ECES 435 - Homework 1 - 01/17/2020

Table of Contents

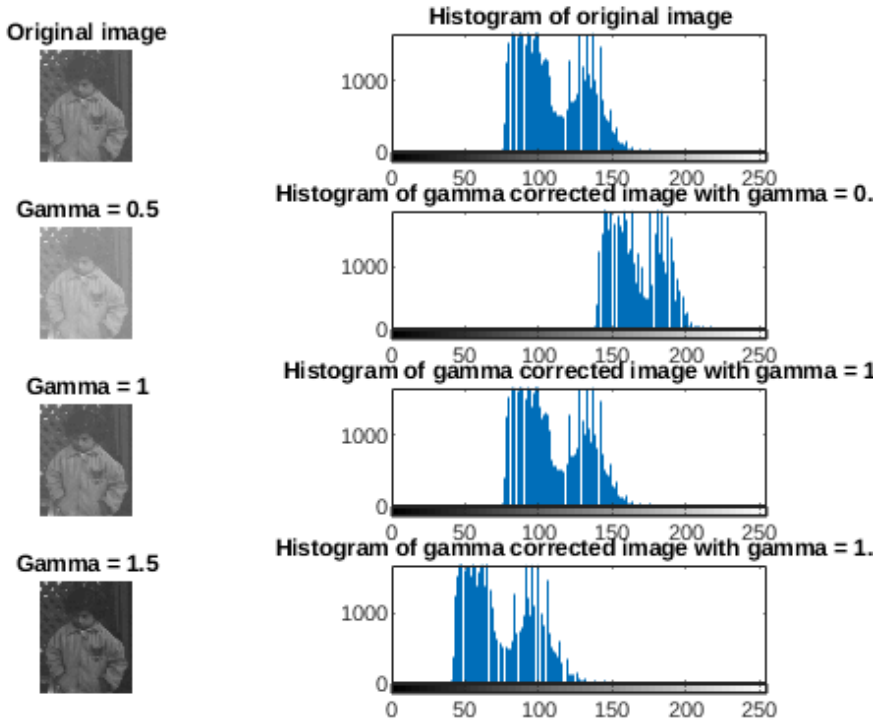
Names: Tai Nguyen, Hieu Mai

```
clear; close all; clc
```

PART 1

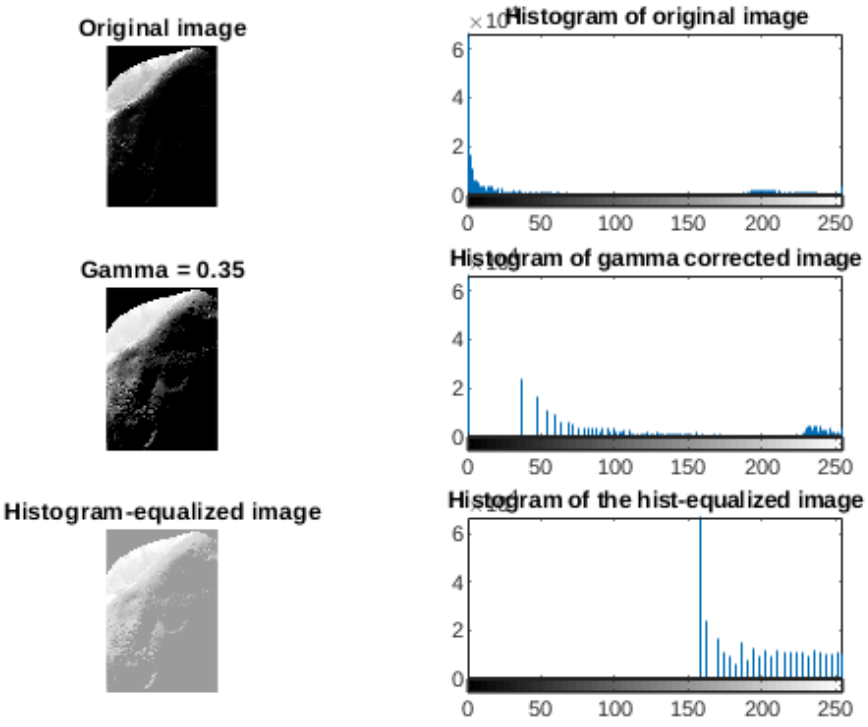
```
input1 = imread("pout.tif");

figure(1)

subplot(4,2,1)
imshow(input1)
title('Original image')

subplot(4,2,2)
imhist(input1)
title('Histogram of original image')

subplot(4,2,3)
output1_1 = gamma_correction(input1, 0.5);
imshow(output1_1)
title('Gamma = 0.5')

subplot(4,2,4)
imhist(output1_1)
title('Histogram of gamma corrected image with gamma = 0.5')

subplot(4,2,5)
output1_2 = gamma_correction(input1, 1);
imshow(output1_2)
title('Gamma = 1')

subplot(4,2,6)
imhist(output1_2)
title('Histogram of gamma corrected image with gamma = 1')

subplot(4,2,7)
output1_3 = gamma_correction(input1, 1.5);
imshow(output1_3)
title('Gamma = 1.5')
```

```
subplot(4,2,8)
imhist(output1_3)
title('Histogram of gamma corrected image with gamma = 1.5')

% Answer to question:
% If gamma = 1, the image stays unchanged.
% If gamma < 1, the image becomes brighter with lower contrast.
% If gamma > 1, the image becomes darker with higher contrast.
```




```
input2 = imread("MoonPhobos.tif");

figure(2)

subplot(3,2,1)
imshow(input2)
title("Original image")

subplot(3,2,2)
imhist(input2)
title("Histogram of original image")

subplot(3,2,3)
output2_1 = gamma_correction(input2, 0.35);
imshow(output2_1)
title("Gamma = 0.35")
```

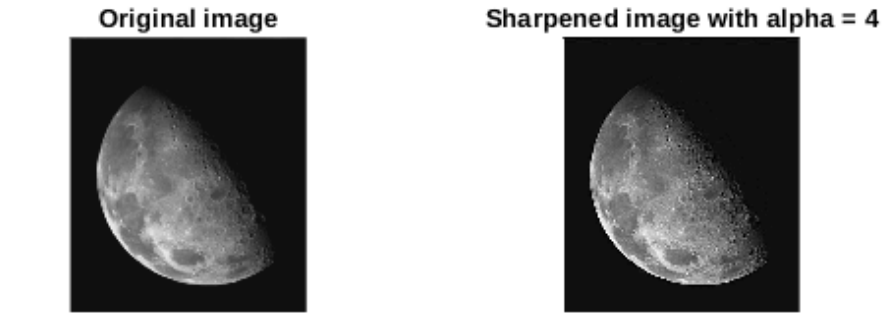
```
subplot(3,2,4)
imhist(output2_1)
title("Histogram of gamma corrected image");

subplot(3,2,5)
output2_2 = histeq(input2);
imshow(output2_2)
title("Histogram-equalized image");

subplot(3,2,6)
imhist(output2_2)
title("Histogram of the hist-equalized image")

% Answer to question:
% The image processed with the gamma correction function has better
% contrast than the one obtained through histogram equalization, but
 the
% latter is brighter.
```

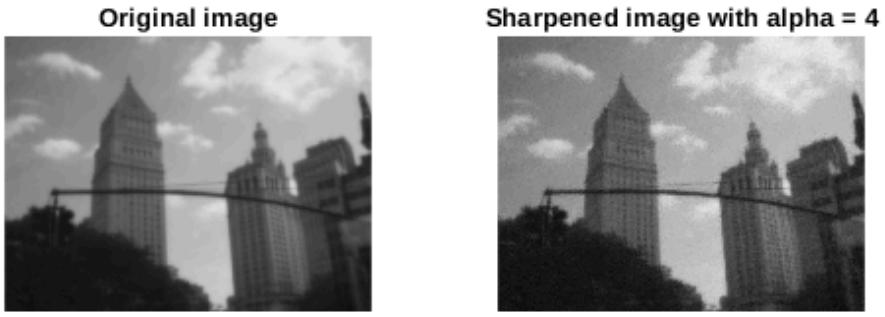


PART 2

```
input3 = imread("moon.tiff");
input4 = imread("outoffocus.tif");

figure(3)

subplot(2,2,1)
```

```
imshow(input3)
title("Original image")

subplot(2,2,2)
output3 = sharpening(input3, 4);
imshow(output3)
title("Sharpened image with alpha = 4")

subplot(2,2,3)
imshow(input4)
title("Original image")

subplot(2,2,4)
output4 = sharpening(input4, 10);
imshow(output4)
title("Sharpened image with alpha = 4")

% Answer to question:
% It is impossible to completely recover the in-focus image with this
% filter, because of the unwanted artifacts created around the regions
 that
% are not edges, causing an unsmooth transitions between some regions.
```

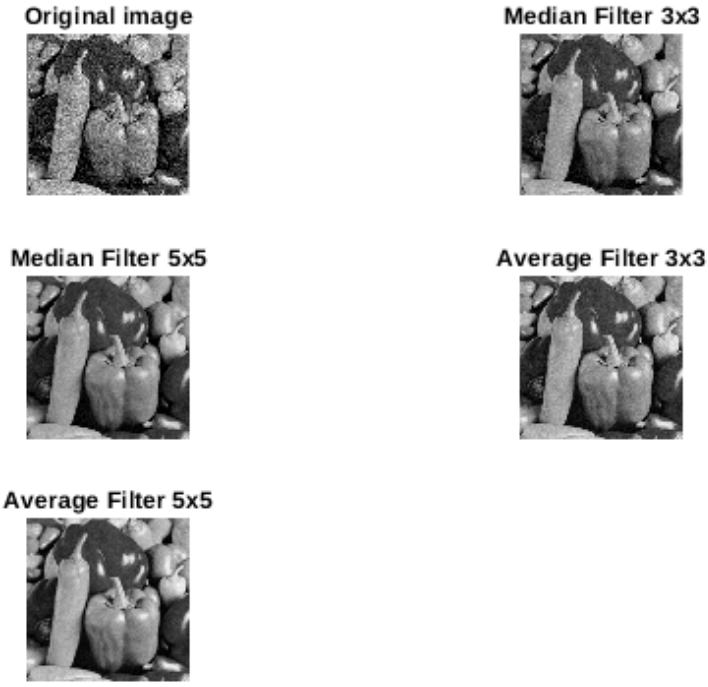




PART 3

```
input5 = imread("peppersNoise1.tiff");
input6 = imread("peppersNoise2.tiff");
```

```
avg_filt3x3 = ones(3,3)/9;
avg_filt5x5 = ones(5,5)/25;

figure(4)

subplot(3,2,1)
imshow(input5)
title("Original image")

subplot(3,2,2)
output5_1 = medfilt2(input5, [3,3]);
imshow(output5_1)
title("Median Filter 3x3")

subplot(3,2,3)
output5_2 = medfilt2(input5, [5,5]);
imshow(output5_2)
title("Median Filter 5x5")

subplot(3,2,4)
output5_3 = conv2(single(input5), avg_filt3x3, 'same');
imshow(output5_3, [])
title("Average Filter 3x3")

subplot(3,2,5)
output5_4 = conv2(single(input5), avg_filt5x5, 'same');
imshow(output5_4, [])
title("Average Filter 5x5")

% Answer to question:
% The average filter is good at softening and removing iid noise from
% images, while the median filter is good for removing pepper noise.
% Depending on the image that needs to be filter, generally a high
 filter
% size will result in a blurry image.
```




```
figure(5)

subplot(3,2,1)
imshow(input6)
title("Original image")

subplot(3,2,2)
output6_1 = medfilt2(input6, [3,3]);
imshow(output6_1)
title("Median Filter 3x3")

subplot(3,2,3)
output6_2 = medfilt2(input6, [5,5]);
imshow(output6_2)
title("Median Filter 5x5")

subplot(3,2,4)
output6_3 = conv2(single(input6), avg_filt3x3, 'same');
imshow(output6_3, [])
title("Average Filter 3x3")

subplot(3,2,5)
output6_4 = conv2(single(input6), avg_filt5x5, 'same');
imshow(output6_4, [])
title("Average Filter 5x5")
```


```
sobel_x = [-1,0,1; -2,0,2; -1,0,1];
sobel_y = [-1,-2,-1; 0,0,0; 1,2,1];

threshold = 160;

figure(6)

subplot(2,2,1)
imshow(output5_1)
title("Median filtered image (3x3)")

subplot(2,2,2)
g_x = conv2(single(output5_1), sobel_x, 'same');
g_y = conv2(single(output5_1), sobel_y, 'same');
G_1 = uint8(sqrt(g_x.^2 + g_y.^2));
G_1(G_1 < threshold) = 0;
imshow(G_1, [])
title("Edgemap of Median filtered image")


subplot(2,2,3)
imshow(output5_3, [])
title("Average filtered image (3x3)")

subplot(2,2,4)
g_x = conv2(single(output5_3), sobel_x, 'same');
g_y = conv2(single(output5_3), sobel_y, 'same');
```

```
G_2 = uint8(sqrt(g_x.^2 + g_y.^2));
G_2(G_2 < threshold) = 0;
imshow(G_2, [])
title("Edgemap of Average filtered image")

% Answer to question:
% The edgemap of the average filtered image looks cleaner than the one
% processed with the median filter, because the average filter evens
 out
% the transition of pixels from high to low values, preserving the
 features
% around the edges, while the median filter leaves pepper noise on the
% image.
```

Median filtered image (3x3)

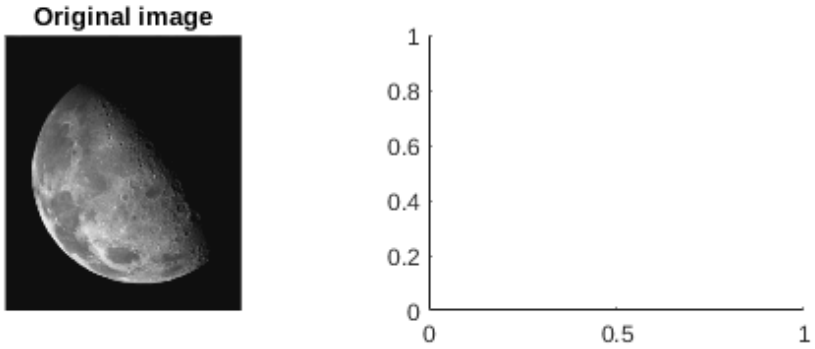
Edgemap of Median filtered image

Average filtered image (3x3)

Edgemap of Average filtered image

```
function output = gamma_correction(input, gamma)
    % This function perform gamma correction on an input image,
 represented
    % as a matlab 2D matrix.
    %
    % input: 2D matrix of the image
    % alpha: scalar defining how stretched is the pixel histogram of
 the
    % image
    % output: 2D matrix of the gamma-corrected image

    output = uint8(255.*(((double(input))./255).^gamma));
```

```
end
```




```
function output = sharpening(input, alpha)
    % This function perform image sharpening on an input image by
 extractin
    % g its high frequency content and add such content back to the
    % original image with a scaling factor `alpha`
    %
    % input: 2D matrix of the image
    % alpha: scaling factor

    filter = [0,-0.25,0;-0.25,1,-0.25;0,-0.25,0];
    output = uint8(double(input) + alpha*conv2(input,
 filter, 'same'));

end
```

Published with MATLAB® R2019b