CS 180 PORTFOLIO ↪ Check out my PHOTOGRAPHY

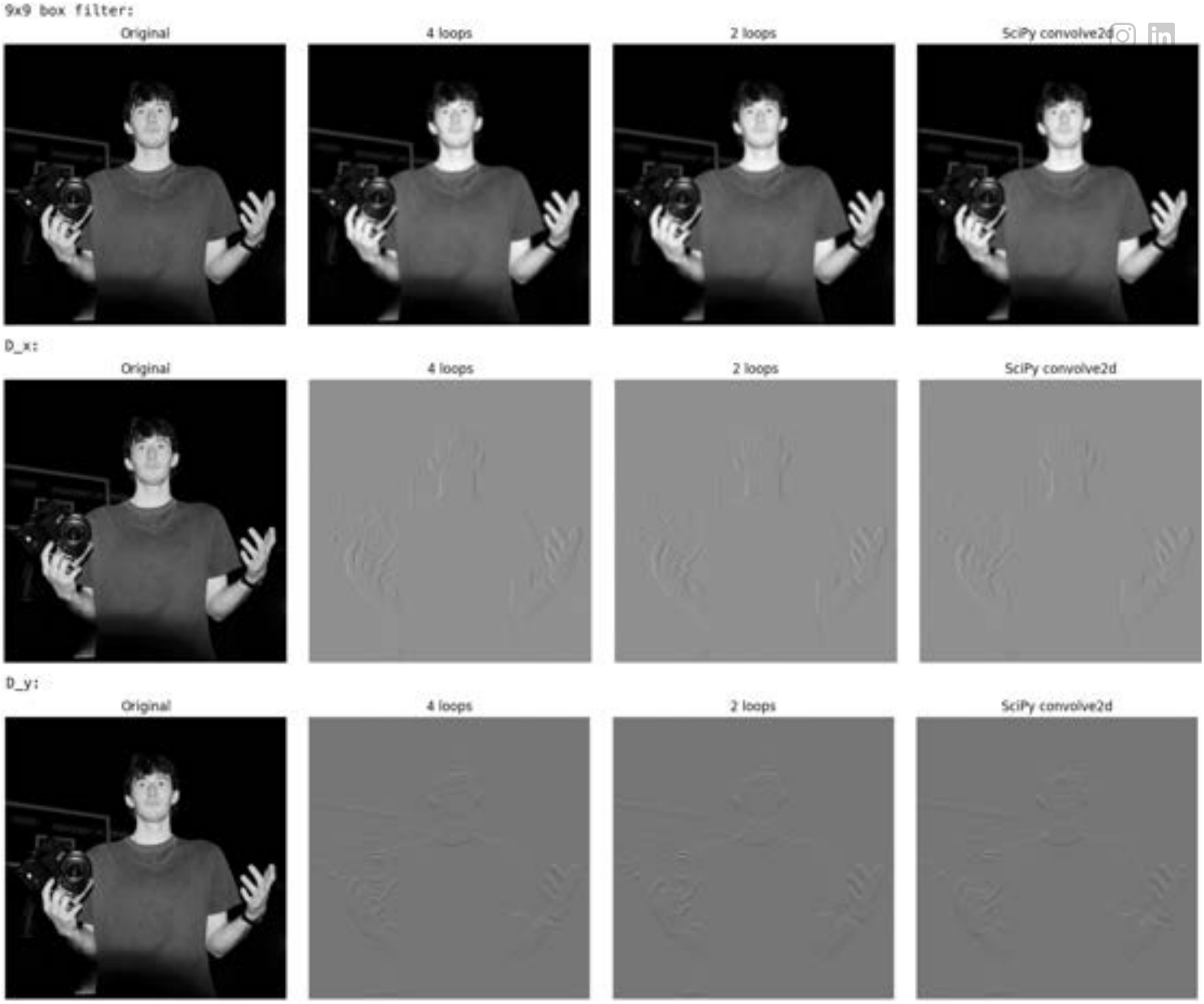
PROJECT TWO

Part 1.1

Below is my implementation of convolution using `numpy`:

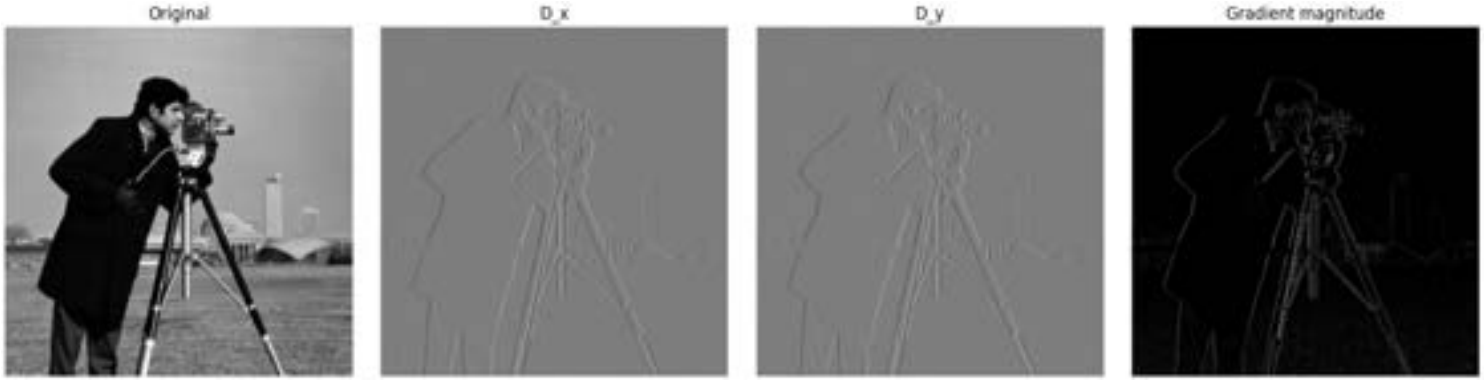
```python
def c4loops(image, kernel):
    img = np.asarray(image, dtype=np.float64)
    ker = np.asarray(kernel, dtype=np.float64)
    ih, iw = img.shape
    kh, kw = ker.shape

    ker_flipped = np.flip(ker)

    img_padded = pad_zeros(img, kh, kw)

    out = np.zeros_like(img)
    for i in range(ih):
        for j in range(iw):
            val = 0.0
            for u in range(kh):
                for v in range(kw):
                    val += img_padded[i + u, j + v] * ker_flipped[u, v]
            out[i, j] = val
    return out

def c2loops(image, kernel):
    img = np.asarray(image, dtype=np.float64)
    ker = np.asarray(kernel, dtype=np.float64)
    ih, iw = img.shape
    kh, kw = ker.shape

    ker_flipped = np.flip(ker)

    img_padded = pad_zeros(img, kh, kw)

    out = np.zeros_like(img)
    for i in range(ih):
        for j in range(iw):
            out[i, j] = np.sum(img_padded[i:i+kh, j:j+kw] * ker_flipped)
    return out
```

Below you can visually see a comparison between `numpy` with 4 for loops, `numpy` with 2 for loops, and the `scipy.signal.convolve2d` function:



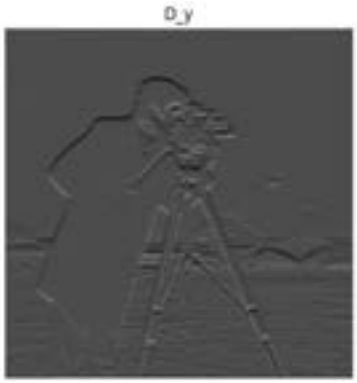
The `numpy` 4 for loop runtime was longer than the `numpy` 2 loop and `scipy` functions. My `numpy` implementations use zero-padding whereas the `scipy.signal.convolve2d` function has different options such as fill, wrap, or symmetrical.

Part 1.2



Edge image with threshold 0.35:

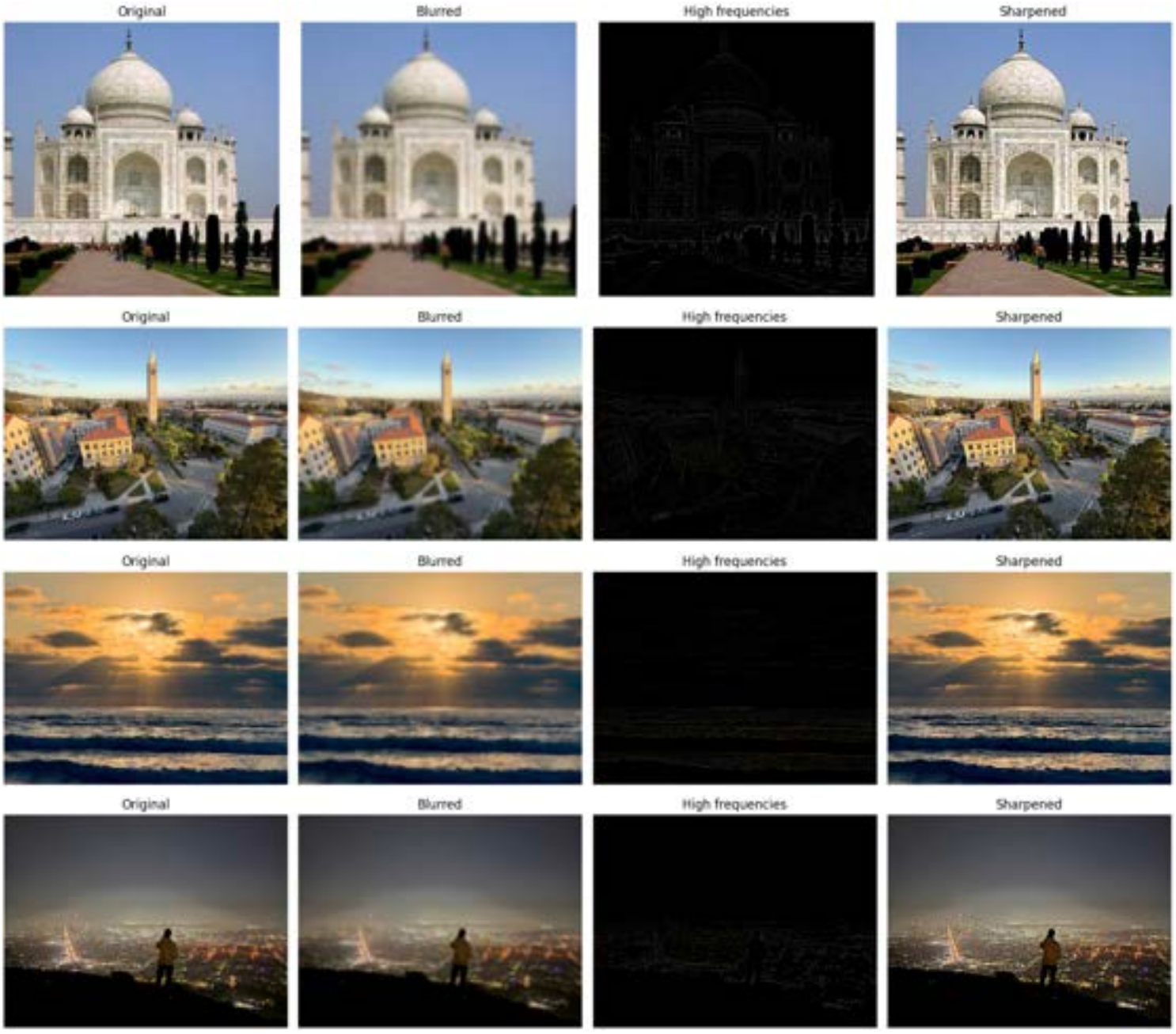
Part 1.3



Edge image with threshold 0.15:

Part 1.3

An unsharp mask boosts the image's high frequencies by subtracting a blurred version of the image from the original to isolate the high frequencies. To sharpen, we just add the original image and the high frequency image together.



Below see the results of different sharpening amounts (multiplying the high frequncies by a scalar):

amount=0.50

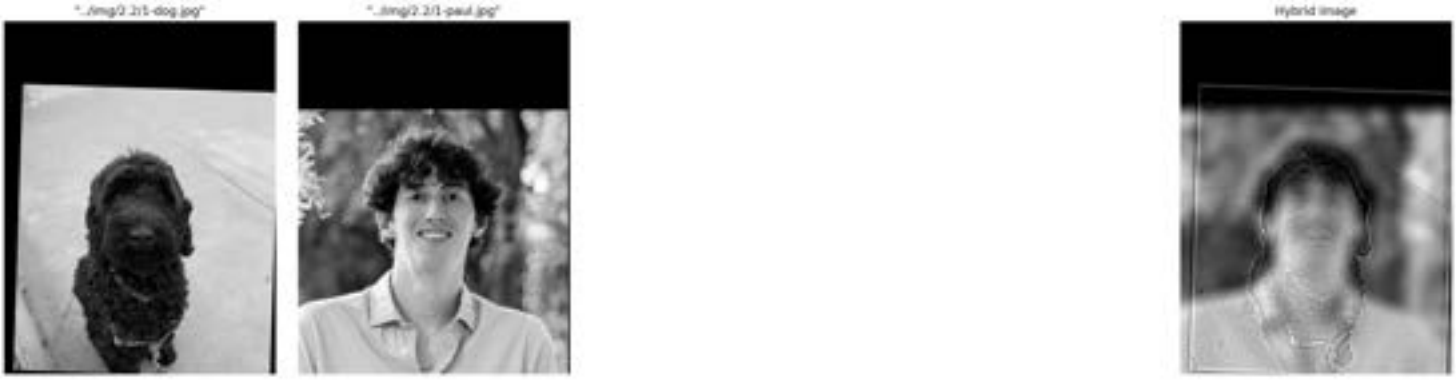
amount=1

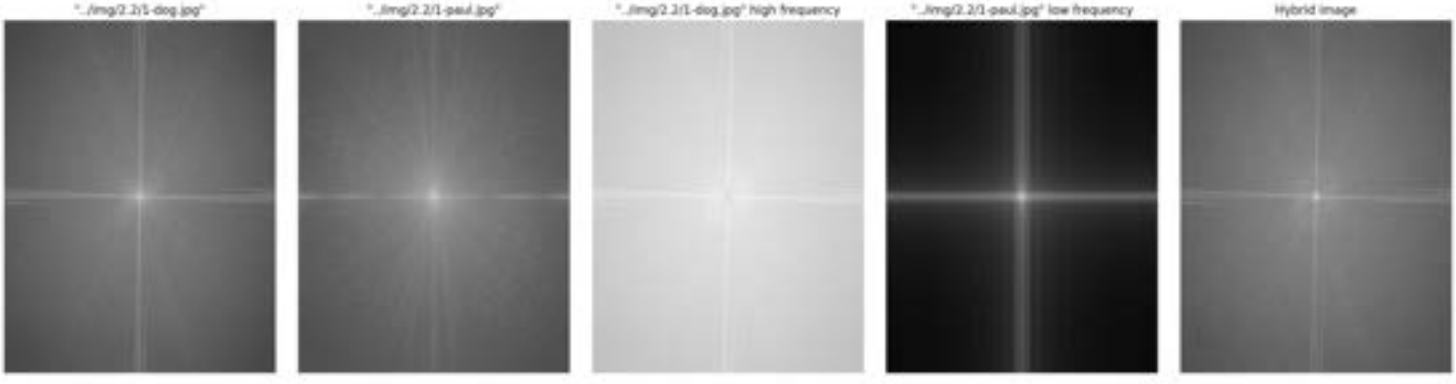
amount=2

amount=5

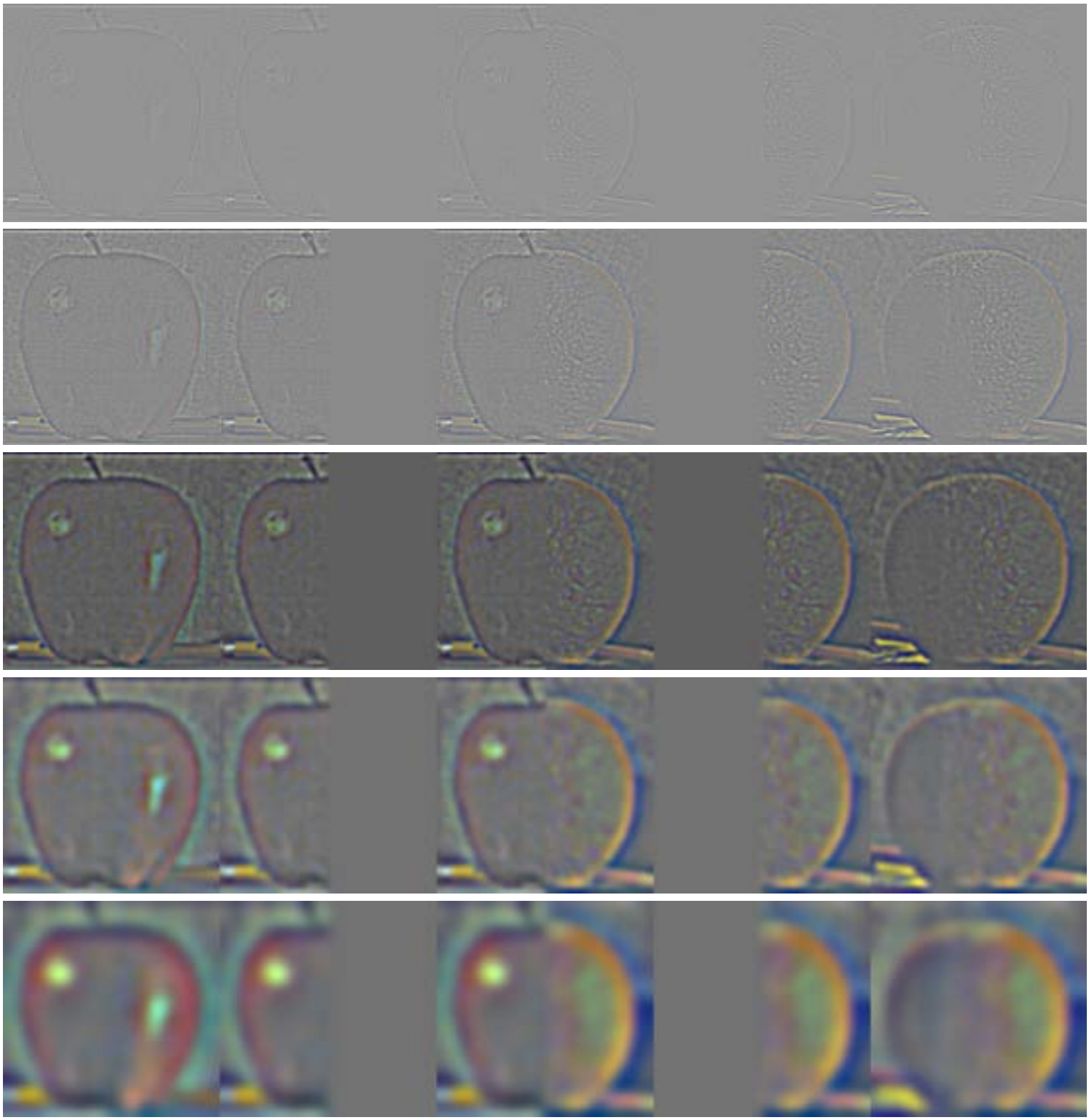
Part 2.1

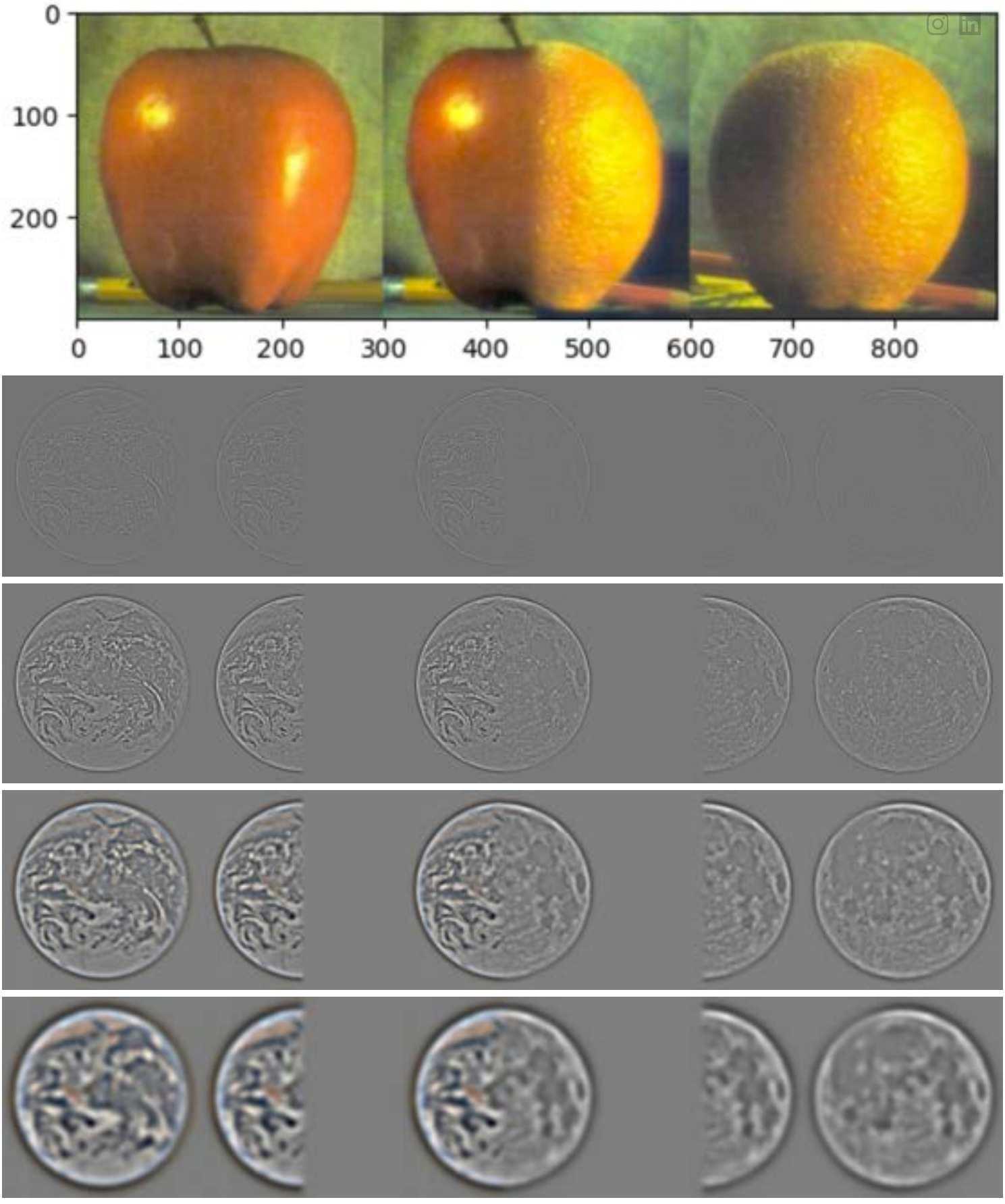

"../img/2.2/nutmeg.jpg"
"../img/2.2/derek.jpg"
Hybrid image

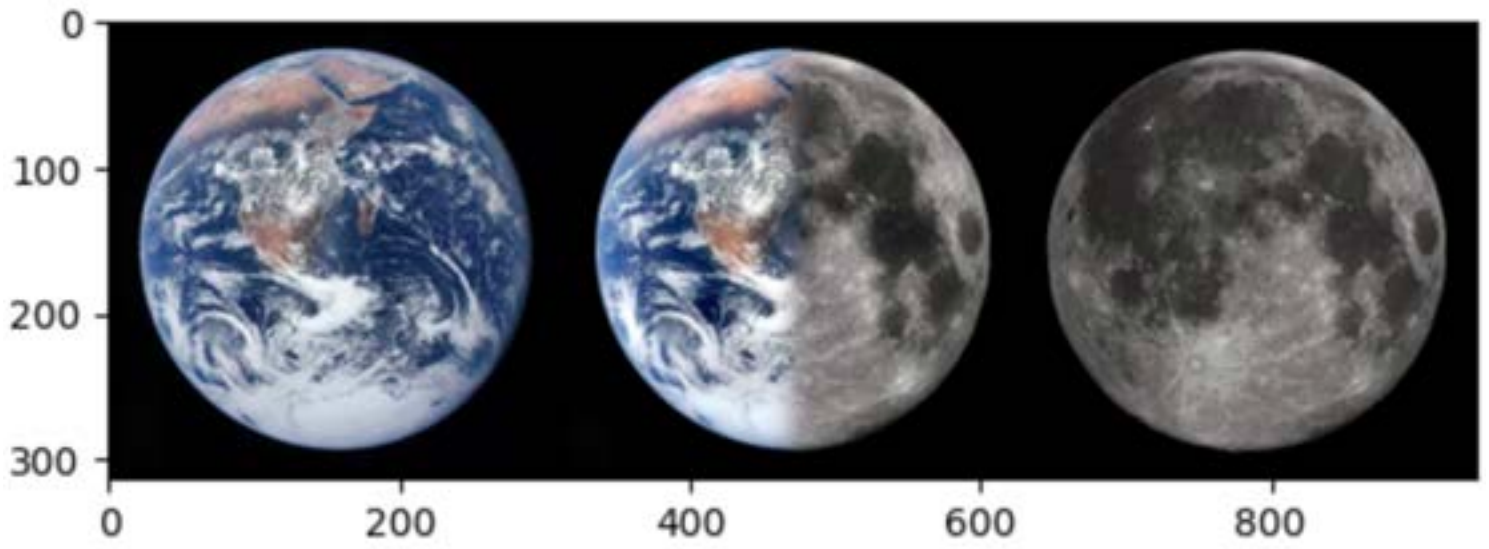

"../img/2.2/1-dog.jpg"
"../img/2.2/1-paul.jpg"
Hybrid image


"../img/2.2/1-dog.jpg"
"../img/2.2/1-paul.jpg"
"../img/2.2/1-dog.jpg" high frequency
"../img/2.2/1-paul.jpg" low frequency
Hybrid image

Parts 2.3 and 2.4




0
100
200
0
100
200
300
400
500
600
700
800


0
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800