```
import cv2
import numpy as np
from google.colab.patches import cv2_imshow

# 1. Read the image
image = cv2.imread("image.jpg")
# 2.original image
cv2_imshow( image)
```

```
# 3. Extract image size (height, width, channels)
height, width, channels = image.shape
print(f"Image Dimensions: Width = {width}, Height = {height}, Channels = {channels}")
```

```
Image Dimensions: Width = 768, Height = 768, Channels = 3
```

```
# 4. Calculate total number of pixels
total_pixels = height * width
print(f"Total Number of Pixels: {total_pixels}")
```

```
Total Number of Pixels: 589824
```

```
# 5. Convert BGR to Grayscale
gray_image = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
cv2_imshow( gray_image)
cv2.imwrite("grayscale_image.jpg", gray_image)
```

True

```
# 6. Convert Grayscale to Binary Image using a threshold
threshold_value = 100
_, binary_image = cv2.threshold(gray_image, threshold_value, 255, cv2.THRESH_BINARY)
cv2_imshow( binary_image)
cv2.imwrite("binary_image.jpg", binary_image)


# Count the number of black pixels in the binary image
black_pixel_count = np.sum(binary_image == 0)
print(f"Black Pixel Count: {black_pixel_count}")
```

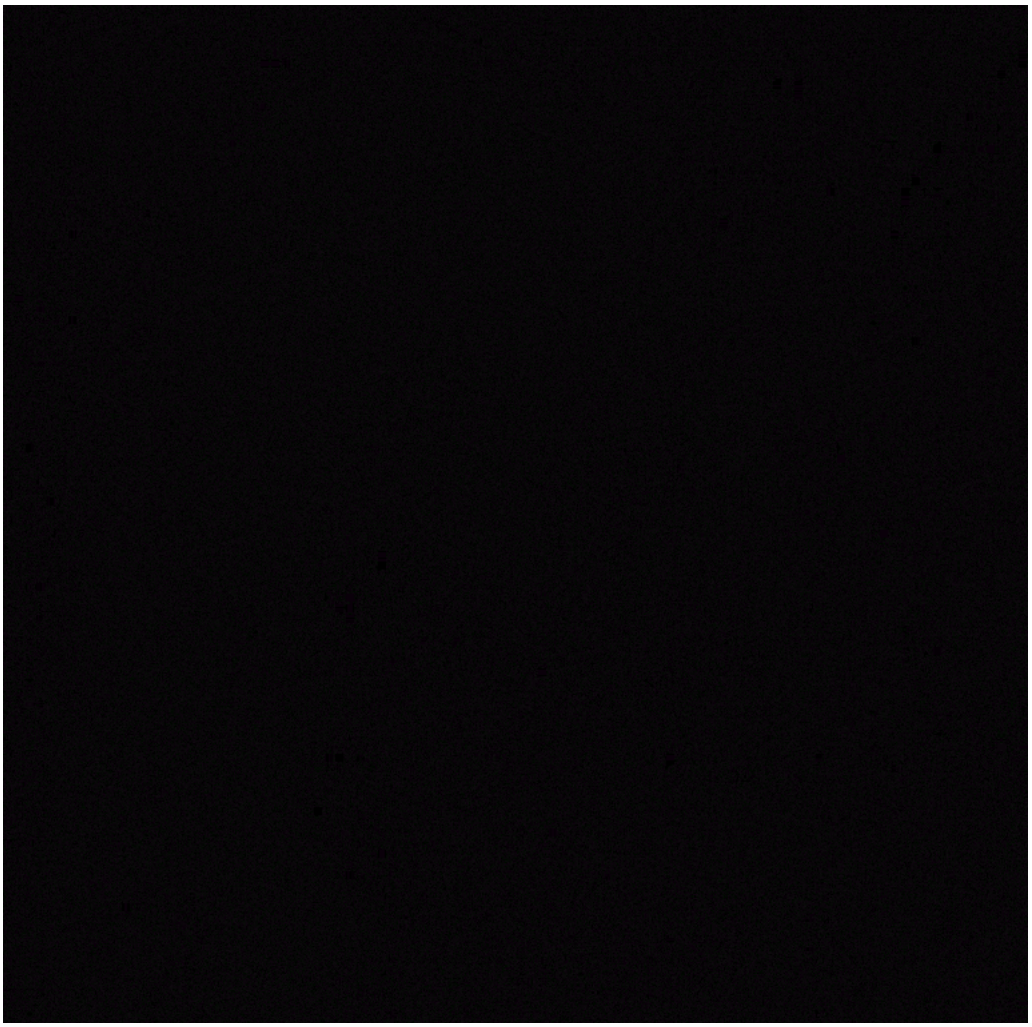
```
Black Pixel Count: 339267
```

```
# Wait for a key press and close all windows
cv2.waitKey(0)
cv2.destroyAllWindows()


#Task 2
 #---------------- EDGE DETECTION ---------------- #
# 1. Sobel Operator (detects horizontal and vertical edges)
sobel_x = cv2.Sobel(image, cv2.CV_64F, 1, 0, ksize=3)
sobel_y = cv2.Sobel(image, cv2.CV_64F, 0, 1, ksize=3)
sobel_combined = cv2.magnitude(sobel_x, sobel_y)
cv2_imshow( sobel_combined)
```

```
# 2. Prewitt Operator (alternative to Sobel, without smoothing)
kernel_x = np.array([[1, 0, -1], [1, 0, -1], [1, 0, -1]])
kernel_y = np.array([[1, 1, 1], [0, 0, 0], [-1, -1, -1]])
prewitt_x = cv2.filter2D(image, -1, kernel_x)
prewitt_y = cv2.filter2D(image, -1, kernel_y)
prewitt_combined = cv2.magnitude(prewitt_x.astype(np.float64), prewitt_y.astype(np.float64))
cv2_imshow( prewitt_combined)
```

```
from scipy import ndimage
# 3. Roberts Cross Operator (highlights diagonal edges)
roberts_x = ndimage.sobel(image, axis=0, mode="constant")
roberts_y = ndimage.sobel(image, axis=1, mode="constant")
roberts_combined = np.sqrt(roberts_x**2 + roberts_y**2)
cv2_imshow(roberts_combined)
```



```
# 4. Canny Edge Detector (best for detecting fine edges)
canny_edges = cv2.Canny(image, 50, 150)
cv2_imshow(canny_edges)
```

```
# ---------------- IMAGE SEGMENTATION ---------------- #
# 1. Global Thresholding
_, global_thresh = cv2.threshold(image, 127, 255, cv2.THRESH_BINARY)
cv2_imshow(global_thresh)
```

```
import cv2
import numpy as np

# Load the image (use an absolute path if needed)
image = cv2.imread("image.jpg", cv2.IMREAD_GRAYSCALE)

# Check if image is loaded correctly
if image is None:
    raise ValueError("Error: Image not found! Please check the file path.")

# Convert grayscale to BGR (for watershed algorithm)
image_color = cv2.cvtColor(image, cv2.COLOR_GRAY2BGR)

# Display the image
cv2_imshow( image_color)
cv2.waitKey(0)
cv2.destroyAllWindows()
```

```
import cv2
import numpy as np
from google.colab.patches import cv2_imshow  # Use this for displaying images in Google Colab

# Load the grayscale image
image = cv2.imread("image.jpg", cv2.IMREAD_GRAYSCALE)

# Check if the image is loaded properly
if image is None:
    raise ValueError("Error: Image not found! Please check the file path.")

# Apply Adaptive Thresholding (use 'image' directly since it's already grayscale)
adaptive_thresh = cv2.adaptiveThreshold(
    image, 255, cv2.ADAPTIVE_THRESH_GAUSSIAN_C, cv2.THRESH_BINARY, 11, 2
)

# Display the result
cv2_imshow(adaptive_thresh)  # Use cv2.imshow() instead if running locally
cv2.waitKey(0)
cv2.destroyAllWindows()
```