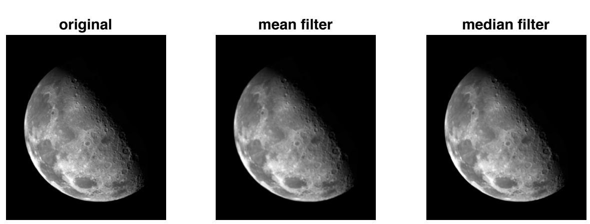
Carleton University
School of Information Technology
OSS 4006 – Image Processing
Fall 2020
Instructor: Dr. Marzieh Amini
Assignment 2

You must submit the assignment to cuLearn by Nov. 2nd, 2020 at 12 pm.

Q1: Spatial Filtering

Write program to perform spatial filtering of an image. You can fix the size of the spatial mask at 3 x 3, but the coefficients need to be variables that can be input into your program. This project is generic, in the sense that it will be used in following project to follow.

```
img = imread('Q2.tif');
subplot(1,3,1);
imshow(img);
title('original');

% Mean filter
% value for hsize is [3 3].
h = fspecial('Mean',[3,3]);
img1 = imfilter(img, h);
subplot(1,3,2);
imshow(img1);
title('Mean filter');

% Median filter
% B = medfilt2(A) performs median filtering of the matrix A using the default
% 3-by-3 neighborhood.
img2 = medfilt2(img);
subplot(1,3,3);
imshow(img2);
title('median filter')
```



Q2: Enhancement Using the Laplacian

(a) Use the programs developed in Q1 to implement the Laplacian enhancement technique described in connection with $g(x, y) = f(x, y) + c[\nabla^2 f(x, y)]$ (b) Duplicate the results in Fig. 3.52.

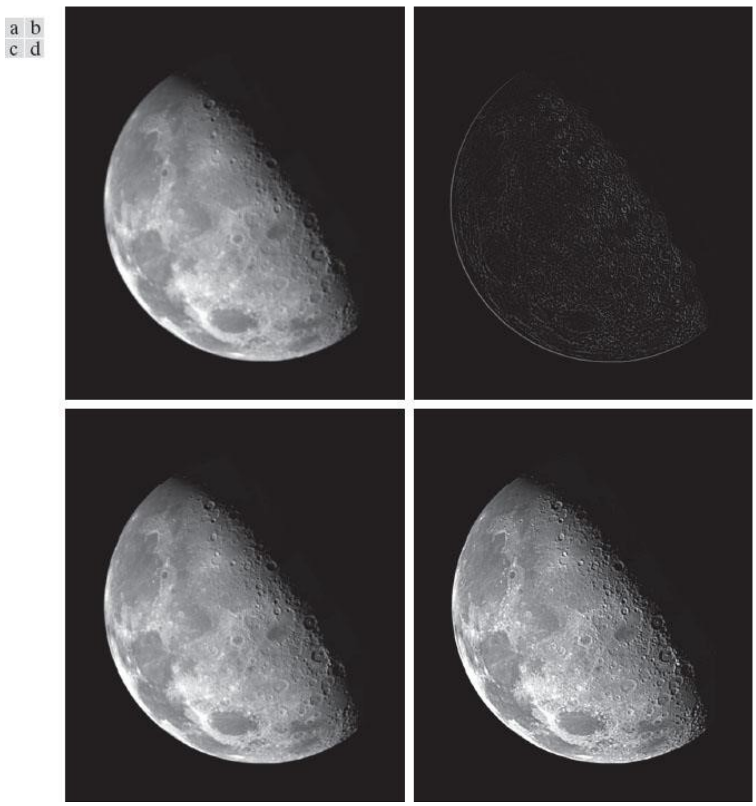


Fig. 3.52. (a) Blurred image of the North Pole of the moon. (b) Laplacian image obtained using the kernel in Fig. 3.51(a). (c) Image sharpened using Eq. (3 -63) with c = −1. (d) Image sharpened using the same procedure, but with the following kernel.

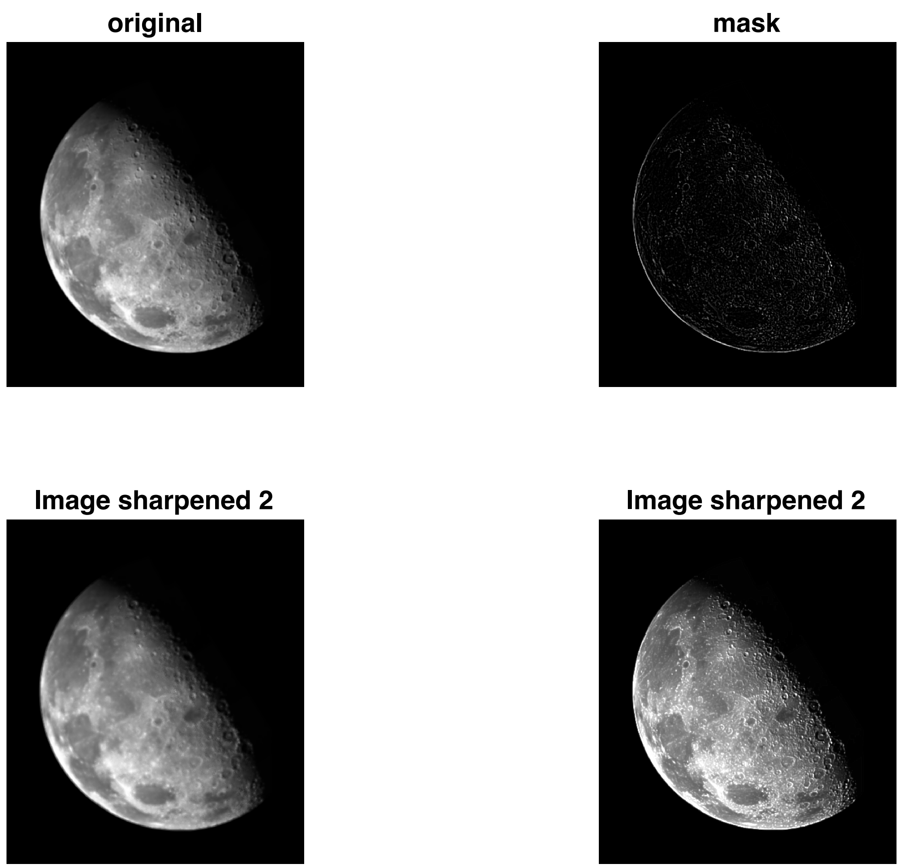
1	1	1
1	−8	1
1	1	1

Code:

```
img = imread('Q2.tif');
subplot(2, 2, 1);
imshow(img);
title('original');

%
h = fspecial('laplacian', 0.2);
img1 = imfilter(img, h);


%
w = [-1, -1, -1; -1, 8, -1; -1, -1, -1];
%'replicate', the image size is extended by copying the value of the outer
boundary
img2 = imfilter(img, w, 'replicate');
subplot(2, 2, 2);
imshow(img2);
title('mask');

%
img3 = img + img1;
```

```
subplot(2, 2, 3);
imshow(img3);
title('Image sharpened 2');

%
img4 = img + img2;
subplot(2, 2, 4);
imshow(img4);
title('Image sharpened 2');
```

Output:



Q3: Histogram Equalization

Assume continuous intensity values, and suppose that the intensity values of an image have the PDF $p_r(r) = \frac{2r}{(L-1)^2}$ where $0 \le r \le L-1$ and $p_r(r) = 0$ for other values of r.

Find the transformation function that will map the input intensity values, r, into values s, of a histogram-equalized image.

Q4: Fourier Transform

Show that $F\{e^{j2\pi t_0 t}\} = \delta(\mu - t_0)$, where t_0 is constant.

Q3. $P_r(r) = \frac{2r}{(L-1)^2}$ $\quad r \in [0, L-1]$

$S = \int_0^r P_r(\omega) d\omega$

$S = \frac{2}{(L-1)} \left[\frac{\omega^2}{2}\right]_0^r \quad \boxed{= \frac{r^2}{(L-1)}}$

Q4. $F\{e^{j2\pi t_0 t}\} = \delta(\mu - t_0)$ where t is constant.

$\int_{-\infty}^{\infty} \delta(\mu - t_0) = x(f)$

$x(f) = \int_{-\infty}^{\infty} x(t) \cdot e^{j2\pi f t} dt$

$x(f) = \int_{-\infty}^{\infty} e^{j2\pi t_0 t} \cdot e^{-j2\pi f t} dt$

$x(f) = \int_{-\infty}^{\infty} e^{j2\pi (t_0 - f) t} dt$

$x(f) = \int_{-\infty}^{\infty} e^{-j2\pi (f - t_0) t} dt = x(f) = \delta(f - t_0)$