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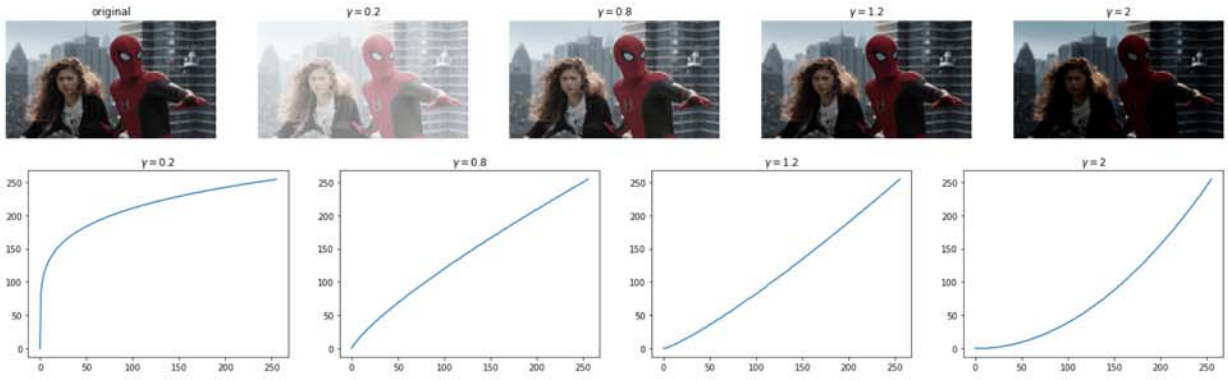
In [ ]:
```
import cv2 as cv
import numpy as np
import matplotlib.pyplot as plt
```

Question One

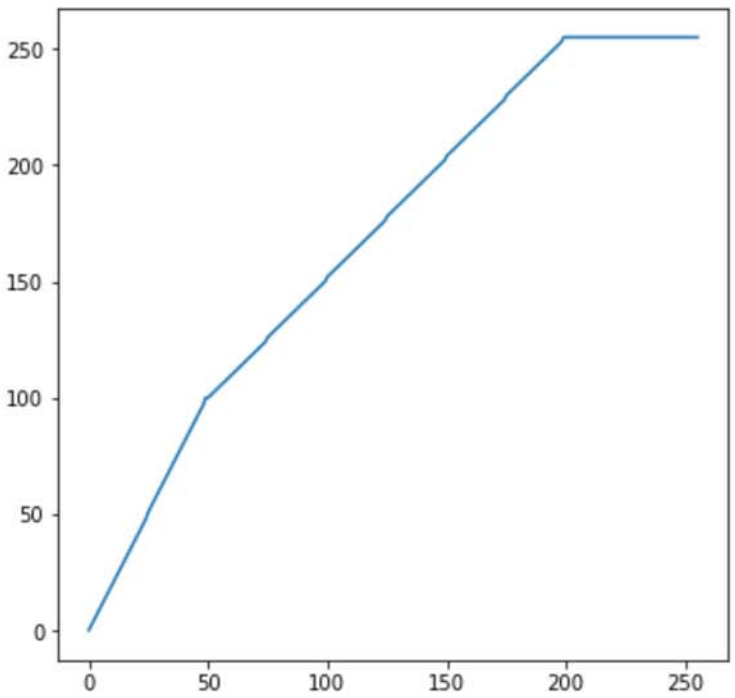
In [ ]:
```
frame = cv.imread(r'spider.PNg')
assert frame is not None

fig_g,ax_g = plt.subplots(1,5)
fig_g.set_figwidth(25)
index = 0
ax_g[index].imshow(cv.cvtColor(frame,cv.COLOR_BGR2RGB))
ax_g[0].axis('off')
ax_g[0].title.set_text('original')

gamma_values = [0.2,0.8,1.2,2]

fig_v,ax_v = plt.subplots(1,4)
fig_v.set_figwidth(25)

for gamma in gamma_values:
    index += 1
    table = np.array([(pixel/255)**gamma*255 for pixel in range (0,256)]).asty
    output_gamma = cv.LUT(frame,table)


    ax_v[index-1].plot(table)
    ax_v[index-1].title.set_text('$\gamma = $'+str(gamma))

    ax_g[index].imshow(cv.cvtColor(output_gamma,cv.COLOR_BGR2RGB))
    ax_g[index].axis('off')
    ax_g[index].title.set_text('$\gamma = $'+str(gamma))

    cv.namedWindow('Image',cv.WINDOW_AUTOSIZE)
    cv.imshow('Image',frame)
    cv.waitKey(0)
    cv.imshow('Image',output_gamma)
    cv.waitKey(0)
    cv.destroyAllWindows()
```

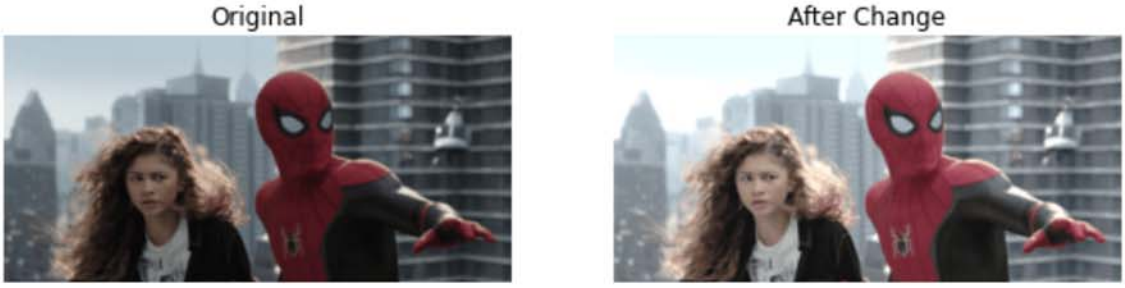


Question two

In [ ]:

```
frame = cv.imread(r'spider.png')
assert frame is not None

t1 = np.linspace(0,100,50)
t2 = np.linspace(100,255,150)
t3 = [255]*56

table = np.concatenate((t1,t2,t3),axis=0).astype(np.uint8)
fig,ax = plt.subplots(figsize=(6,6))
ax.plot(table)
#ax.set_aspect('equal')

assert len(table) == 256
output_g = cv.LUT(frame,table)



cv.namedWindow('Image',cv.WINDOW_AUTOSIZE)
cv.imshow('Image',frame)
cv.waitKey(0)
cv.imshow('Image',output_g)
cv.waitKey(0)
cv.destroyAllWindows()

fig,ax = plt.subplots(1,2,figsize=(10,8))
ax[0].imshow(cv.cvtColor(frame,cv.COLOR_BGR2RGB))
ax[0].axis('off')
ax[0].title.set_text("Original")
ax[1].imshow(cv.cvtColor(output_g,cv.COLOR_BGR2RGB))
ax[1].axis('off')
ax[1].title.set_text("After Change")
```



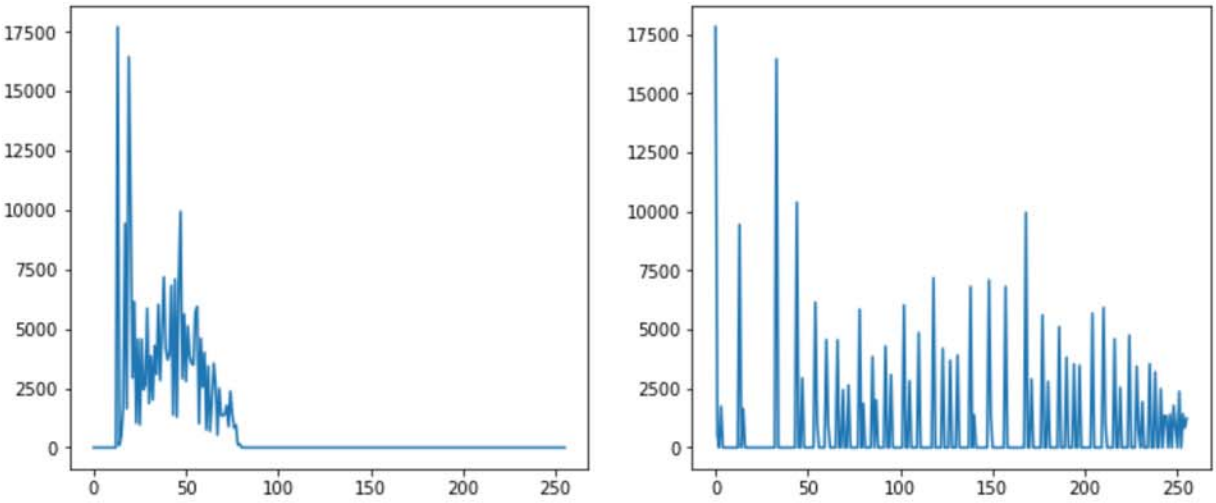


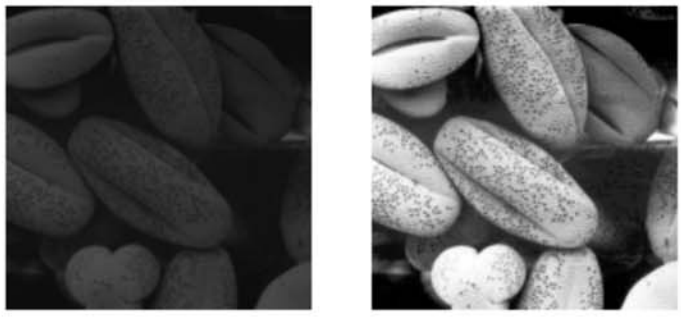
Question Three

In [ ]:

```
frame = cv.imread(r'shells.tif',cv.IMREAD_GRAYSCALE)
assert frame is not None

histf = cv.calcHist([frame],[0],None,[256],[0,256])

eq_hist = cv.equalizeHist(frame)
hist_eq = cv.calcHist([eq_hist],[0],None,[256],[0,256])

fig,ax = plt.subplots(1,2,figsize=(12,5))

ax[0].plot(histf)
ax[1].plot(hist_eq)
fig,ax = plt.subplots(1,2,figsize=(6,6))
ax[0].imshow(cv.cvtColor(frame,cv.COLOR_BGR2RGB))
ax[1].imshow(cv.cvtColor(eq_hist,cv.COLOR_BGR2RGB))
ax[0].axis('off')
ax[1].axis('off')
```

Out[ ]: (-0.5, 499.5, 499.5, -0.5)





Question Four (a)

In [ ]:

```
frame = cv.imread(r'zion_pass.jpg')
assert frame is not None

hsv_org = cv.cvtColor(frame,cv.COLOR_BGR2HSV)
(h_org,s_org,v_org) = cv.split(hsv_org)

sat_level = 63

s = cv.add(s_org,sat_level)

hsv = cv.merge([h_org,s,v_org])

fig,ax = plt.subplots(1,2)
fig.set_figheight(15)
fig.set_figwidth(20)

ax[0].imshow(cv.cvtColor(frame,cv.COLOR_BGR2RGB))
ax[0].title.set_text('Original')
ax[0].axis('off')

ax[1].imshow(cv.cvtColor(hsv,cv.COLOR_HSV2RGB))
ax[1].title.set_text('After Saturation')
ax[1].axis('off')
```

Out[ ]: (-0.5, 899.5, 505.5, -0.5)

Question Four (b)

In [ ]:
```
hue_level = 63

h = cv.add(h_org,hue_level)
hsv = cv.merge([h,s_org,v_org])

fig,ax = plt.subplots(1,2)
fig.set_figheight(15)
fig.set_figwidth(20)

ax[0].imshow(cv.cvtColor(frame,cv.COLOR_BGR2RGB))
ax[0].title.set_text('Original')
ax[0].axis('off')

ax[1].imshow(cv.cvtColor(hsv,cv.COLOR_HSV2RGB))
ax[1].title.set_text('After hue change')
ax[1].axis('off')
```

Out[ ]: (-0.5, 899.5, 505.5, -0.5)

In [ ]: