Prac 03. Part 1

For this homework you are going to implement the **unsharp masking** filter (USM). It is a technique to improve the sharpness of an image by combining the image with its blurred (unsharp) version. See the Wikipedia page for more details.

Unsharp Masking (USP)

The USM technique consists of the following steps:

- Load the image you will be working with.
- Create a blurred (unsharp) version of the original image.
- Add the unsharp image (with a certain **weight**) to the original.

To sum it up, the USM performs the following operation:

$$sharpened = original + (original - unsharp) \times amount$$

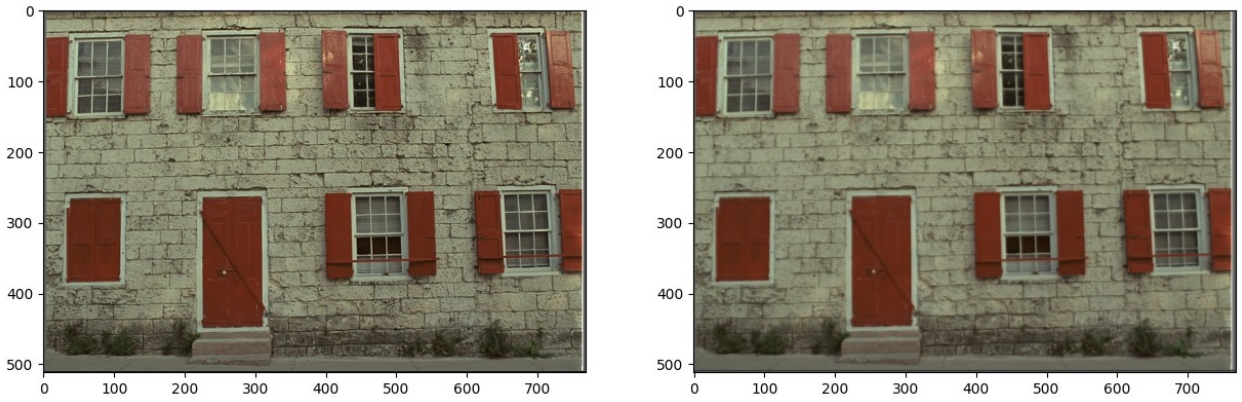
Even though we provide you an image to work with, you are welcome to use your own images :-)

```
import cv2
import numpy as np
from matplotlib import pyplot as plt
plt.rcParams['figure.figsize'] = [15, 10]

img = cv2.imread('kodim01.png')
img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
plt.imshow(img)
```

```
<matplotlib.image.AxesImage at 0x12c498aa270>
```

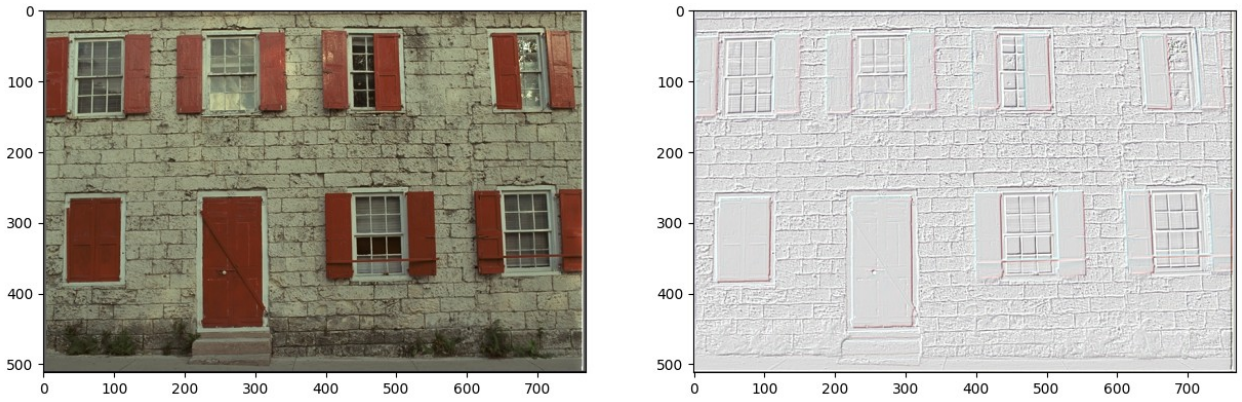

```
# Create a blurred (unsharp) version of the original image (you can
use Gaussian blurring)
kernel_size = 5
kernel = np.ones((kernel_size, kernel_size))
for i in range(kernel_size):
    for j in range(kernel_size):
        kernel[i][j] = 2**(i+j)
kernel = kernel/np.sum(kernel)
unsharp = cv2.filter2D(src = img, ddepth = -1, kernel = kernel)
plt.subplot(121), plt.imshow(img)
plt.subplot(122), plt.imshow(unsharp)
```

```
(<Axes: >, <matplotlib.image.AxesImage at 0x12c50158e60>)
```



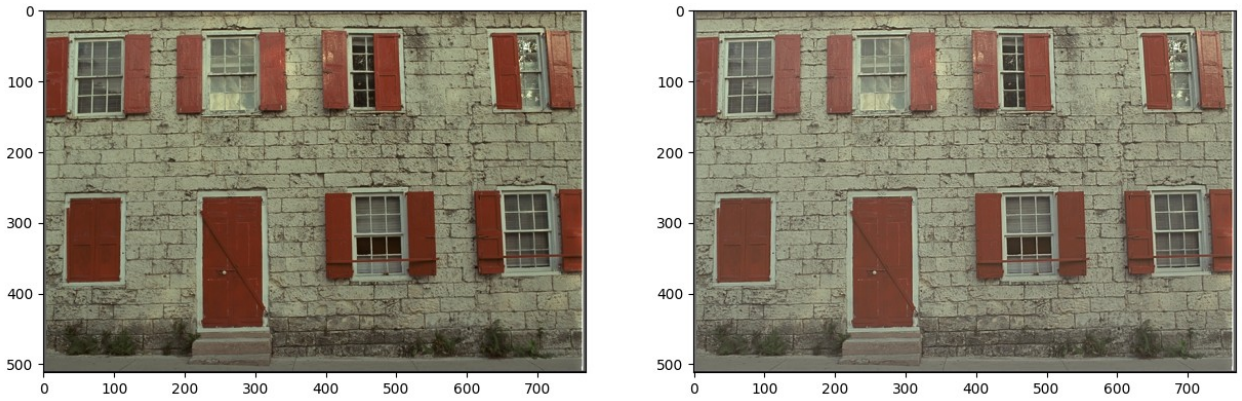
```
# Create the difference image (original - unsharp)
# Note: Remember that you are working with uint8 data types. Any
addition or substractions
# might result in overflow or underflow, respectively. You can prevent
this by casting the images to float.
diff = img.astype(np.float32) - unsharp.astype(np.float32)

diff_show = (diff-np.min(diff))*255/np.max(diff)
diff_show = np.clip(diff_show, 0, 255).astype(np.uint8)
plt.subplot(121), plt.imshow(img)
plt.subplot(122), plt.imshow(diff_show)
```

```
(<Axes: >, <matplotlib.image.AxesImage at 0x12c50209310>)
```



```
# Apply USM to get the resulting image using `sharpened = original +
(original - unsharp) × amount`
# Note: Again, take care of underflows/overflows if necessary.
amount = 0.2
sharpened = img.astype(np.float32) + (img.astype(np.float32) -
unsharp) * amount
sharpened = (sharpened-np.min(sharpened))*255/np.max(sharpened)
sharpened = np.clip(sharpened, 0, 255).astype(np.uint8)
plt.subplot(121), plt.imshow(img)
plt.subplot(122), plt.imshow(sharpened)
```

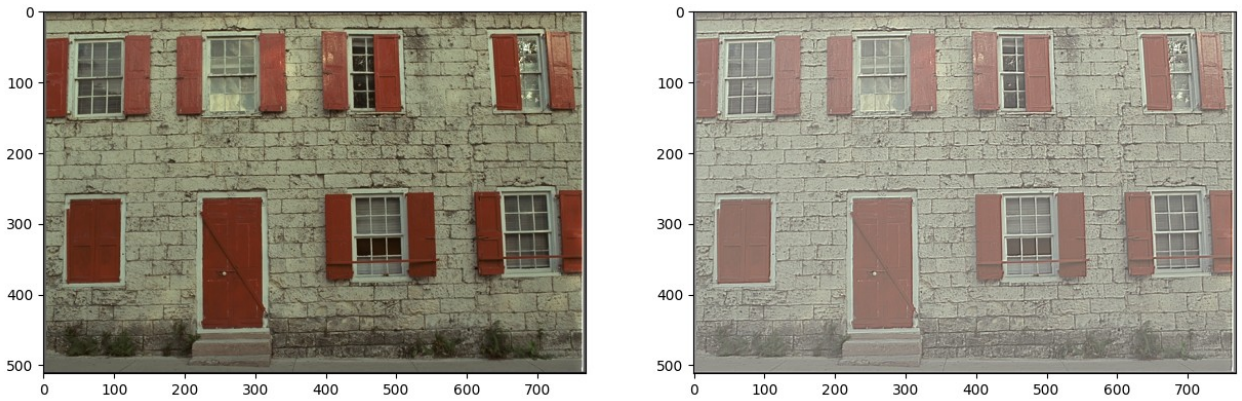
```
(<Axes: >, <matplotlib.image.AxesImage at 0x12c503152e0>)
```



Questions

- What is a good (reasonable) value for the `amount` parameter? -- 0.2 seems fine
- What happens if it is too small? -- nothing happens
- What happens if it is too large? -- whitening and oversharpening

```
# Too large amount (whitening)
amount = 0.9
sharpened = img.astype(np.float32) + (img.astype(np.float32) -
unsharp) * amount
sharpened = (sharpened-np.min(sharpened))*255/np.max(sharpened)
sharpened = np.clip(sharpened, 0, 255).astype(np.uint8)
plt.subplot(121), plt.imshow(img)
plt.subplot(122), plt.imshow(sharpened)

(<Axes: >, <matplotlib.image.AxesImage at 0x12c570d0500>)
```



```
# Too small amount (nothing happens)
amount = 0.05
sharpened = img.astype(np.float32) + (img.astype(np.float32) -
unsharp) * amount
sharpened = (sharpened-np.min(sharpened))*255/np.max(sharpened)
```

```
sharpened = np.clip(sharpened, 0, 255).astype(np.uint8)
plt.subplot(121), plt.imshow(img)
plt.subplot(122), plt.imshow(sharpened)
```

```
(<Axes: >, <matplotlib.image.AxesImage at 0x12c5719fe90>)
```