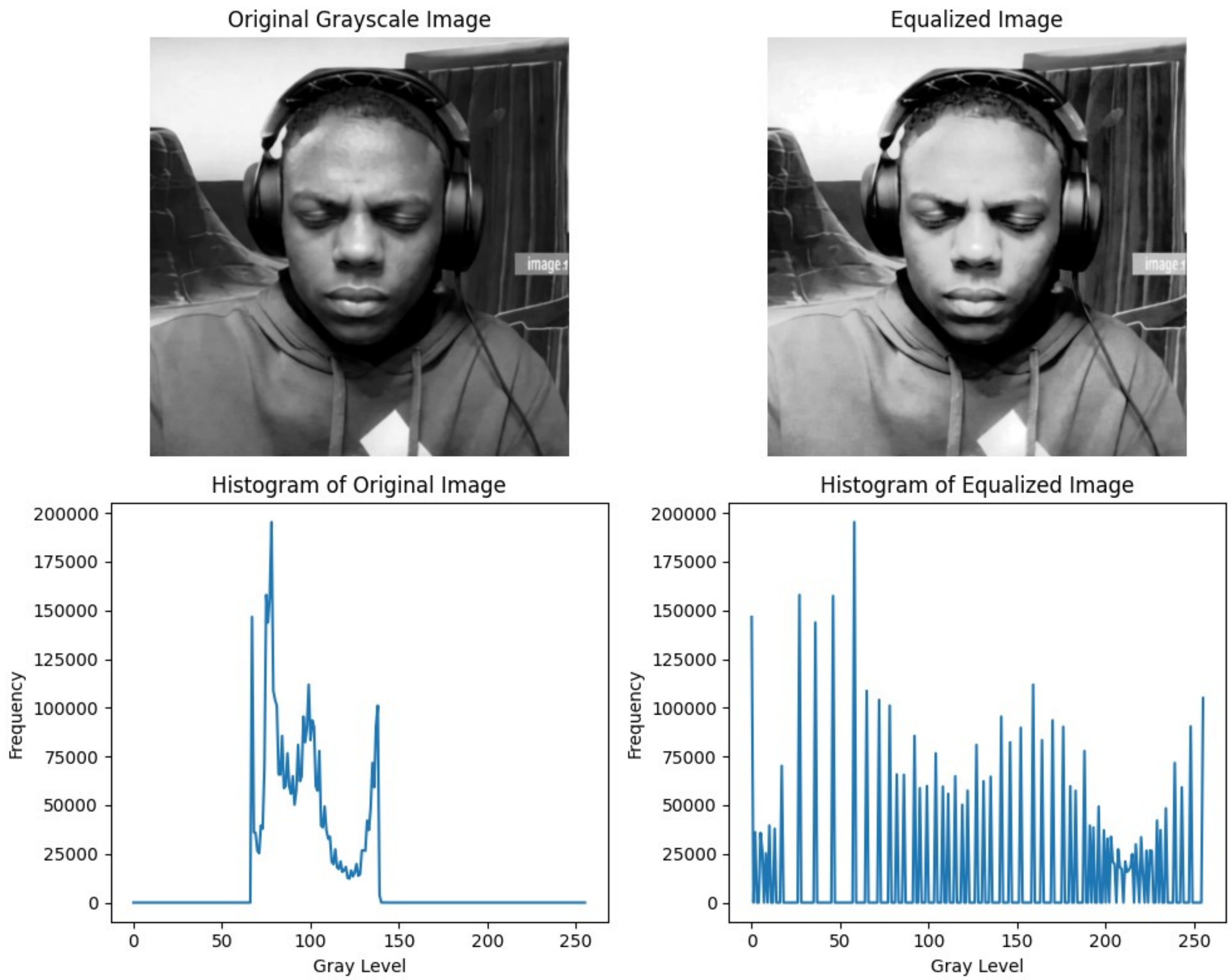
Part 1

```
import cv2
import numpy as np
import matplotlib.pyplot as plt

img = cv2.imread(r"D:\MIT WPU B.Tech Data\3nd Year Data\IPPR\
low_contrast_image.png", cv2.IMREAD_GRAYSCALE)

hist_original = cv2.calcHist(
    [img],
    [0],
    None,
    [256],
    [0, 256]
)

equalized_img = cv2.equalizeHist(img)

hist_equalized = cv2.calcHist(
    [equalized_img],
    [0],
    None,
    [256],
    [0, 256]
)

plt.figure(figsize=(10, 8))

plt.subplot(2, 2, 1)
plt.title("Original Grayscale Image")
plt.imshow(img, cmap='gray')
plt.axis("off")

plt.subplot(2, 2, 2)
plt.title("Equalized Image")
plt.imshow(equalized_img, cmap='gray')
plt.axis("off")

plt.subplot(2, 2, 3)
plt.title("Histogram of Original Image")
plt.plot(hist_original)
plt.xlabel("Gray Level")
plt.ylabel("Frequency")

plt.subplot(2, 2, 4)
plt.title("Histogram of Equalized Image")
plt.plot(hist_equalized)
plt.xlabel("Gray Level")
```

```
plt.ylabel("Frequency")

plt.tight_layout()
plt.show()
```

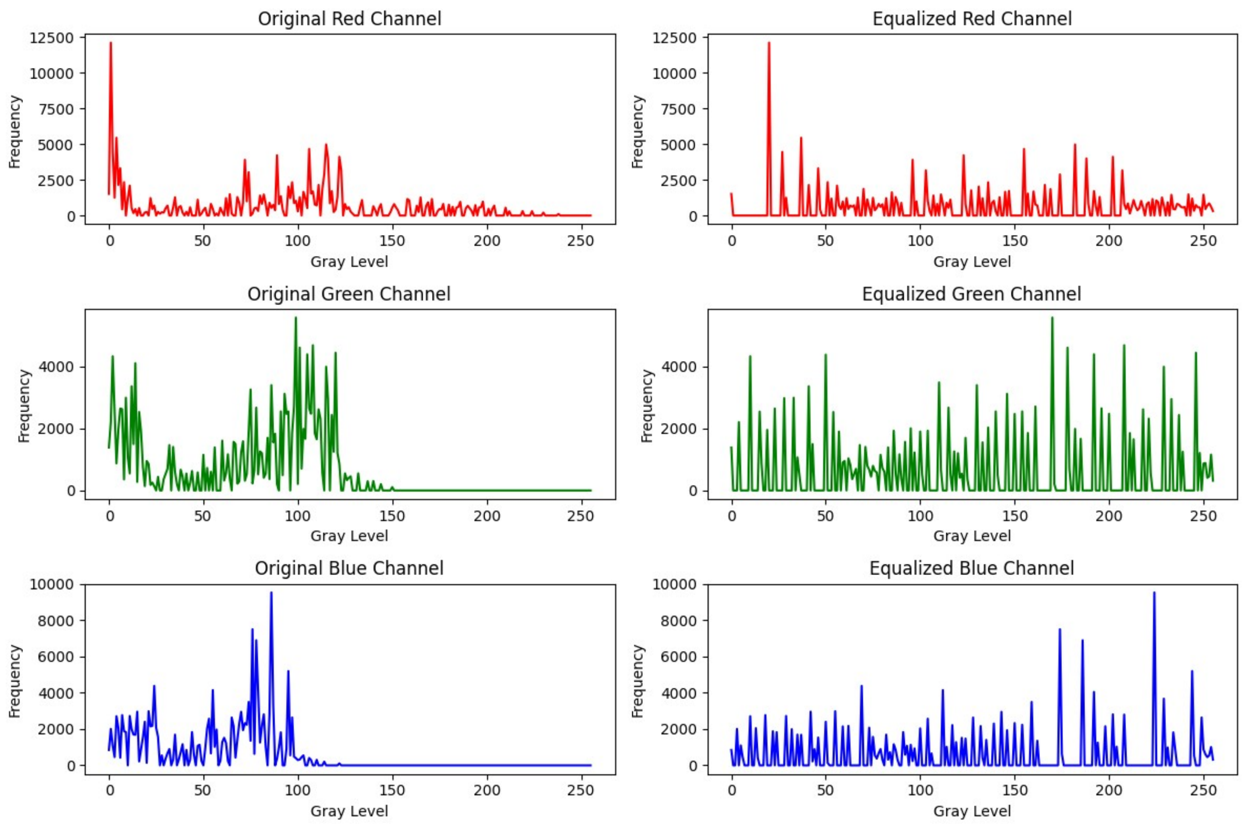


Part 2

```
img_rgb = cv2.imread(r"D:\MIT WPU B.Tech Data\3nd Year Data\IPPR\
charlie-kirk-charlie-kirk-meme.gif")
img_rgb = cv2.cvtColor(img_rgb, cv2.COLOR_BGR2RGB)

R, G, B = cv2.split(img_rgb)

hist_R = cv2.calcHist([R], [0], None, [256], [0,256])
hist_G = cv2.calcHist([G], [0], None, [256], [0,256])
hist_B = cv2.calcHist([B], [0], None, [256], [0,256])
```

```
R_eq = cv2.equalizeHist(R)
G_eq = cv2.equalizeHist(G)
B_eq = cv2.equalizeHist(B)

img_rgb_eq = cv2.merge((R_eq, G_eq, B_eq))

hist_R_eq = cv2.calcHist([R_eq], [0], None, [256], [0,256])
hist_G_eq = cv2.calcHist([G_eq], [0], None, [256], [0,256])
hist_B_eq = cv2.calcHist([B_eq], [0], None, [256], [0,256])


plt.figure(figsize=(8,4))
plt.subplot(1,2,1)
plt.title("Original RGB")
plt.imshow(img_rgb)
plt.axis("off")

plt.subplot(1,2,2)
plt.title("Equalized RGB")
plt.imshow(img_rgb_eq)
plt.axis("off")
plt.show()

plt.figure(figsize=(12, 8))

plt.subplot(3, 2, 1)
plt.title("Original Red Channel")
plt.plot(hist_R, color='r')
plt.xlabel("Gray Level")
plt.ylabel("Frequency")

plt.subplot(3, 2, 2)
plt.title("Equalized Red Channel")
plt.plot(hist_R_eq, color='r')
plt.xlabel("Gray Level")
plt.ylabel("Frequency")

plt.subplot(3, 2, 3)
plt.title("Original Green Channel")
plt.plot(hist_G, color='g')
plt.xlabel("Gray Level")
plt.ylabel("Frequency")

plt.subplot(3, 2, 4)
plt.title("Equalized Green Channel")
plt.plot(hist_G_eq, color='g')
plt.xlabel("Gray Level")
plt.ylabel("Frequency")

plt.subplot(3, 2, 5)
```

```
plt.title("Original Blue Channel")
plt.plot(hist_B, color='b')
plt.xlabel("Gray Level")
plt.ylabel("Frequency")

plt.subplot(3, 2, 6)
plt.title("Equalized Blue Channel")
plt.plot(hist_B_eq, color='b')
plt.xlabel("Gray Level")
plt.ylabel("Frequency")

plt.tight_layout()
plt.show()
```



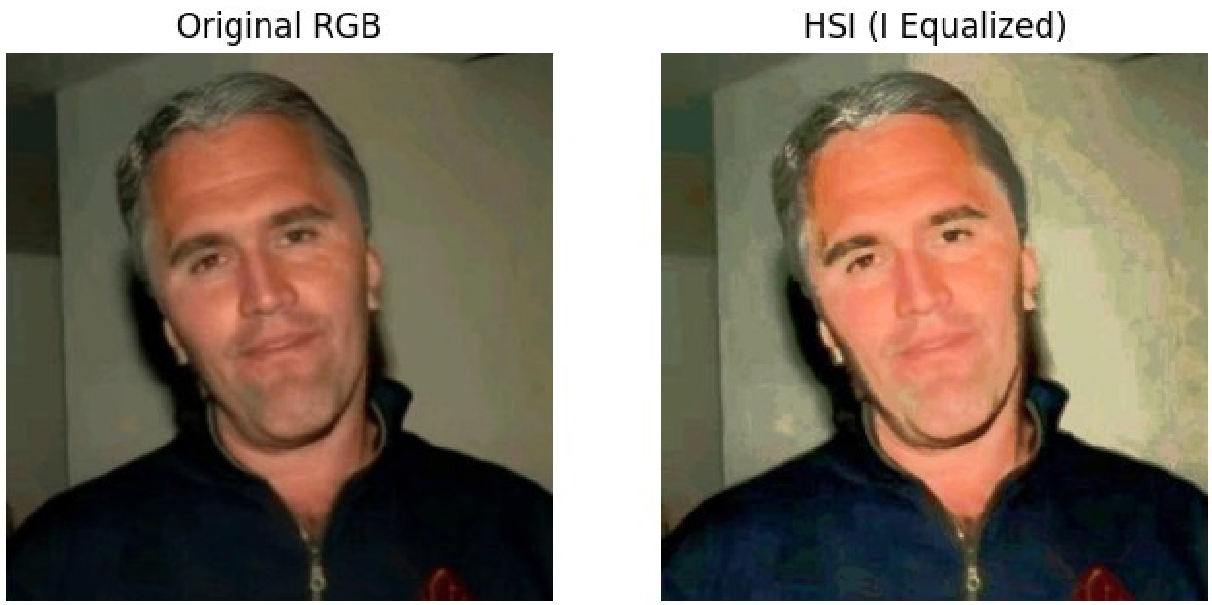
Convert the RGB image to HSI

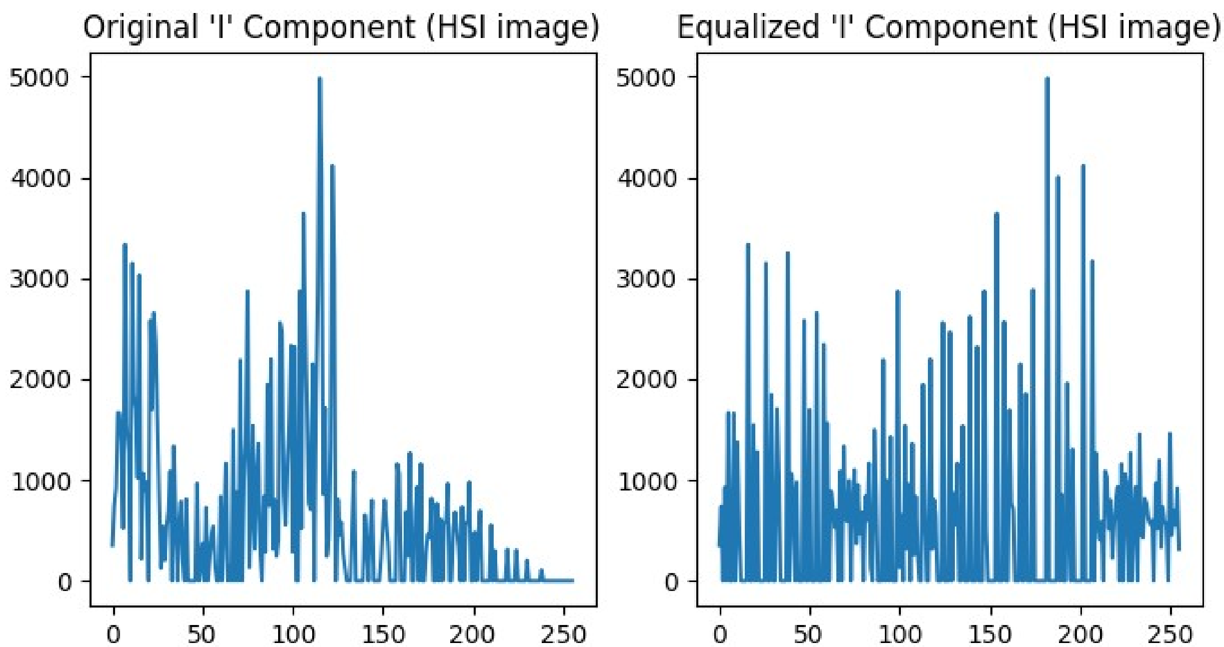
```
img_hsv = cv2.cvtColor(img_rgb, cv2.COLOR_RGB2HSV)

H, S, V = cv2.split(img_hsv)

hist_V = cv2.calcHist([V], [0], None, [256], [0,256])

V_eq = cv2.equalizeHist(V)

hist_V_eq = cv2.calcHist([V_eq], [0], None, [256], [0,256])

img_hsv_eq = cv2.merge((H, S, V_eq))
```

Convert the HSI image back to RGB

```
img_rgb_hsi_eq = cv2.cvtColor(img_hsv_eq, cv2.COLOR_HSV2RGB)

plt.figure(figsize=(8,4))
plt.subplot(1,2,1)
plt.title("Original RGB")
plt.imshow(img_rgb)
plt.axis("off")

plt.subplot(1,2,2)
plt.title("HSI (I Equalized)")
```

```
plt.imshow(img_rgb_hsi_eq)
plt.axis("off")
plt.show()

plt.figure(figsize=(8,4))
plt.subplot(1,2,1)
plt.title("Original 'I' Component (HSI image)")
plt.plot(hist_V)

plt.subplot(1,2,2)
plt.title("Equalized 'I' Component (HSI image)")
plt.plot(hist_V_eq)

plt.show()
```

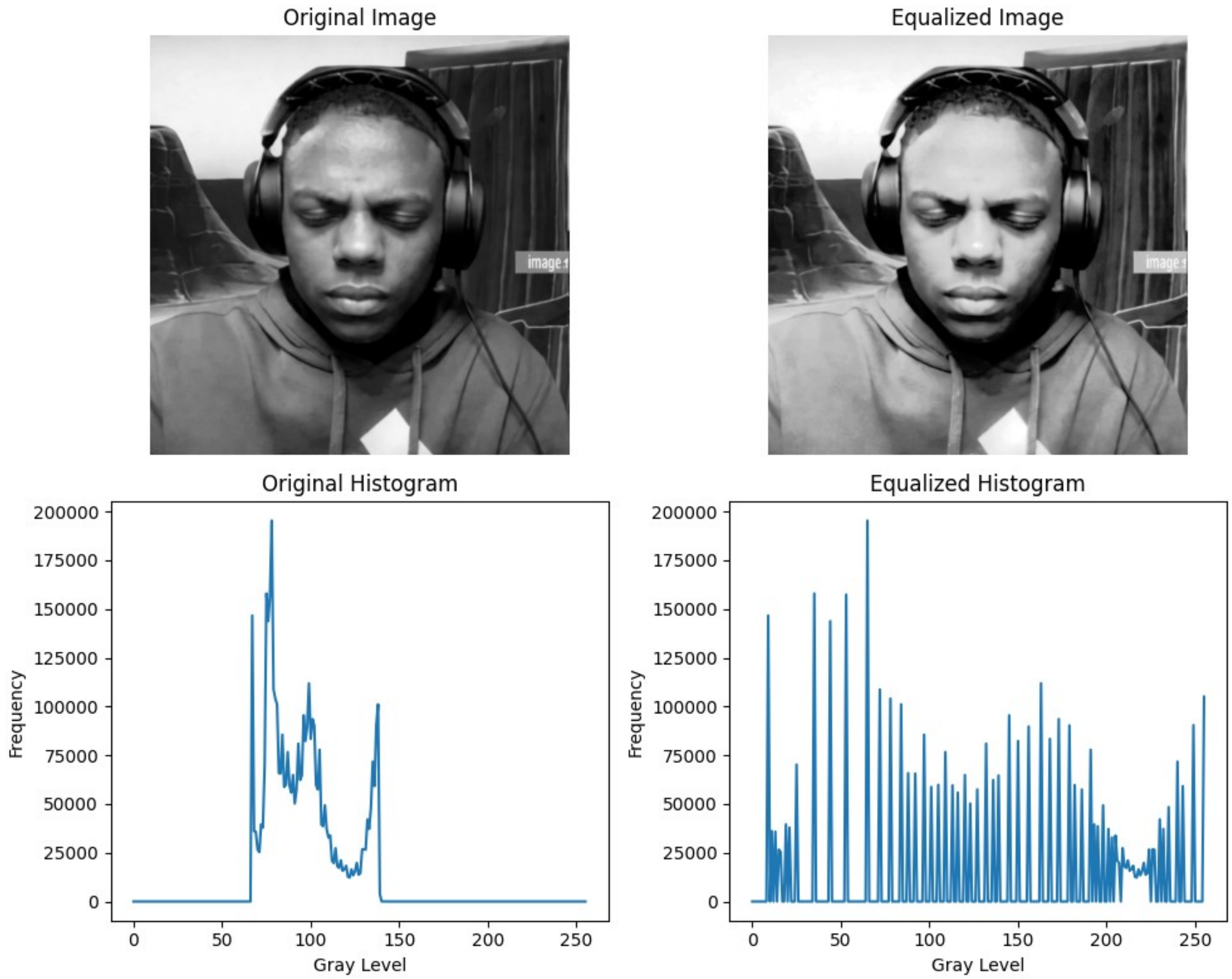




Calculating the histogram and equlizing the image manually

```
img = cv2.imread(r"D:\MIT WPU B.Tech Data\3nd Year Data\IPPR\
low_contrast_image.png", cv2.IMREAD_GRAYSCALE)

rows, cols = img.shape
n = rows * cols
L = 256

hist = np.zeros(L, dtype=int)
for i in range(rows):
    for j in range(cols):
        hist[img[i, j]] += 1

cum_hist = np.zeros(L, dtype=int)
cum_hist[0] = hist[0]
for k in range(1, L):
    cum_hist[k] = cum_hist[k - 1] + hist[k]

cdf = cum_hist / n
mapping = np.round(cdf * (L - 1)).astype(np.uint8)

equalized_img = np.zeros_like(img)
for i in range(rows):
    for j in range(cols):
        equalized_img[i, j] = mapping[img[i, j]]

hist_eq = np.zeros(L, dtype=int)
for i in range(rows):
    for j in range(cols):
```

```
        hist_eq[equalized_img[i, j]] += 1

plt.figure(figsize=(10, 8))

plt.subplot(2, 2, 1)
plt.title("Original Image")
plt.imshow(img, cmap="gray")
plt.axis("off")

plt.subplot(2, 2, 2)
plt.title("Equalized Image")
plt.imshow(equalized_img, cmap="gray")
plt.axis("off")

plt.subplot(2, 2, 3)
plt.title("Original Histogram")
plt.plot(hist)
plt.xlabel("Gray Level")
plt.ylabel("Frequency")

plt.subplot(2, 2, 4)
plt.title("Equalized Histogram")
plt.plot(hist_eq)
plt.xlabel("Gray Level")
plt.ylabel("Frequency")

plt.tight_layout()
plt.show()
```

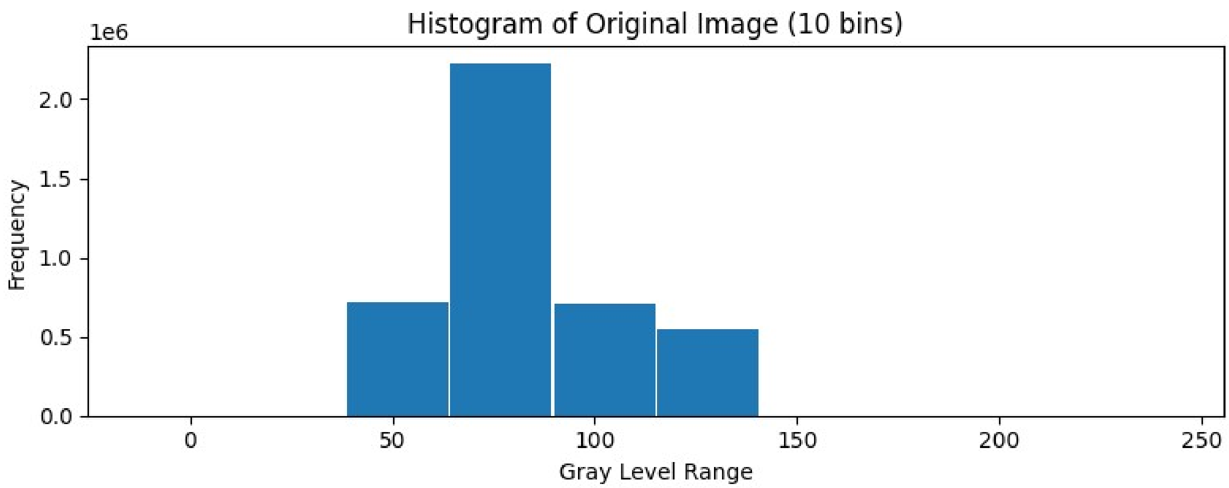


Changing the bin component in the calcHist() function

```
hist_original = cv2.calcHist(
    [img],
    [0],
    None,
    [10],
    [0, 256]
)

bin_edges = np.linspace(0, 256, 11)

plt.figure(figsize=(8, 6))

plt.subplot(2, 1, 1)
plt.title("Original Grayscale Image")
plt.imshow(img, cmap='gray')
plt.axis("off")

plt.subplot(2, 1, 2)
```

```
plt.title("Histogram of Original Image (10 bins)")
plt.bar(bin_edges[:-1], hist_original.flatten(), width=25)
plt.xlabel("Gray Level Range")
plt.ylabel("Frequency")

plt.tight_layout()
plt.show()
```

Original Grayscale Image



IPPR

Name - Uzair Shaikh
Prn - 1032240100

Good!
2/2

* Experiment - 2

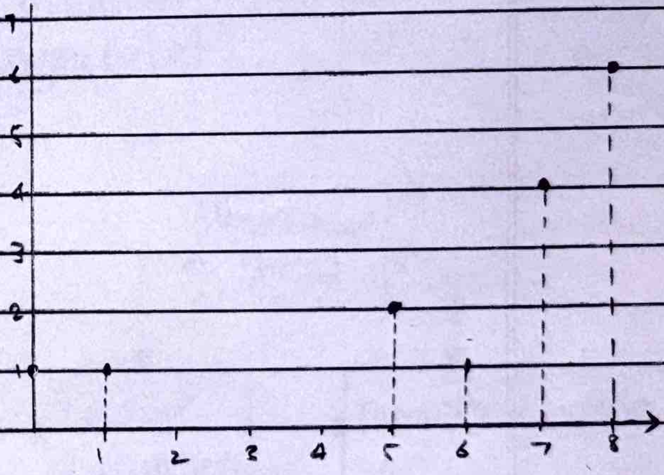
* Post lab Quetions.

1. A bright image will have what kind of histogram?

→ A bright image will have histogram that is shifted towards the higher gray level values. As most of the pixels intensities are high, therefore the histogram bars would be mostley concentrated to the right side of the axis. No to very few pixels would present at the lower gray levels.

8	6	7	8
7	5	8	8
1	0	7	8
8	5	7	6

4x4 image
Gray-scale - 0 to 8



2) What is 'dynamic range' and 'contrast' of digital image?

→ Dynamic range of digital image:-
A dynamic range is the difference between the maximum and minimum gray-level intensity values present in an image.

It shows how much of the available intensity scale the image uses.

1) ~~A Image~~ large dynamic range (Ex 0 to 255) means the image uses wide range of grey levels.

2) A small dynamic range (Ex 80 to 120) means pixel values are compressed into narrow range

Contrast of digital image:

Contrast is the difference in intensity between objects & there background in an image. It determines how clearly objects can be distinguised.

1. high contrast - Edges & details are clearly visible
2. low contrast - ~~Edges &~~ Image looks dull & more on the dark side.

3.) An image with dynamic range 0 to 7 is given below (3 bits). Perform the following on the image.

2	2	3	0
0	0	0	0
1	1	3	3
1	1	3	3

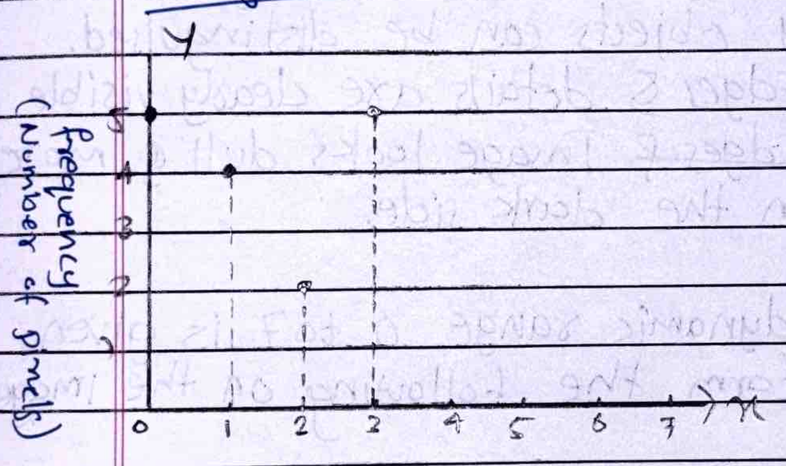
a) Determine the histogram of the image

Total pixels = 4x4 = 16

Gray levels = 0 to 7
(3-bit)

Grey level	Count
0	5
1	4
2	2
3	5
4	0
5	0
6	0
7	0

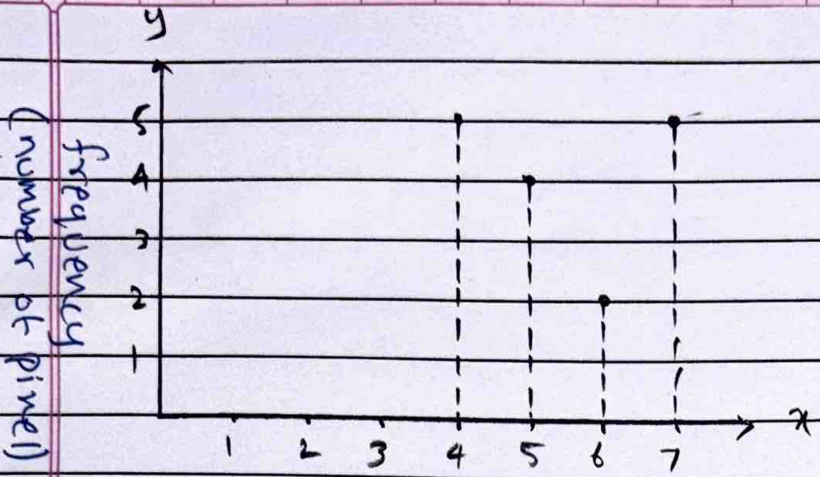
Histogram:



Pixel intensity values.

b) what is the effect on histogram if MSB of every pixel is made 1

Gray level	binary (original)	binary (after MSB = 1)	New Gray level.
0	000	100	4
1	001	101	5
2	010	110	6
3	011	111	7



when the MSB of every pixel is made 1, all gray levels shifts twoards higher instensities (4-7). Even the histogram shifts to right side making the image more brighter.