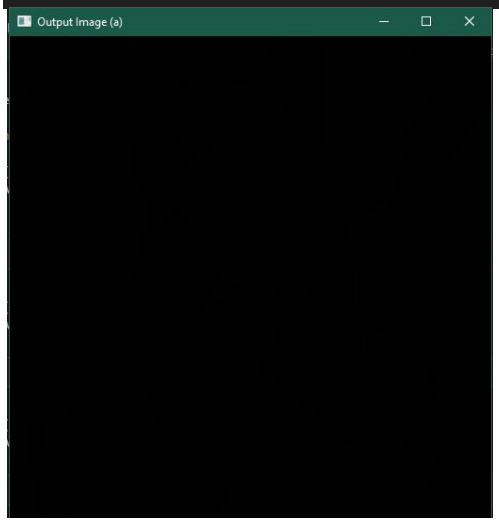
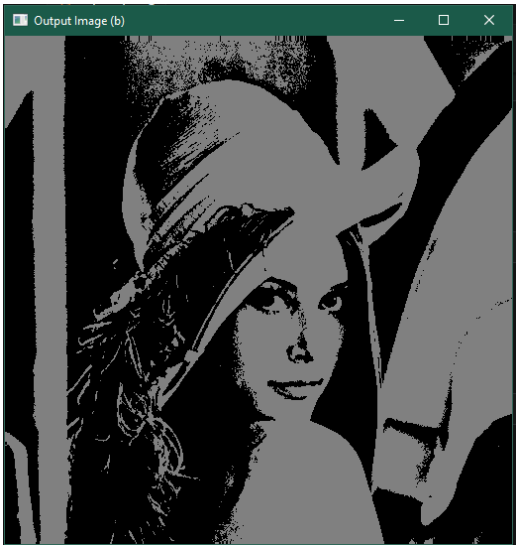
```python
import cv2
import numpy as np
import matplotlib.pyplot as plt
# Load the color image
color_image = cv2.imread("lena_color.tiff")
gray_image = cv2.cvtColor(color_image, cv2.COLOR_BGR2GRAY)
```

```python
def store_bit(image, from_bit, to_bit):
    # Extract the specified bit from the image
    bit_data = (image >> from_bit) & 1

    # Shift the bit data to the target bit position
    stored_image = bit_data << to_bit

    return stored_image.astype(np.uint8)
# Display the original and output images
cv2.imshow('Original Image', gray_image)
cv2.waitKey(0)
cv2.destroyAllWindows()
```

```python
# Task (a): Store the 8th bit in the 1st bit
output_image_a = store_bit(gray_image, 7, 0)
cv2.imshow('Output Image (a)', output_image_a)
cv2.waitKey(0)
cv2.destroyAllWindows()
```



```python
# Task (b): Store the 8th bit in the 8th bit
output_image_b = store_bit(gray_image, 7, 7)
cv2.imshow('Output Image (b)', output_image_b)
cv2.waitKey(0)
cv2.destroyAllWindows()
```




```python
# Task (c): Store the 1st bit in the 8th bit
output_image_c = store_bit(gray_image, 0, 7)
cv2.imshow('Output Image (c)', output_image_c)
cv2.waitKey(0)
cv2.destroyAllWindows()
```

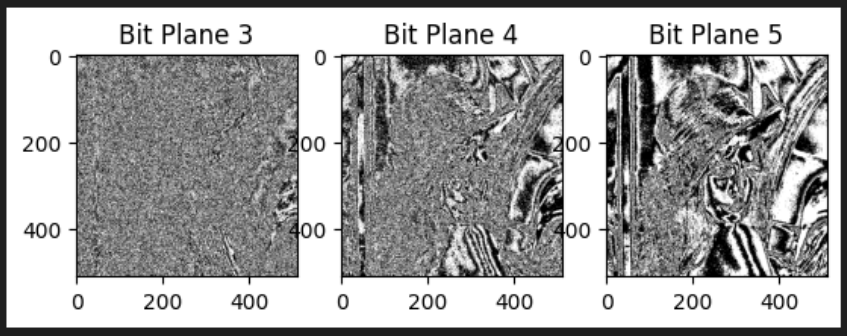
```python
def get_bit_plane(image, bit):
    # Extract the specified bit plane from the image
    bit_plane = (image >> bit) & 1

    # Scale the bit plane to the range [0, 255]
    bit_plane *= 255

    return bit_plane.astype(np.uint8)
```

Part a:

```python
# Task (a): Show 3rd, 4th, and 5th bit planes
bit_plane_3 = get_bit_plane(gray_image, 2)
bit_plane_4 = get_bit_plane(gray_image, 3)
bit_plane_5 = get_bit_plane(gray_image, 4)
plt.subplot(1, 3, 1), plt.imshow(bit_plane_3, cmap='gray'), plt.title('Bit Plane 3')
plt.subplot(1, 3, 2), plt.imshow(bit_plane_4, cmap='gray'), plt.title('Bit Plane 4')
plt.subplot(1, 3, 3), plt.imshow(bit_plane_5, cmap='gray'), plt.title('Bit Plane 5')
```

[63] ✓ 4.1s

```
(<AxesSubplot:title={'center':'Bit Plane 5'}>,
 <matplotlib.image.AxesImage at 0x1be52461588>,
 Text(0.5, 1.0, 'Bit Plane 5'))
```

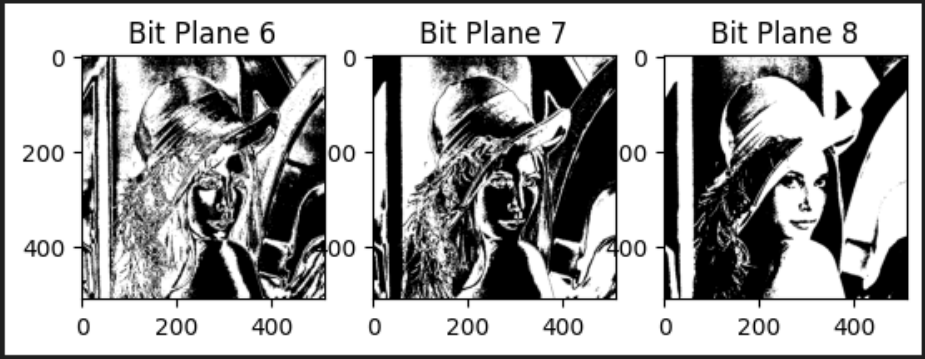


Part b:

```
# Task (b): Show 6th, 7th, and 8th bit planes
bit_plane_6 = get_bit_plane(gray_image, 5)
bit_plane_7 = get_bit_plane(gray_image, 6)
bit_plane_8 = get_bit_plane(gray_image, 7)
plt.subplot(1, 3, 1), plt.imshow(bit_plane_6, cmap='gray'), plt.title('Bit Plane 6')
plt.subplot(1, 3, 2), plt.imshow(bit_plane_7, cmap='gray'), plt.title('Bit Plane 7')
plt.subplot(1, 3, 3), plt.imshow(bit_plane_8, cmap='gray'), plt.title('Bit Plane 8')
```

[64] ✓ 5.4s

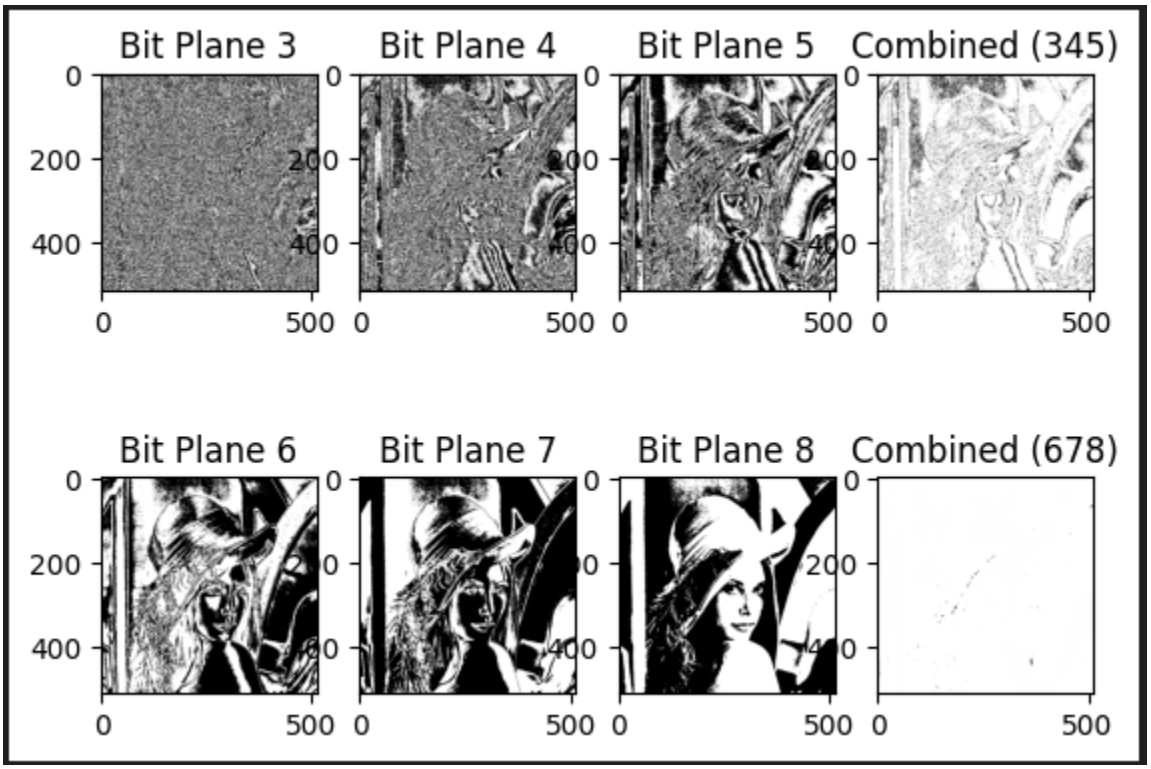
```
(<AxesSubplot:title={'center':'Bit Plane 8'}>,
 <matplotlib.image.AxesImage at 0x1be4ffa0748>,
 Text(0.5, 1.0, 'Bit Plane 8'))
```



Part c:

```
# Task (c): Show the output images in a single figure
combined_345 = bit_plane_3 + bit_plane_4 + bit_plane_5
combined_678 = bit_plane_6 + bit_plane_7 + bit_plane_8

plt.subplot(2, 4, 1), plt.imshow(bit_plane_3, cmap='gray'), plt.title('Bit Plane 3')
plt.subplot(2, 4, 2), plt.imshow(bit_plane_4, cmap='gray'), plt.title('Bit Plane 4')
plt.subplot(2, 4, 3), plt.imshow(bit_plane_5, cmap='gray'), plt.title('Bit Plane 5')
plt.subplot(2, 4, 4), plt.imshow(combined_345, cmap='gray'), plt.title('Combined (345)')
```

```
plt.subplot(2, 4, 5), plt.imshow(bit_plane_6, cmap='gray'), plt.title('Bit Plane
6')
plt.subplot(2, 4, 6), plt.imshow(bit_plane_7, cmap='gray'), plt.title('Bit Plane
7')
plt.subplot(2, 4, 7), plt.imshow(bit_plane_8, cmap='gray'), plt.title('Bit Plane
8')
plt.subplot(2, 4, 8), plt.imshow(combined_678, cmap='gray'), plt.title('Combined
(678)')

plt.show()
```



Part d:

```python
# Task (d): Calculate memory requirements
original_memory = gray_image.nbytes / (1024 * 1024)  # in megabytes
a_memory = combined_345.nbytes / (1024 * 1024)  # in megabytes
b_memory = combined_678.nbytes / (1024 * 1024)  # in megabytes

print(f"Original Image Memory: {original_memory:.2f} MB")
print(f"Memory for Combined (345): {a_memory:.2f} MB")
print(f"Memory for Combined (678): {b_memory:.2f} MB")
```

✓ 0.0s

```
Original Image Memory: 0.25 MB
Memory for Combined (345): 0.25 MB
Memory for Combined (678): 0.25 MB
```