```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

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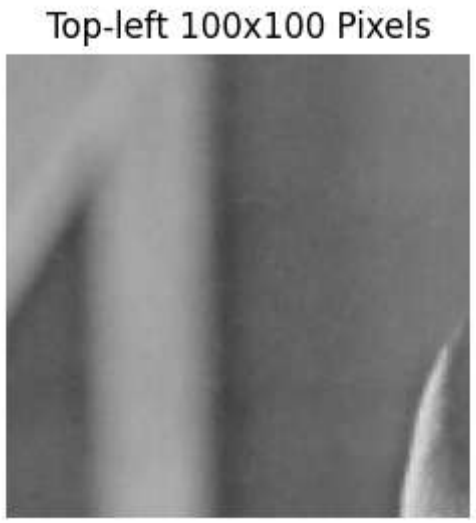
Worksheet1

```
import numpy as np
import matplotlib.pyplot as plt
from PIL import Image


img = Image.open("/content/drive/MyDrive/AI and machine learning/lenna_image.png")
# Display the original image
plt.figure(figsize=(5,5))
plt.imshow(img)
plt.title("Original Image")
plt.axis("off")
plt.show()
```


```
# Convert image to NumPy array
img_array = np.array(img)
# Extract and display the top-left 100x100 pixels
top_left = img_array[:100, :100]
plt.figure(figsize=(3,3))
plt.imshow(top_left)
plt.title("Top-left 100x100 Pixels")
plt.axis("off")
plt.show()
```




```
# Task 3: Extract and display R, G, and B channels
r_channel = img_array[:, :, 0]  # Red channel
g_channel = img_array[:, :, 1]  # Green channel
b_channel = img_array[:, :, 2]  # Blue channel
# Display the Red channel
plt.figure(figsize=(5,5))
plt.imshow(r_channel, cmap="Reds")
plt.title("Red Channel")
plt.axis("off")
plt.show()
```


```
# Display the Green channel
plt.figure(figsize=(5,5))
plt.imshow(g_channel, cmap="Greens")
plt.title("Green Channel")
plt.axis("off")
plt.show()
```


```
# Display the Blue channel
plt.figure(figsize=(5,5))
plt.imshow(b_channel, cmap="Blues")
plt.title("Blue Channel")
plt.axis("off")
plt.show()
```


```
#  Modify the top 100x100 pixels to 210 (light gray)
modified_img = img_array.copy()
modified_img[:100, :100] = 210


plt.figure(figsize=(5,5))
plt.imshow(modified_img)
plt.axis("off")
plt.show()
```

2nd Exercise

```
gray_img = Image.open("/content/drive/MyDrive/AI and machine learning/camera_man.jpg").convert("L")
# Display the grayscale image
plt.figure(figsize=(5,5))
plt.imshow(gray_img, cmap="gray")
plt.title("Grayscale Image")
plt.axis("off")
plt.show()
```

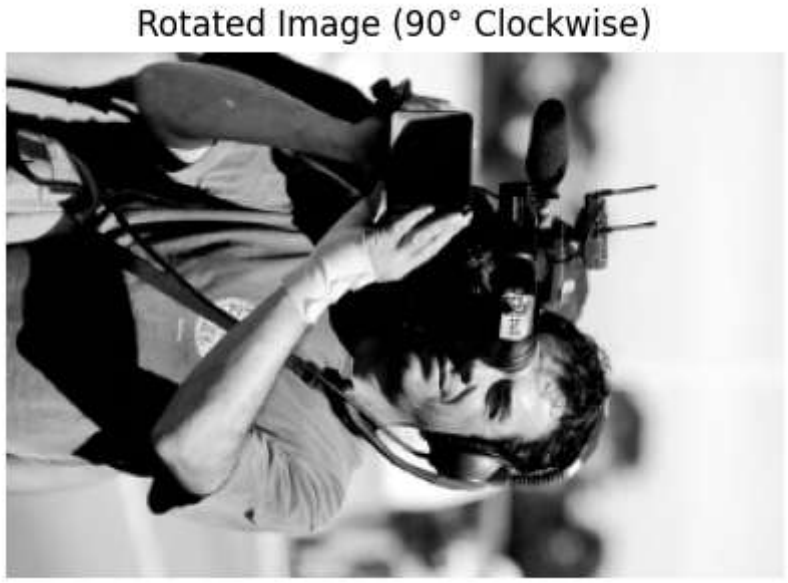

```
# Convert image to NumPy array
gray_array = np.array(gray_img)
#Extract and display the middle 150-pixel section
height, width = gray_array.shape
start_x = width // 2 - 75
end_x = width // 2 + 75
middle_section = gray_array[:, start_x:end_x]


# Display the middle section
plt.figure(figsize=(5,5))
plt.imshow(middle_section, cmap="gray")
plt.title("Middle 150-Pixel Section")
```

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


```
# Apply a threshold (Binary Image)
threshold_img = np.where(gray_array < 100, 0, 255)
# Display the binary image
plt.figure(figsize=(5,5))
plt.imshow(threshold_img, cmap="gray")
plt.title("Binary Image (Threshold Applied)")
plt.axis("off")
plt.show()
```

Binary Image (Threshold Applied)

```
#Rotate the image 90 degrees clockwise
rotated_img = np.rot90(gray_array, k=-1)
# Display the rotated image
plt.figure(figsize=(5,5))
plt.imshow(rotated_img, cmap="gray")
plt.title("Rotated Image (90° Clockwise)")
plt.axis("off")
plt.show()
```




```
#Convert the grayscale image to RGB
rgb_img = np.stack([gray_array]*3, axis=-1)
# Display the RGB image
plt.figure(figsize=(5,5))
plt.imshow(rgb_img)
plt.title("Converted RGB Image")
plt.axis("off")
plt.show()
```

3rd Exercise

```
# Convert image to grayscale
gray_img = Image.fromarray(img_array).convert("L")
gray_array = np.array(gray_img, dtype=np.float64)
# Display the grayscale image
plt.figure(figsize=(5,5))
plt.imshow(gray_array, cmap="gray")
plt.title("Grayscale Image")
plt.axis("off")
plt.show()
```


```
# Compute mean and standard deviation
mean_pixel = np.mean(gray_array, axis=0)
std_pixel = np.std(gray_array, axis=0)

# Standardize the image
standardized_data = (gray_array - mean_pixel) / (std_pixel + 1e-8)

# Display standardized image
plt.figure(figsize=(5,5))
plt.imshow(standardized_data, cmap="gray")
plt.title("Standardized Image")
plt.axis("off")
plt.show()
```


```
# Compute covariance matrix
cov_matrix = np.dot(standardized_data.T, standardized_data) / (gray_array.shape[0] - 1)

# Print covariance matrix shape
print("Covariance Matrix Shape:", cov_matrix.shape)
```

```
Covariance Matrix Shape: (366, 366)
```

```
# Compute Eigenvalues and Eigenvectors
eigenvalues, eigenvectors = np.linalg.eigh(cov_matrix

# Print the number of eigenvalues obtained
```

```
print("Number of Eigenvalues:", len(eigenvalues))
```

```
Number of Eigenvalues: 366
```

```
# Sort Eigenvalues and Eigenvectors in Descending Order
sorted_indices = np.argsort(eigenvalues)[::-1]
eigenvalues = eigenvalues[sorted_indices]
eigenvectors = eigenvectors[:, sorted_indices]

# Compute explained variance
explained_variance = eigenvalues / np.sum(eigenvalues)
cumulative_variance = np.cumsum(explained_variance)

# Plot cumulative variance
plt.figure(figsize=(8,5))
plt.plot(cumulative_variance, marker='o', linestyle='--', color='r')
plt.xlabel("Number of Principal Components")
plt.ylabel("Cumulative Explained Variance")
plt.title("Explained Variance vs Principal Components")
plt.grid()
plt.show()
```