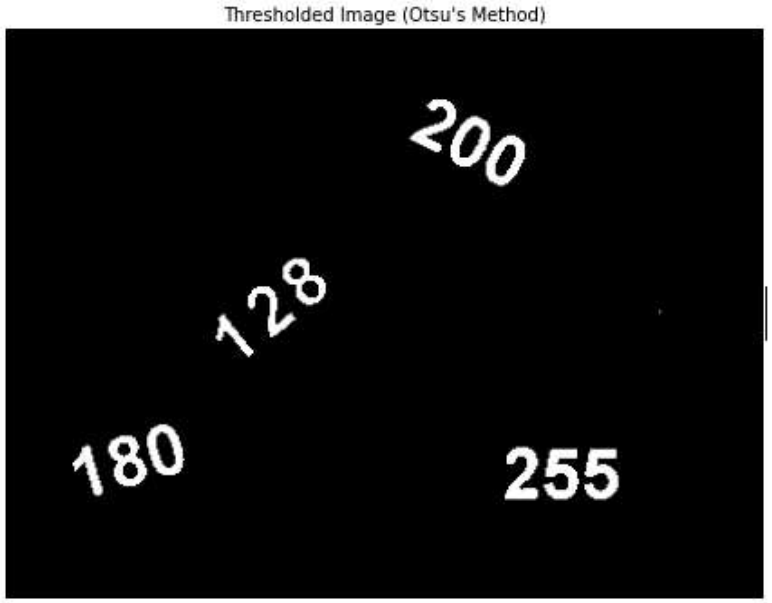
Out[ ]:
```
<matplotlib.image.AxesImage at 0x279b78226d0>
```



Apply Otsu's thresholding

In [ ]:
```
image_path = './images/ostuExample.png'
ostu_image = cv.imread(image_path)

# Convert the image to grayscale using OpenCV
ostu_image = cv.cvtColor(ostu_image, cv.COLOR_BGR2GRAY)

rest, thresholded_image = cv.threshold(ostu_image, 127, 255,cv.THRESH_OTSU)

# Create a figure with the specified size
fig, ax = plt.subplots(1, 2, figsize=(20, 10))

# Display the original grayscale image
ax[0].imshow(ostu_image, cmap='gray')
ax[0].set_title("Original Grayscale Image")
ax[0].axis('off')  # Hide axis

# Display the thresholded image using Otsu's method
ax[1].imshow(thresholded_image, cmap='gray')
ax[1].set_title("Thresholded Image (Otsu's Method)")
ax[1].axis('off')  # Hide axis

# Show the plot
plt.show()
```

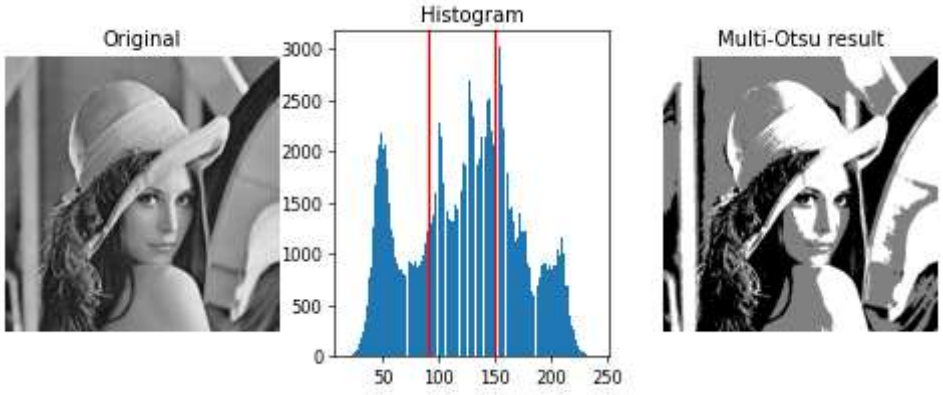




Try MultiThresholding (one or more thresholds)

In [ ]:
```
from skimage.filters import threshold_multiotsu


image = cv.imread('./images/lenna.png',0)

thresholds = threshold_multiotsu(image)


regions = np.digitize(image, bins=thresholds)

fig, ax = plt.subplots(nrows=1, ncols=3, figsize=(10, 3.5))

# Plotting the original image.
ax[0].imshow(image, cmap='gray')
ax[0].set_title('Original')
ax[0].axis('off')

# Plotting the histogram and the two thresholds obtained from
# multi-Otsu.
ax[1].hist(image.ravel(), bins=255)
```

```
ax[1].set_title('Histogram')
for thresh in thresholds:
    ax[1].axvline(thresh, color='r')

# Plotting the Multi Otsu result.
ax[2].imshow(regions, cmap='gray')
ax[2].set_title('Multi-Otsu result')
ax[2].axis('off')

plt.subplots_adjust()

plt.show()
```



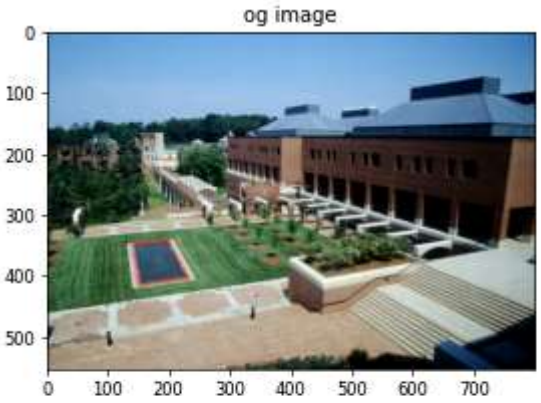
Practice question:

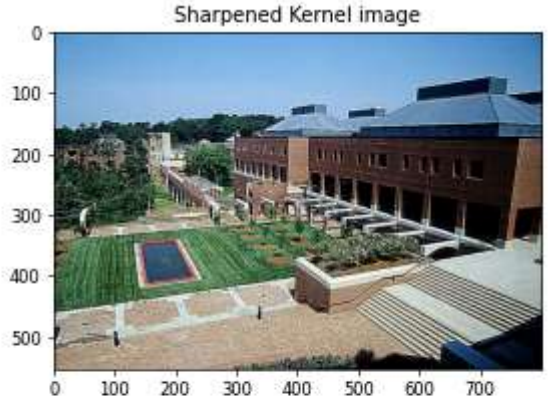
1. Apply Guassian smoothing on the lena image by varying sigma (1,2,0.5,0.25 and 1.5) or by varying radius [use GaussianBlur() function]
2. suggest and apply a kernel to move the image to left by 1 pixel
3. suggest and apply a kernel to move the image to down right by 1 pixel
4. suggest and apply a kernel to sharpen the image by 3 units
5. Apply a median filter and get the kernel for the same
6. apply a averaging filter

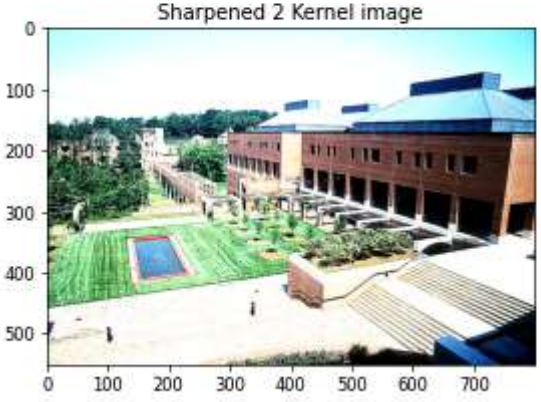
In [ ]:
```
kernel_sharpening = np.array([[-1,-1,-1],[-1,9,-1],[-1,-1,-1]])
kernel_sharpening_2 = np.array([[-1,-1,-1],[-1,10,-1],[-1,-1,-1]])
# kernel_sharpening_3 = np.array([[-3,-3,-3],[-3,10,-3],[-3,-3,-3]])
kernel_sharpening_3 = np.array([[3,3,3],[3,-10,3],[3,3,3]])
```

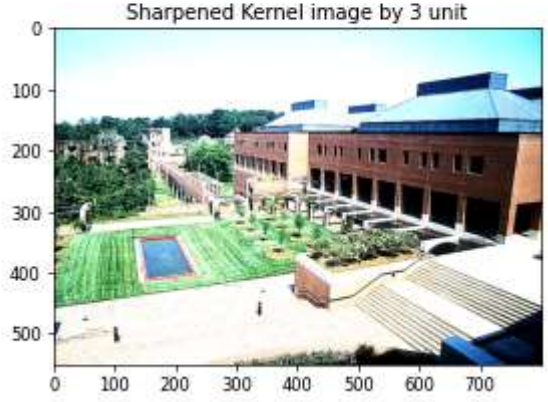
In [ ]:
```
fig, ax = plt.subplots(2,2,figsize=(16,8))
# fig.tight_layout()
school_img = cv.imread('./images/school.jpg')
# school_img,_,m= getImage('./images/school.jpg')
ax[0][0].imshow(cv.cvtColor(school_img,cv.COLOR_BGR2RGB))
ax[0][0].set_title('og image')

sharpened = cv.filter2D(school_img,-1,kernel_sharpening)
sharpened2 = cv.filter2D(school_img,-1,kernel_sharpening_2)

ax[0][1].set_title('Sharpened Kernel image')
ax[0][1].imshow(cv.cvtColor(sharpened,cv.COLOR_BGR2RGB))

ax[1][0].set_title('Sharpened 2 Kernel image')
ax[1][0].imshow(cv.cvtColor(sharpened2,cv.COLOR_BGR2RGB))
ax[1][1].set_title('Sharpened Kernel image by 3 unit')
ax[1][1].imshow(cv.cvtColor(sharpened2,cv.COLOR_BGR2RGB))
# plt.show()
```

Out[ ]:
```
<matplotlib.image.AxesImage at 0x279b34c6190>
```









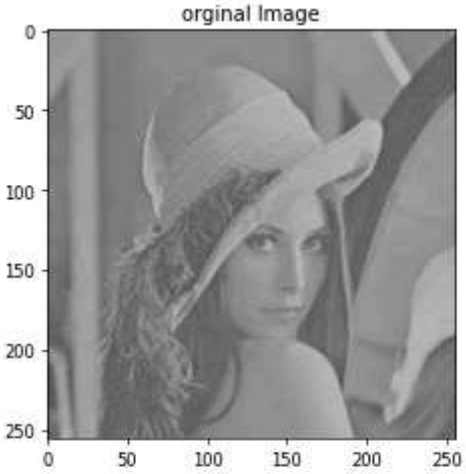
Pratice Question:

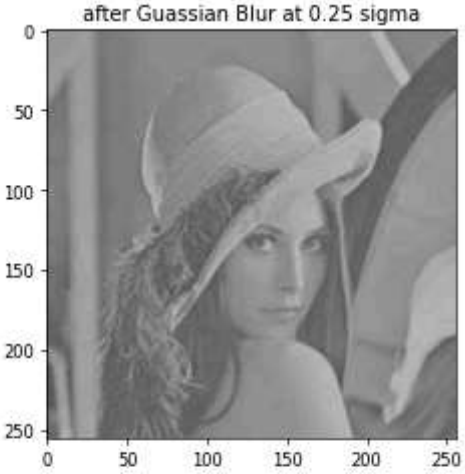
Apply Guassian smoothing on the lena image by varying sigma (1,2,0.5,0.25 and 1.5) or by varying radius [use GaussianBlur() function]

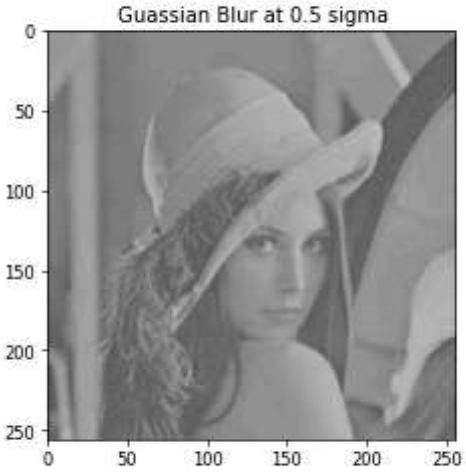
In [ ]:
```
low_img_np= cv.imread('./images/low.jpeg')
gaussian_image = cv.GaussianBlur(low_img_np, (5, 5), 1)
# 1,2,0.5,0.25
fig = plt.figure(figsize=(12,15))
# fig.tight_layout()
col = 2
row = 3

fig.add_subplot(row,col,1)
plt.imshow(low_img_np)
```

```
plt.title("orginal Image")


fig.add_subplot(row,col,2)
plt.title("after Guassian Blur at 0.25 sigma")
plt.imshow(cv.GaussianBlur(low_img_np, (5, 5), 0.25))

fig.add_subplot(row,col,3)
plt.title(" Guassian Blur at 0.5 sigma")
plt.imshow(cv.GaussianBlur(low_img_np, (5, 5), 0.5))

fig.add_subplot(row,col,4)
plt.title("after Guassian Blur at 1 sigma")
plt.imshow(cv.GaussianBlur(low_img_np, (5, 5), 1))

fig.add_subplot(row,col,5)
plt.title("Guassian Blur at 2 sigma")
plt.imshow(cv.GaussianBlur(low_img_np, (5, 5), 2))
```

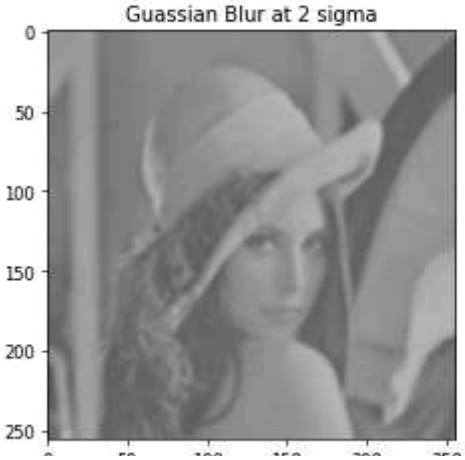
Out[ ]: <matplotlib.image.AxesImage at 0x279b7b1ce50>


orginal Image
0
50
100
150
200
250
0
50
100
150
200
250


after Guassian Blur at 0.25 sigma
0
50
100
150
200
250
0
50
100
150
200
250


Guassian Blur at 0.5 sigma
0
50
100
150
200
250
0
50
100
150
200
250


after Guassian Blur at 1 sigma
0
50
100
150
200
250
0
50
100
150
200
250


Guassian Blur at 2 sigma
0
50
100
150
200
250

0 50 100 150 200 250

Pratice Question 2,3,4,5,6:

2. suggest and apply a kernel to move the image to left by 1 pixel
3. suggest and apply a kernel to move the image to down right by 1 pixel
4. suggest and apply a kernel to sharpen the image by 3 units
5. Apply a median filter and get the kernel for the same
6. apply a averaging filter

In [ ]:

```
left, right, up, down = 1,1,1,1
# left, right, up, down = 2,2,2,2
# left, right, up, down = 3,3,3,3
# left, right, up, down = 5,5,5,5
depth = -1

school_img = plt.imread('./images/rose1.jpg',0)

left_shift_kernel = np.array([[0,0,0],
                      [0,0,left],
                      [0,0,0]]
)
right_shift_kernel = np.array([[0,0,0],
                       [right,0,0],
                       [0,0,0]])

up_shift_kernel = np.array([[0,up,0],
                    [0,0,0],
                    [0,0,0]])

down_shift_kernel = np.array([[0,0,0],
                      [0,0,0],
                      [0,down,0]])

down_left_shift_kernel = np.array([[0,0,0],
                          [0,0,left],
```

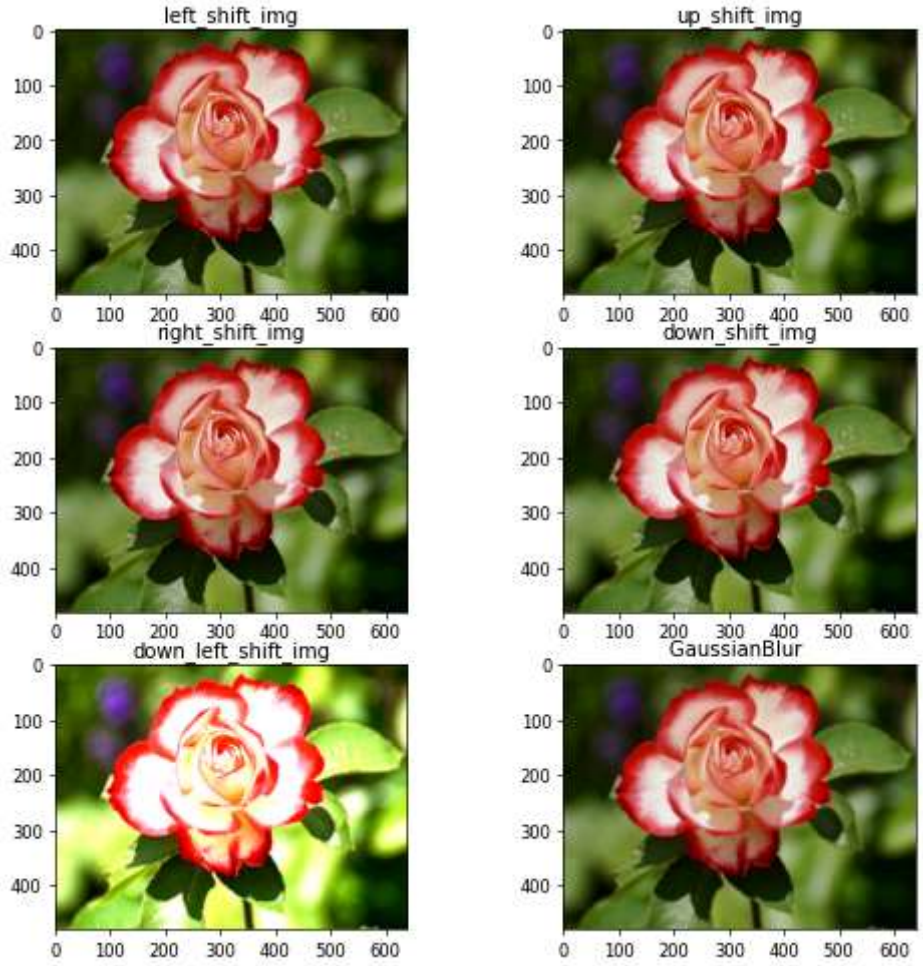
```
                           [0,down,0]])

blur_kernel = np.array(  [[0.111,0.111,0.111],
                          [0.111,0.111,0.111],
                          [0.111,0.111,0.111]])
sigma = 8
gaussian_blur_kernel = np.array(  [[sigma+1/16,sigma+2/16,sigma+1/16],
                          [sigma+2/16,sigma+4/16,sigma+2/16],
                          [sigma+1/16,sigma+2/16,sigma+1/16]])


left_shift_img = cv.filter2D(school_img,depth,left_shift_kernel)
right_shift_img = cv.filter2D(school_img,depth,right_shift_kernel)
up_shift_img = cv.filter2D(school_img,depth,up_shift_kernel)
down_shift_img = cv.filter2D(school_img,depth,down_shift_kernel)
down_left_shift_img = cv.filter2D(school_img,depth,down_left_shift_kernel)

blur_kernel_img = cv.filter2D(school_img,depth,blur_kernel)
gaussian_blur_kernel_img = cv.filter2D(school_img,depth,blur_kernel)
```

In [ ]:

```
fig = plt.figure(figsize=(10,20))
fig.tight_layout()
row = 6
col = 2

fig.add_subplot(row,col,1)
plt.imshow(left_shift_img)
plt.title("left_shift_img")

fig.add_subplot(row,col,2)
plt.imshow(up_shift_img)
plt.title("up_shift_img")

fig.add_subplot(row,col,3)
plt.imshow(right_shift_img)
plt.title("right_shift_img")


fig.add_subplot(row,col,4)
plt.imshow(down_shift_img)
plt.title("down_shift_img")
```

```
fig.add_subplot(row,col,5)
plt.imshow(down_left_shift_img)
plt.title("down_left_shift_img")
gaussian_image = cv.GaussianBlur(school_img, (5, 5), 8)
fig.add_subplot(row,col,6)
plt.imshow(gaussian_image,cmap="gray")
plt.title("GaussianBlur ")
```

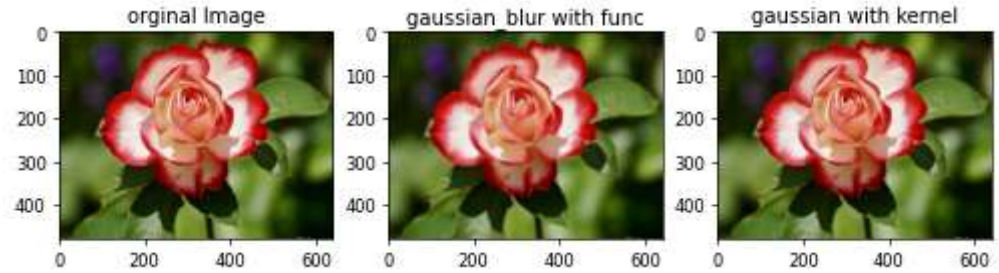
Out[ ]: Text(0.5, 1.0, 'GaussianBlur ')



In [ ]:
```
fig = plt.figure(figsize=(10,7))
fig.tight_layout()
```

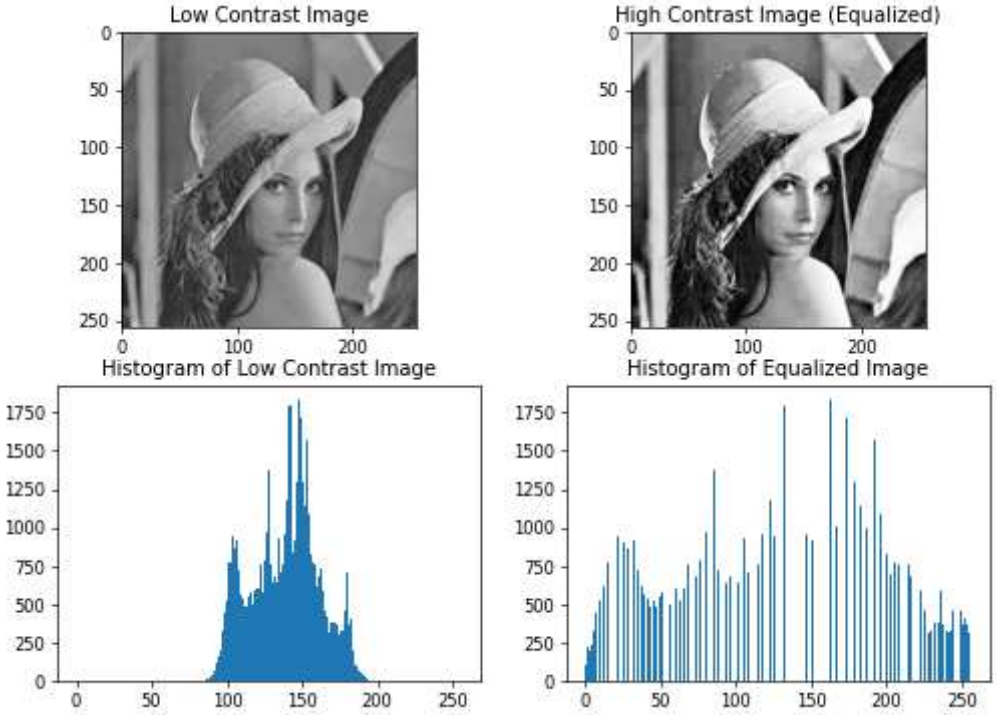
```
row = 1
col = 3
og_gaussian_image = school_img
gaussian_image = cv.GaussianBlur(og_gaussian_image, (5, 5), 8)
fig.add_subplot(row,col,1)
plt.imshow(og_gaussian_image)
plt.title("orginal Image")
fig.add_subplot(row,col,2)
plt.imshow(gaussian_image)
plt.title("gaussian_blur with func")

fig.add_subplot(row,col,3)
plt.imshow(gaussian_blur_kernel_img)
plt.title("gaussian with kernel")
```

Out[ ]: Text(0.5, 1.0, 'gaussian with kernel')



In [ ]:
```
import cv2 as cv
import numpy as np
import matplotlib.pyplot as plt

# Load the low-contrast image
low_contrast_img_path = './images/low.jpeg'
low_contrast_img = plt.imread(low_contrast_img_path, 0)

# Convert the image to NumPy array and data type int
low_contrast_img = cv.cvtColor(low_contrast_img, cv.COLOR_RGB2GRAY)
low_contrast_img = np.array(low_contrast_img)
# low_contrast_img = low_contrast_img.astype(np.uint8)

# Perform histogram equalization on the low-contrast image
equalized_img = cv.equalizeHist(low_contrast_img)
```

```python
# Create a figure with the specified size
fig = plt.figure(figsize=(10, 7))

# Plot the original low-contrast image
fig.add_subplot(2, 2, 1)
plt.imshow(low_contrast_img, cmap='gray')
plt.title("Low Contrast Image")

# Plot the equalized high-contrast image
fig.add_subplot(2, 2, 2)
plt.imshow(equalized_img, cmap='gray')
plt.title("High Contrast Image (Equalized)")

# Plot the histogram of the low-contrast image
fig.add_subplot(2, 2, 3)
plt.hist(low_contrast_img.ravel(), bins=256, range=[0, 256])
plt.title("Histogram of Low Contrast Image")

# Plot the histogram of the equalized image
fig.add_subplot(2, 2, 4)
plt.hist(equalized_img.ravel(), bins=256, range=[0, 256])
plt.title("Histogram of Equalized Image")

# Display the plots
plt.show()
```



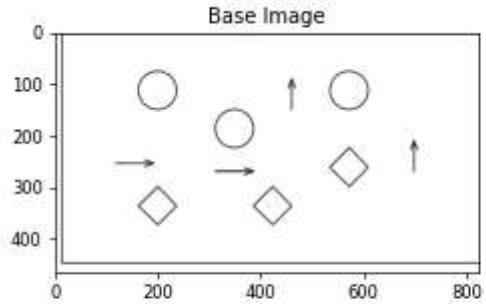
Practice question

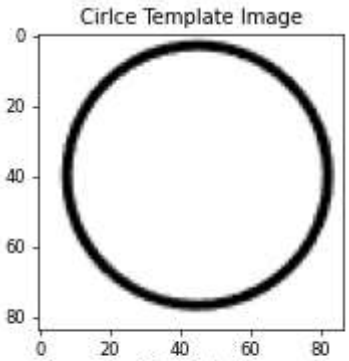
1. try to match a group of similar objects (2 stars as above)
2. try to match a group of diffrent objects (a stars and a cup etc.)

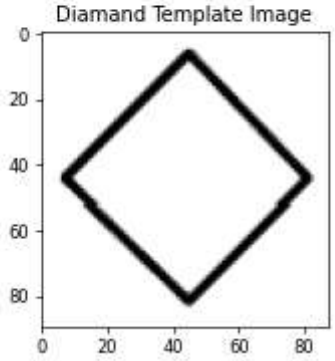
In [ ]:
```
fig = plt.figure(figsize=(10,7))

baseImg = cv.imread('./images/baseImage.png')
baseImg = cv.cvtColor(baseImg,cv.COLOR_BGR2GRAY)
circleTemplate = cv.imread('./images/circleTemplate.png')

cirlceTemplate = cv.cvtColor(circleTemplate, cv.COLOR_BGR2GRAY)

diamandTemplate = cv.imread('./images/diamandTemplate.png')

diamandTemplate = cv.cvtColor(diamandTemplate, cv.COLOR_BGR2GRAY)
```

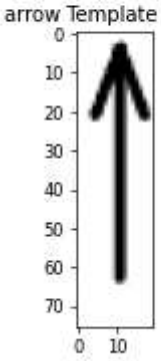
```
arrowTemplate = cv.imread('./images/arrowTemplate.png')
arrowTemplate = cv.cvtColor(arrowTemplate, cv.COLOR_BGR2GRAY)

fig.add_subplot(2,2,1)
plt.imshow(baseImg,cmap='gray')
plt.title("Base Image")

fig.add_subplot(2,2,2)
plt.imshow(cirlceTemplate,cmap='gray')
plt.title("Cirlce Template Image")

fig.add_subplot(2,2,3)
plt.imshow(diamandTemplate,cmap='gray')
plt.title("Diamand Template Image")

fig.add_subplot(2,2,4)
plt.imshow(arrowTemplate,cmap='gray')
plt.title("arrow Template Image")
```

Out[ ]: Text(0.5, 1.0, 'arrow Template Image')





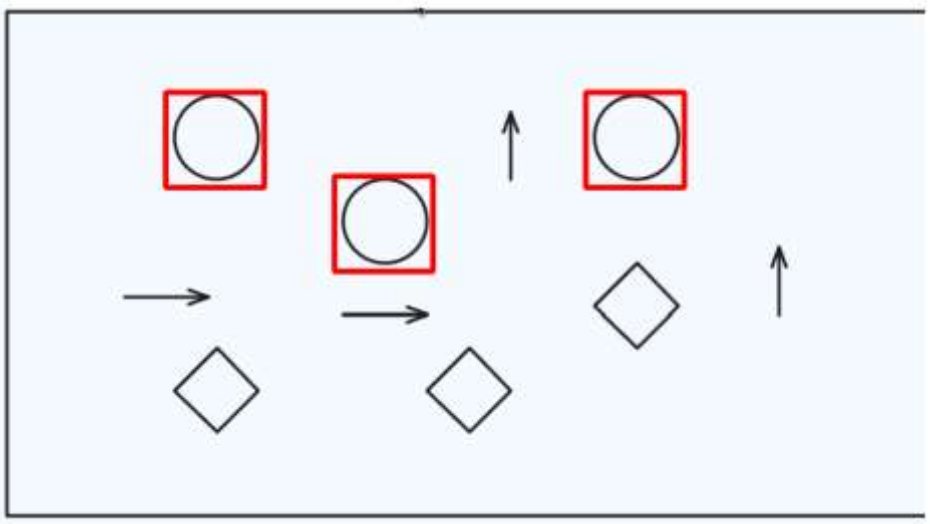




In [ ]:

```python
import cv2 as cv
import numpy as np
from matplotlib import pyplot as plt

img_rgb = cv.imread('./images/baseImage.png')

img_gray = cv.cvtColor(img_rgb, cv.COLOR_BGR2GRAY)
template = cv.imread('./images/circleTemplate.png', cv.IMREAD_GRAYSCALE)
template2 = cv.imread('./images//diamandTemplate.png', cv.IMREAD_GRAYSCALE)

w, h = template.shape[::-1]

res = cv.matchTemplate(img_gray,template,cv.TM_CCOEFF_NORMED)
threshold = 0.8
loc = np.where( res >= threshold)
for pt in zip(*loc[::-1]):
 cv.rectangle(img_rgb, pt, (pt[0] + w, pt[1] + h), (0,0,255), 2)
```

```
result_image_path = './res.png'

# Save the annotated source image as an image file
cv.imwrite(result_image_path, img_rgb)

# Display the resulting image
result_image = plt.imread(result_image_path)
plt.imshow(result_image)
plt.axis('off')  # Hide the axes for better visualization
plt.show()
```



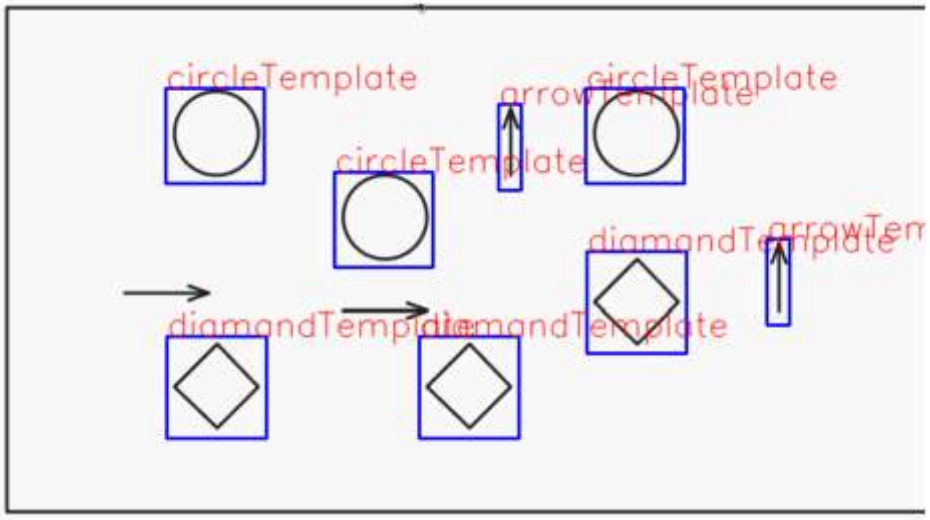
Multi template matching with different object

In [ ]:
```
import MTM,os
from MTM import matchTemplates

listTemplate = []

image_folder = "./templates/"
for filename in os.listdir(image_folder):
    template_img = cv.imread(os.path.join(image_folder, filename))
    template_img = cv.cvtColor(template_img, cv.COLOR_BGR2GRAY)
    listTemplate.append((filename.split('.')[0], template_img))
```

```
hits = matchTemplates(listTemplate,
                      baseImg,
                      score_threshold=0.9,
                      searchBox=(0, 0, 3000, 750),
                      method=cv.TM_CCOEFF_NORMED,
                      maxOverlap=0.1)
```

In [ ]:

```
import matplotlib.pyplot as plt
from MTM import drawBoxesOnRGB
overlay = drawBoxesOnRGB(baseImg,
                         hits,
                         showLabel = True,
                         labelColor=(255, 0, 0),
                         boxColor = (0, 0, 255),
                         labelScale=1,
                         boxThickness = 2)

plt.imshow(overlay)
plt.axis('off')
plt.show()
```



Practice Question

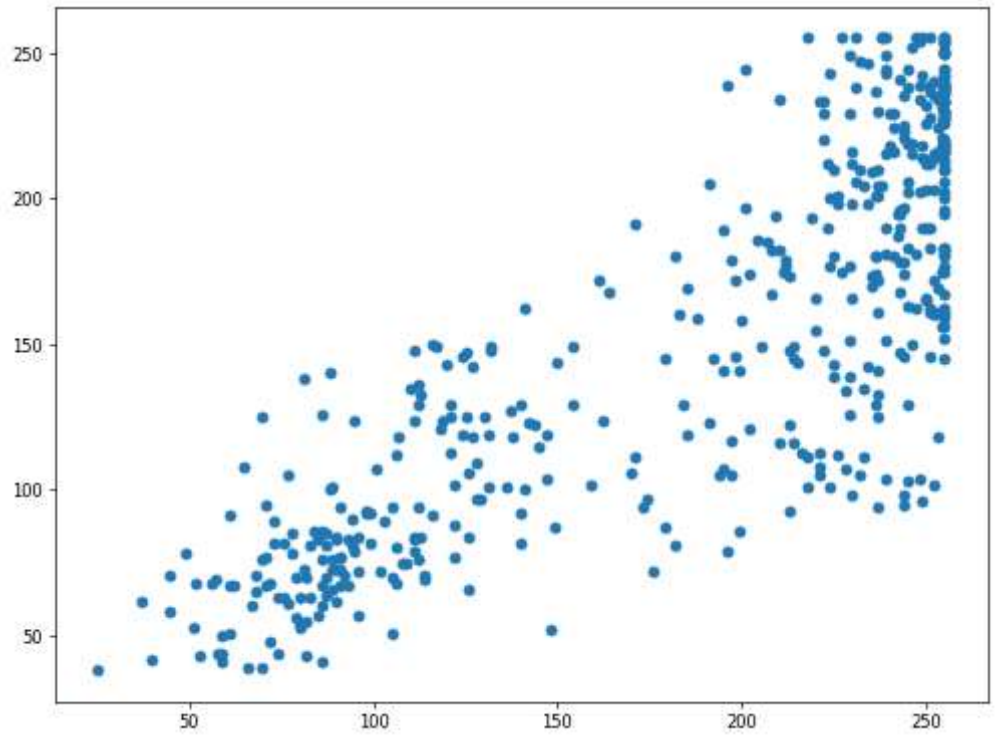
1. Check for the optimal number of clusters in an image either using silloutte or elbow method
2. Quantify the quality of the clustered image using DBI or silloutte methold

In [ ]:
```
img = plt.imread('./images/sunflower.jpeg')
img_np = np.array(img)
img_np = img_np.astype('int')
plt.imshow(img_np,cmap='gray')
```

Out[ ]:
```
<matplotlib.image.AxesImage at 0x279b9d82650>
```

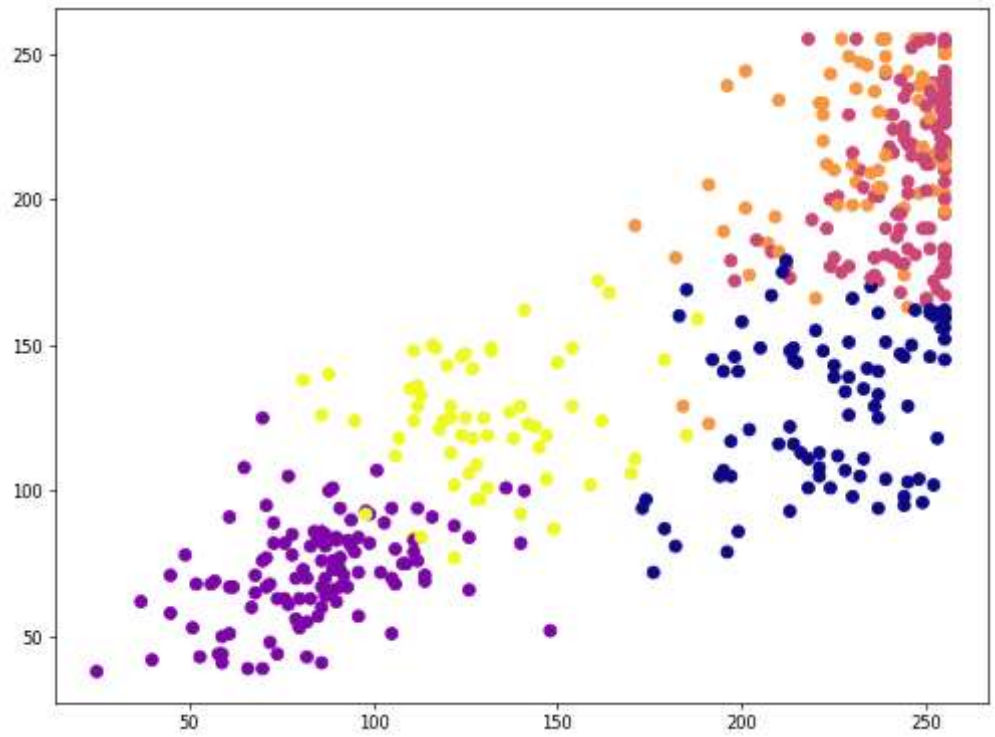
In [ ]:
```
x,y = img_np[:2]

plt.rcParams.update({'figure.figsize':(10,7.5), 'figure.dpi':60})
plt.scatter(x[:, 0], x[:, 1])
```

Out[ ]: <matplotlib.collections.PathCollection at 0x279ba24bad0>



In [ ]:
```
from sklearn.cluster import KMeans
from sklearn.metrics import silhouette_score, davies_bouldin_score
Cluster = KMeans(n_clusters=5)
Cluster.fit(x)
y_pred = Cluster.predict(x)
```

In [ ]:
```
plt.scatter(x[:, 0], x[:, 1], c=y_pred, s=50, cmap='plasma')
plt.rcParams.update({'figure.figsize':(10,7.5), 'figure.dpi':60})
```



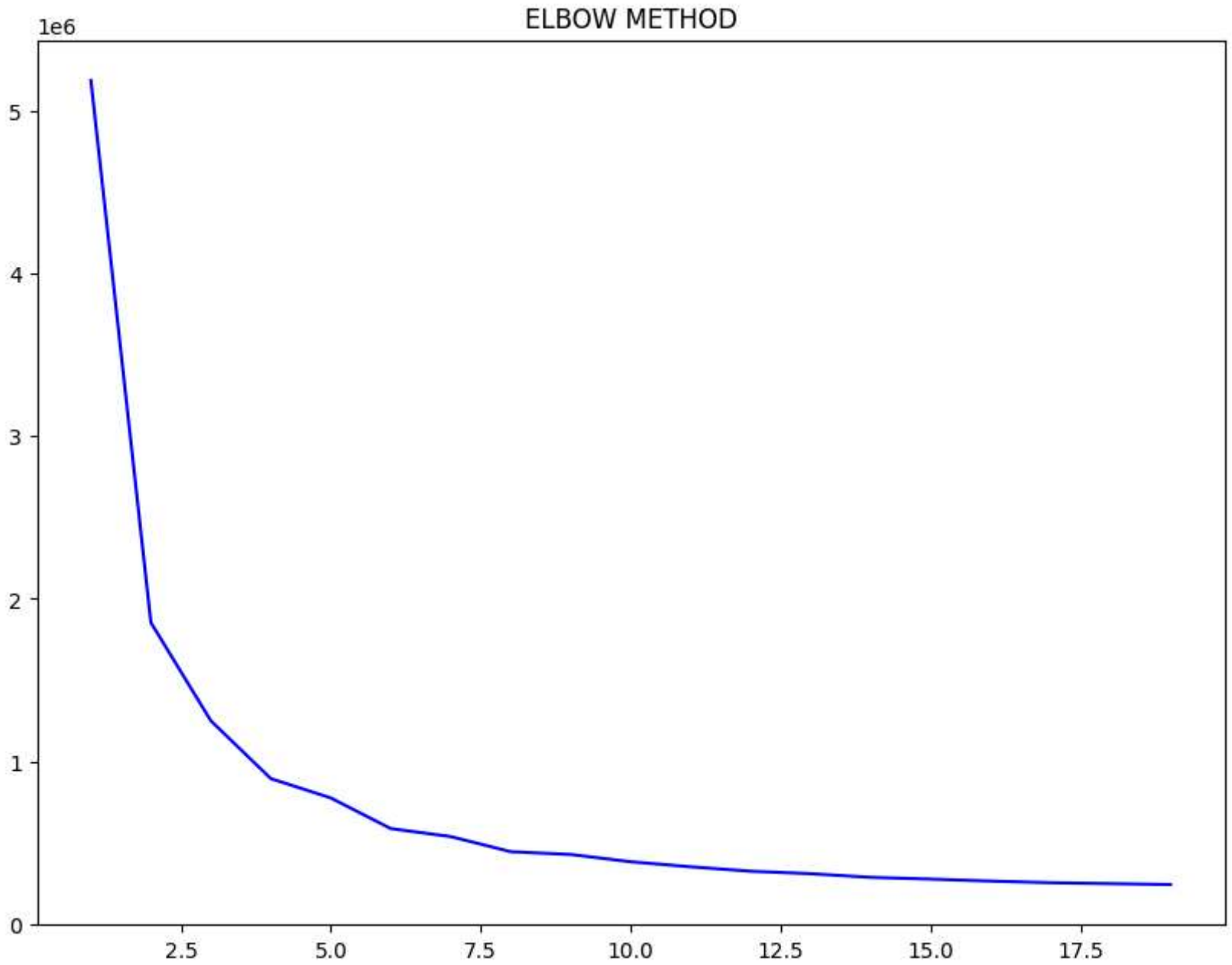
Elbow Method

In [ ]:

```
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans

# Array to store inertia values (sum of squared distances)
elbow = []

# Calculate inertia for different numbers of clusters
for i in range(1, 20):
    kmeans = KMeans(n_clusters=i, init='k-means++', random_state=101)
    kmeans.fit(x)
    elbow.append(kmeans.inertia_)

# Plot the elbow method using Seaborn's lineplot
plt.figure(figsize=(10, 7.5), dpi=100)
plt.title('ELBOW METHOD')
```

```
sns.lineplot(x=range(1, 20), y=elbow, color='blue')
# plt.show()
```

Out[ ]: <Axes: title={'center': 'ELBOW METHOD'}>



In [ ]:
```
import cv2
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
```

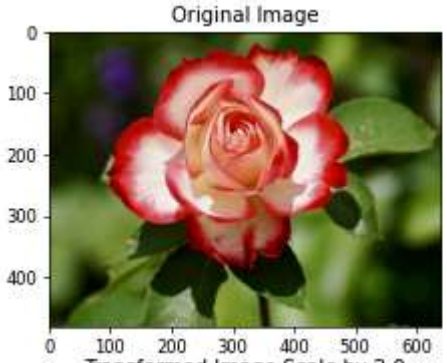
```
og_img = cv2.imread("./images/rose1.jpg")
img = cv2.cvtColor(og_img, cv2.COLOR_BGR2RGB)

img=cv2.cvtColor(og_img,cv2.COLOR_BGR2RGB)
vectorized = img.reshape((-1,3))
vectorized = np.float32(vectorized)
criteria = (cv2.TERM_CRITERIA_EPS + cv2.TERM_CRITERIA_MAX_ITER, 10, 1.0)
K = 3
attempts=10
ret,label,center=cv2.kmeans(vectorized,K,None,criteria,attempts,cv2.KMEANS_PP_CENTERS)
center = np.uint8(center)
res = center[label.flatten()]
result_image = res.reshape((img.shape))
figure_size = 10
plt.figure(figsize=(figure_size,figure_size))
plt.subplot(1,2,1),plt.imshow(img)
plt.title('Original Image'), plt.xticks([]), plt.yticks([])
plt.subplot(1,2,2),plt.imshow(result_image)
plt.title('Segmented Image when K = %i' % K), plt.xticks([]), plt.yticks([])
plt.show()
```

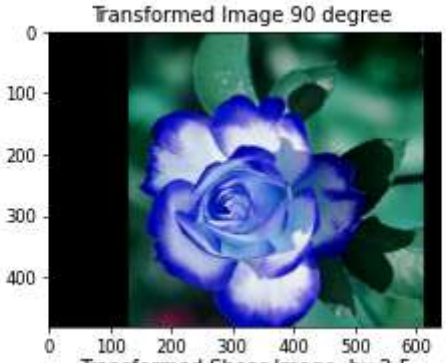
Practice question

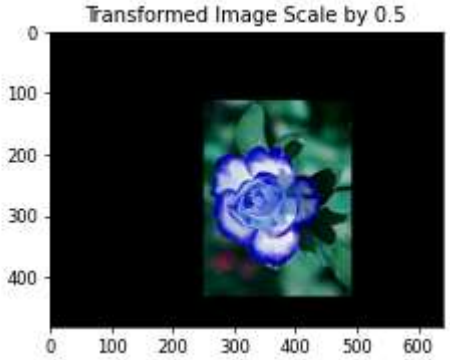
1. Try Affine transformation
2. try scaling the object in the image by sx=2 and sy=2
3. try scaling a object in the image by sx=0.5,sy=0.5
4. try shearing with sx=2.5 and sy=1.5
5. rotate the object by 90degree
6. tranform the object to new coordinates

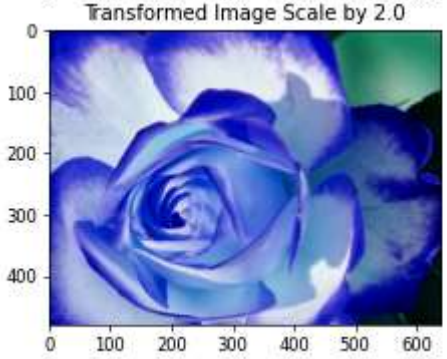
In [ ]:
```
img = cv.imread('./images/rose1.jpg')


rows, cols = img.shape[:2]

img_rgb = cv.cvtColor(img, cv.COLOR_BGR2RGB)
center = (cols // 2, rows // 2)
angle = 90  # Rotate by 45 degrees
tx, ty = 50, 30  # Translate by 50 units in x and 30 units in y

scale = 2

rotation_matrix = cv.getRotationMatrix2D(center, angle, 0.5)
rotation_matrix_o = cv.getRotationMatrix2D(center, angle, 1)
rotation_matrix_s = cv.getRotationMatrix2D(center, angle, scale)

rotation_matrix[0, 2] += tx
rotation_matrix[1, 2] += ty

rotation_matrix_o[0, 2] += tx
rotation_matrix_o[1, 2] += ty

rotation_matrix_s[0, 2] += tx
rotation_matrix_s[1, 2] += ty

transformed_img = cv.warpAffine(img, rotation_matrix_o, (cols, rows))
transformed_img1 = cv.warpAffine(img, rotation_matrix, (cols, rows))
transformed_img2 = cv.warpAffine(img, rotation_matrix_s, (cols, rows))
```

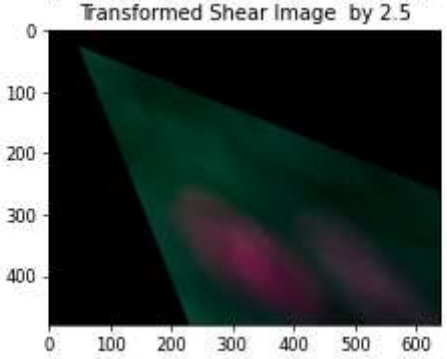
```
sx = 2.5
sy = 2.5
shear_matrix = np.array([
[1, sx, tx],
[sy, 1, ty]
], dtype=float)
# Apply the affine transformation using the shearing matrix
transformed_img_shear = cv.warpAffine(img, shear_matrix, (cols, rows))
# Apply the affine transformation

# Display the original and transformed images using matplotlib
plt.figure(figsize=(15, 7))

plt.subplot(2, 3, 1)
plt.imshow(img_rgb)
plt.title('Original Image')

plt.subplot(2, 3, 2)
plt.imshow(transformed_img)
plt.title('Transformed Image 90 degree ')
plt.subplot(2, 3, 3)
plt.imshow(transformed_img1)
plt.title('Transformed Image Scale by 0.5')
plt.subplot(2, 3, 4)
plt.imshow(transformed_img2)
plt.title('Transformed Image Scale by 2.0')
plt.subplot(2, 3, 5)
plt.imshow(transformed_img_shear)
plt.title('Transformed Shear Image  by 2.5')

plt.show()
```


Original Image
0
100
200
300
400
0
100
200
300
400
500
600


Transformed Image 90 degree
0
100
200
300
400
0
100
200
300
400
500
600


Transformed Image Scale by 0.5
0
100
200
300
400
0
100
200
300
400
500
600


Transformed Image Scale by 2.0
0
100
200
300
400
0
100
200
300
400
500
600


Transformed Shear Image by 2.5
0
100
200
300
400
0
100
200
300
400
500
600