Homework 1 Report

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Programming Environment:
Python 3.11.3
numpy 1.23.5
Pillow 9.5.0

Execution Command:
python3 main.py

Program Description:
Reading the input image "lena.png" by "PIL" API, and create multiple empty numpy array for the gray value of image.

```python
# Load image
image = Image.open('lena.png')
pixels = np.array(image)

# Prepare empty arrays for the grayscale images
R_image = np.empty(pixels.shape[:2], dtype=np.uint8)
G_image = np.empty(pixels.shape[:2], dtype=np.uint8)
B_image = np.empty(pixels.shape[:2], dtype=np.uint8)
Y_image = np.empty(pixels.shape[:2], dtype=np.uint8)
U_image = np.empty(pixels.shape[:2], dtype=np.uint8)
V_image = np.empty(pixels.shape[:2], dtype=np.uint8)
Cb_image = np.empty(pixels.shape[:2], dtype=np.uint8)
Cr_image = np.empty(pixels.shape[:2], dtype=np.uint8)
```

Tracing all pixels in image, and calculating every required values (Y, U, V, Cb, Cr).
Putting every calculated value into the empty numpy array which created before.
Showing the progress by print the current row number.

```python
# Calculate R, G, B, Y, U, V, Cb, Cr for each pixel
for i in range(pixels.shape[0]):
    for j in range(pixels.shape[1]):
        R, G, B = pixels[i, j][:3]

        # Y, U, V calculations
        Y = int(0.299 * R + 0.587 * G + 0.114 * B)
        U = int(-0.169 * R - 0.331 * G + 0.5 * B + 128)
        V = int(0.5 * R - 0.419 * G - 0.081 * B + 128)

        # YCbCr calculations
        Cb = int(128 - 0.168736 * R - 0.331264 * G + 0.5 * B)
        Cr = int(128 + 0.5 * R - 0.418688 * G - 0.081312 * B)

        # Store values
        R_image[i, j] = R
        G_image[i, j] = G
        B_image[i, j] = B
        Y_image[i, j] = Y
        U_image[i, j] = U
        V_image[i, j] = V
        Cb_image[i, j] = Cb
        Cr_image[i, j] = Cr

    # Show progress
    print("Completing Row",i,"/",pixels.shape[0])
```

Saving image by "PIL" API.

```python
# Save images
Image.fromarray(R_image).save('output/R_image.png')
Image.fromarray(G_image).save('output/G_image.png')
Image.fromarray(B_image).save('output/B_image.png')
Image.fromarray(Y_image).save('output/Y_image.png')
Image.fromarray(U_image).save('output/U_image.png')
Image.fromarray(V_image).save('output/V_image.png')
Image.fromarray(Cb_image).save('output/Cb_image.png')
Image.fromarray(Cr_image).save('output/Cr_image.png')
```
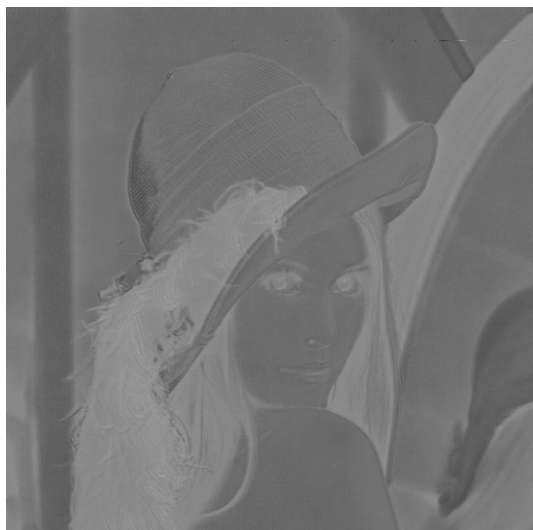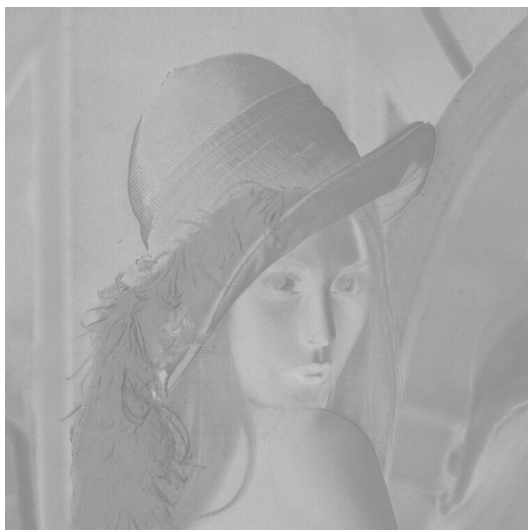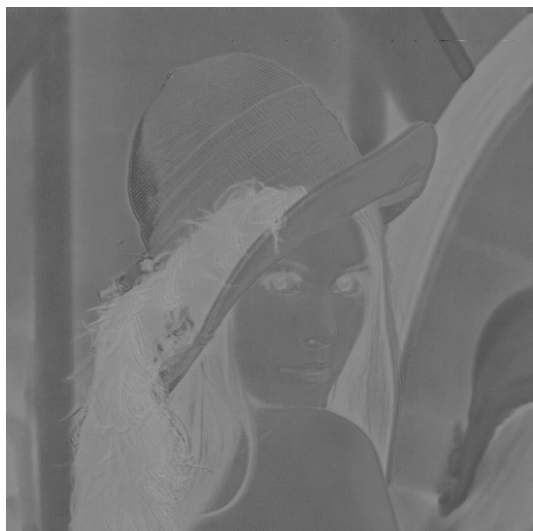
Output Image:

R:

G:

B:

Y:

U:

V:

Cb:

Cr: