Import Modules

In [1]:
```
import cv2

import numpy as np
import matplotlib.pyplot as plt

from skimage import exposure
```

Initialize and load original image

In [2]:
```
raw_image = cv2.imread('../images/lenna.png')
# raw_image = cv2.imread('../images/cameraman.png')
# raw_image = cv2.imread('../images/mdn_castle.png')
# raw_image = cv2.imread('../images/bowl_fruit.png')
# raw_image = cv2.imread('../images/peppers.png')
# raw_image = cv2.imread('../images/map_of_spain.png')

img_rgb = cv2.cvtColor(raw_image, cv2.COLOR_BGR2RGB)
```

Display original image and description

In [3]:
```
plt.imshow(img_rgb)
plt.title('Original Image')
plt.show()

height, width, color_channel = img_rgb.shape

print(f'Height        : {height} pixels')
print(f'Width         : {width} pixels')
print(f'Color channel : {color_channel} (RGB)')
```


```
Height        : 512 pixels
Width         : 512 pixels
Color channel : 3 (RGB)
```

Display original image histogram

In [4]:
```
color = ('r', 'g', 'b')

for i, col in enumerate(color):
    histr = cv2.calcHist([img_rgb], [i], None, [256], [0, 256])

    plt.plot(histr, color = col)
    plt.xlim([0, 256])

plt.title('Original Image Histogram')
plt.xlabel('Intensity Value')
plt.ylabel('Number of Intensity Value')
plt.show()
```

Show list value each pixel

In [5]:
```
img_rgb
```

Out[5]:
```
array([[[226, 137, 125],
        [226, 137, 125],
        [223, 137, 133],
        ...,
        [230, 148, 122],
        [221, 130, 110],
        [200,  99,  90]],

       [[226, 137, 125],
        [226, 137, 125],
        [223, 137, 133],
        ...,
        [230, 148, 122],
        [221, 130, 110],
        [200,  99,  90]],

       [[226, 137, 125],
        [226, 137, 125],
        [223, 137, 133],
        ...,
        [230, 148, 122],
        [221, 130, 110],
        [200,  99,  90]],

       ...,

       [[ 84,  18,  60],
        [ 84,  18,  60],
        [ 92,  27,  58],
        ...,
        [173,  73,  84],
        [172,  68,  76],
        [171,  62,  79]],

       [[ 82,  22,  57],
        [ 82,  22,  57],
        [ 96,  32,  62],
        ...,
        [179,  70,  79],
        [181,  71,  81],
        [185,  74,  81]],

       [[ 82,  22,  57],
        [ 82,  22,  57],
        [ 96,  32,  62],
        ...,
        [179,  70,  79],
        [181,  71,  81],
        [185,  74,  81]]], dtype=uint8)
```

Logarithmic transformation

- Formula, sebagai berikut **s = c * log(1 + r)**
- **c** adalah kontanta yang didapatkan melalui formula, berikut **255 / log(1 + m)**
- **m** adalah nilai piksel tertinggi dari gambar yang digunakan sebagai input
- Nilai piksel yang berada pada rentang atu-atu yang jumlah kecil akan ditingkatkan nilainya, sehingga menjadi lebih terlihat

- Calculate constant

In [6]:
```
c = 255 / (np.log(1 + np.max(img_rgb)))

print(f'Constant value             : {c}')
print(f'Max value pixel from image : {np.max(img_rgb)}')
```

```
Constant value             : 45.98590442833571
Max value pixel from image : 255
```

- Calculate logarithmic transformation

In [7]:
```
log_transformed = c * np.log(255 + img_rgb)
```

- Specify the data type

In [8]:
```
log_transformed = np.array(log_transformed, dtype=np.uint8)
```

- Show value of log_transformed variable

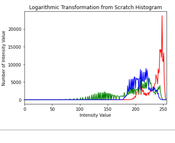
In [9]:
```
log_transformed
```

Out[9]:
```
array([[[249, 226, 221],
        [249, 226, 221],
        [248, 226, 224],
        ...,
        [250, 229, 220],
        [248, 223, 215],
        [243, 211, 206]],

       [[249, 226, 221],
        [249, 226, 221],
        [248, 226, 224],
        ...,
        [250, 229, 220],
        [248, 223, 215],
        [243, 211, 206]],

       [[249, 226, 221],
        [249, 226, 221],
        [248, 226, 224],
        ...,
        [250, 229, 220],
        [248, 223, 215],
        [243, 211, 206]],

       ...,

       [[203, 130, 187],
        [203, 130, 187],
        [207, 149, 186],
        ...,
        [236, 196, 203],
        [236, 193, 198],
        [237, 189, 200]],

       [[202, 140, 185],
        [202, 140, 185],
        [209, 158, 189],
        ...,
        [238, 194, 200],
        [238, 195, 201],
        [239, 197, 201]],

       [[202, 140, 185],
        [202, 140, 185],
        [209, 158, 189],
        ...,
        [238, 194, 200],
        [238, 195, 201],
        [239, 197, 201]]], dtype=uint8)
```

- Display image with logarithmic transformation

In [10]:
```
plt.imshow(log_transformed)
plt.title('Logarithmic Transformation from Scratch')
plt.show()
```

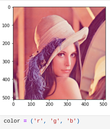
In [11]:
```
color = ('r', 'g', 'b')

for i, col in enumerate(color):
    histr = cv2.calcHist([log_transformed], [i], None, [256], [0, 256])

    plt.plot(histr, color = col)
    plt.xlim([0, 256])

plt.title('Logarithmic Transformation from Scratch Histogram')
plt.xlabel('Intensity Value')
plt.ylabel('Number of Intensity Value')
plt.show()
```



With image processing module

- Logarithmic transformation image with scikit-image module

In [12]:
```
logarithmic_corrected = exposure.adjust_log(image=img_rgb, gain=1)
plt.imshow(logarithmic_corrected)
plt.show()
```



In [13]:
```
color = ('r', 'g', 'b')

for i, col in enumerate(color):
    histr = cv2.calcHist([logarithmic_corrected], [i], None, [256], [0, 256])

    plt.plot(histr, color = col)
    plt.xlim([0, 256])

plt.title('Logarithmic Transformation with Scikit-Image Module')
plt.xlabel('Intensity Value')
plt.ylabel('Number of Intensity Value')
plt.show()
```