



Biomedical Imaging

Lab Manual

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Biomedical Imaging

Lab # 1

Tasks A.

```
a = [1 2;3 4 6 4 3 4 5]
b = a * 2;
```

Solution A.

```
a = [1 2 3; 4 6 4; 3 4 5]
b = a + 2
```

Task B.

```
plot(a)
grid on
```

Solution B.

```
plot(a,b)
grid off
```

Task C.

```
bar(b)
xlabel("Sample #")
ylabel("Pounds")
```

Solution C.

```
bar(b)
xlabel("Usairim Isani")
ylabel("Pounds")
```

Task 4.

```
plot(b,"*")  
axis([0 10 0 10])
```

Solution 4.

```
plot(b,"-+")  
axis([0 10 0 10])
```

Lab #2

Task A

```
x = 0.0:0.05:5;  
y = sin(x.^2);  
plot(x,y)  
xlabel("Time")  
ylabel("Amplitude")
```

Solution

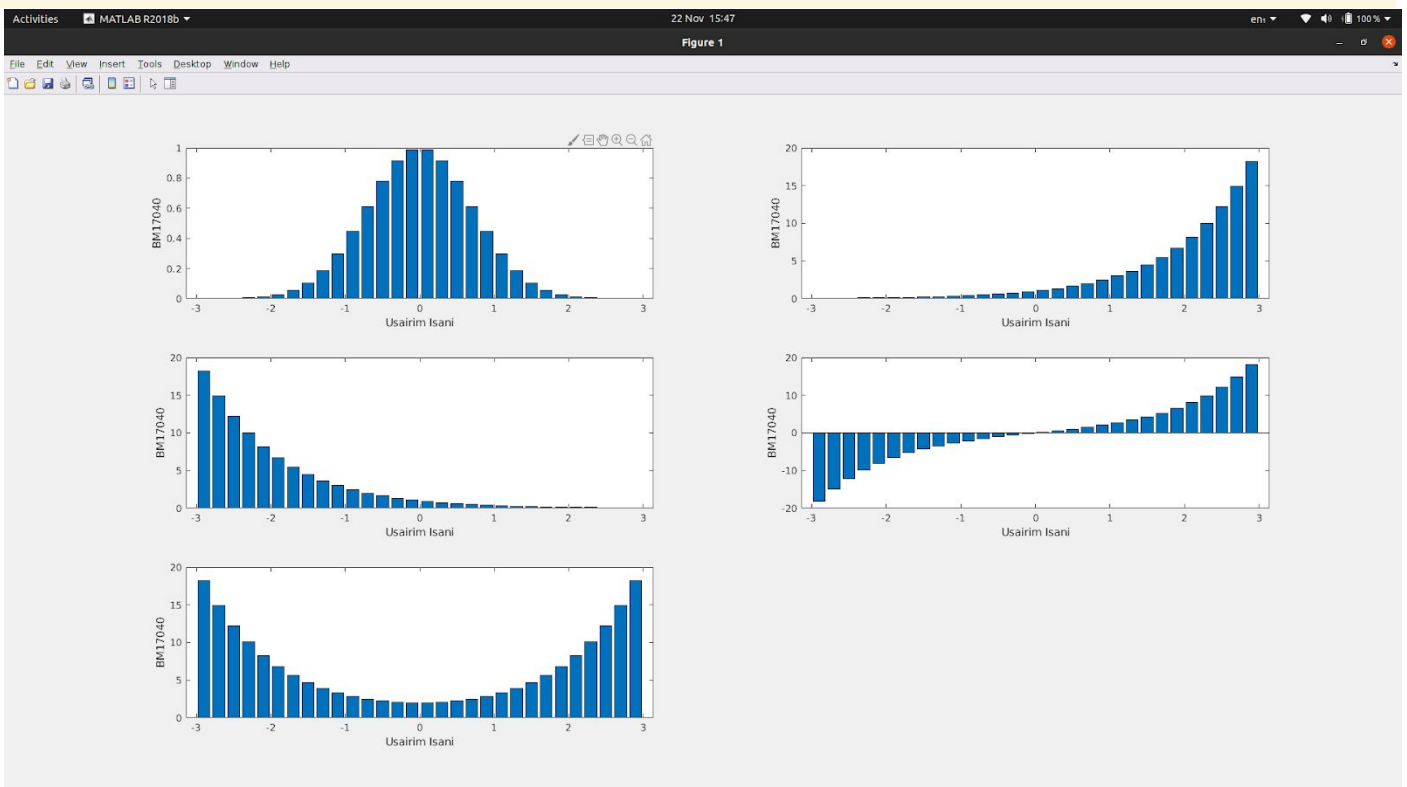
```
x = 0.0:0.05:5;  
y = -x;  
plot(x,y)  
xlabel("Time")  
ylabel("Amplitude")
```

Lab # 3

```

clc;
clear all;
close all;
x = -2.9:0.2:2.9;
subplot(3,2,1)
bar(x,exp(-x.*x));
xlabel("Usairim Isani")
ylabel("BM17040")
subplot(3,2,2)
bar(x,exp(x))
xlabel("Usairim Isani")
ylabel("BM17040")
subplot(3,2,3)
bar(x,exp(-x))
xlabel("Usairim Isani")
ylabel("BM17040")
subplot(3,2,4)
bar(x,exp(x)-exp(-x))
xlabel("Usairim Isani")
ylabel("BM17040")
subplot(3,2,5)
bar(x,exp(x)+exp(-x))
xlabel("Usairim Isani")
ylabel("BM17040")

```



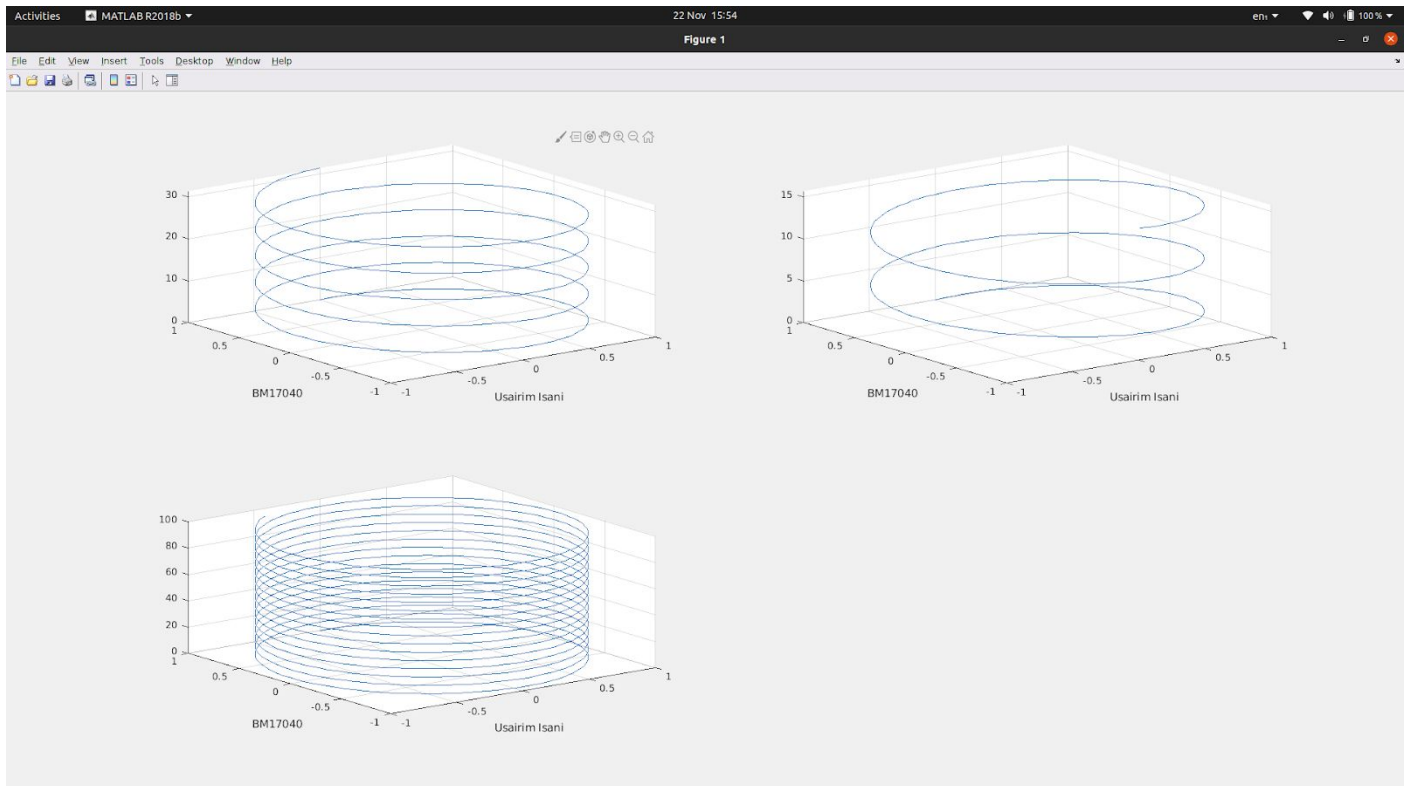
Lab # 4

```
clc;
clear all;
close all;

subplot(2,2,1)
t = 0:pi/50:10*pi;
st = sin(t);
ct = cos(t);
plot3(st,ct,t)
xlabel("Usairim Isani")
ylabel("BM17040")
grid on

subplot(2,2,2)
t = 0:pi/50:5*pi;
st = sin(t);
ct = cos(t);
plot3(st,ct,t)
xlabel("Usairim Isani")
ylabel("BM17040")
grid on

subplot(2,2,3)
t = 0:pi/50:100;
length(t)
st = sin(t);
ct = cos(t);
plot3(st,ct,t)
xlabel("Usairim Isani")
ylabel("BM17040")
grid on
```



Lab # 5

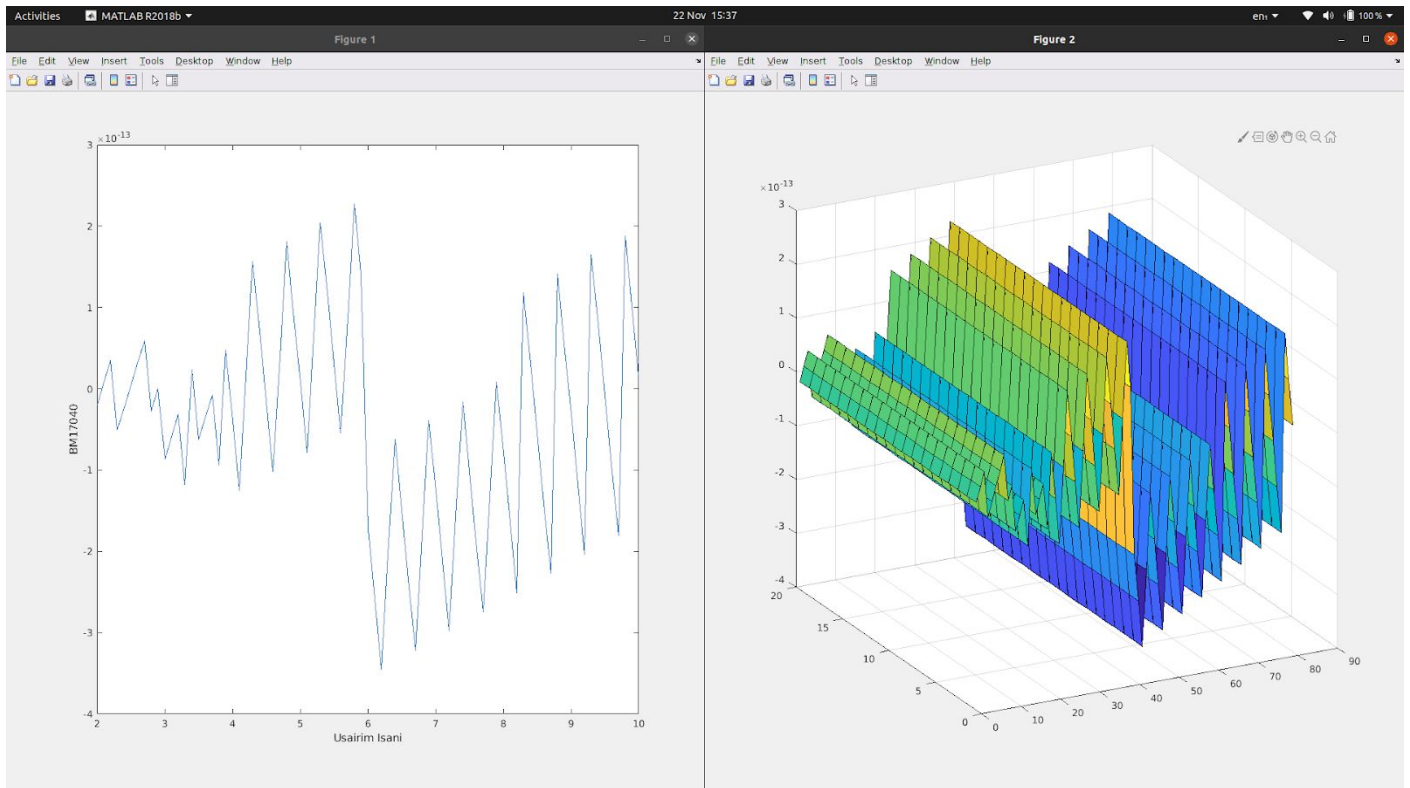
Task # 1

Q) Write a code in a new script file that takes initial and final input in form of time and plots a graph of the following equation $y = \sin(2 * \pi * f * t)$ where f is your roll number.

```
f = 40; %rollno;  
t = a:interval:b;
```

Solution

```
clear all;  
clc;  
close all;  
a = input("Enter a ");  
b = input("Enter b ");  
t = a:0.1:b;  
f = 40;  
y = sin(2 * pi * f * t);  
figure;  
plot(t,y)  
xlabel("Usairim Isani");  
ylabel("BM17040");  
[X,Y] = meshgrid(t,1:20);  
Z = sin(2 * pi * f * X);  
figure  
xlabel("Usairim Isani");  
ylabel("BM17040");  
surf(Z)
```

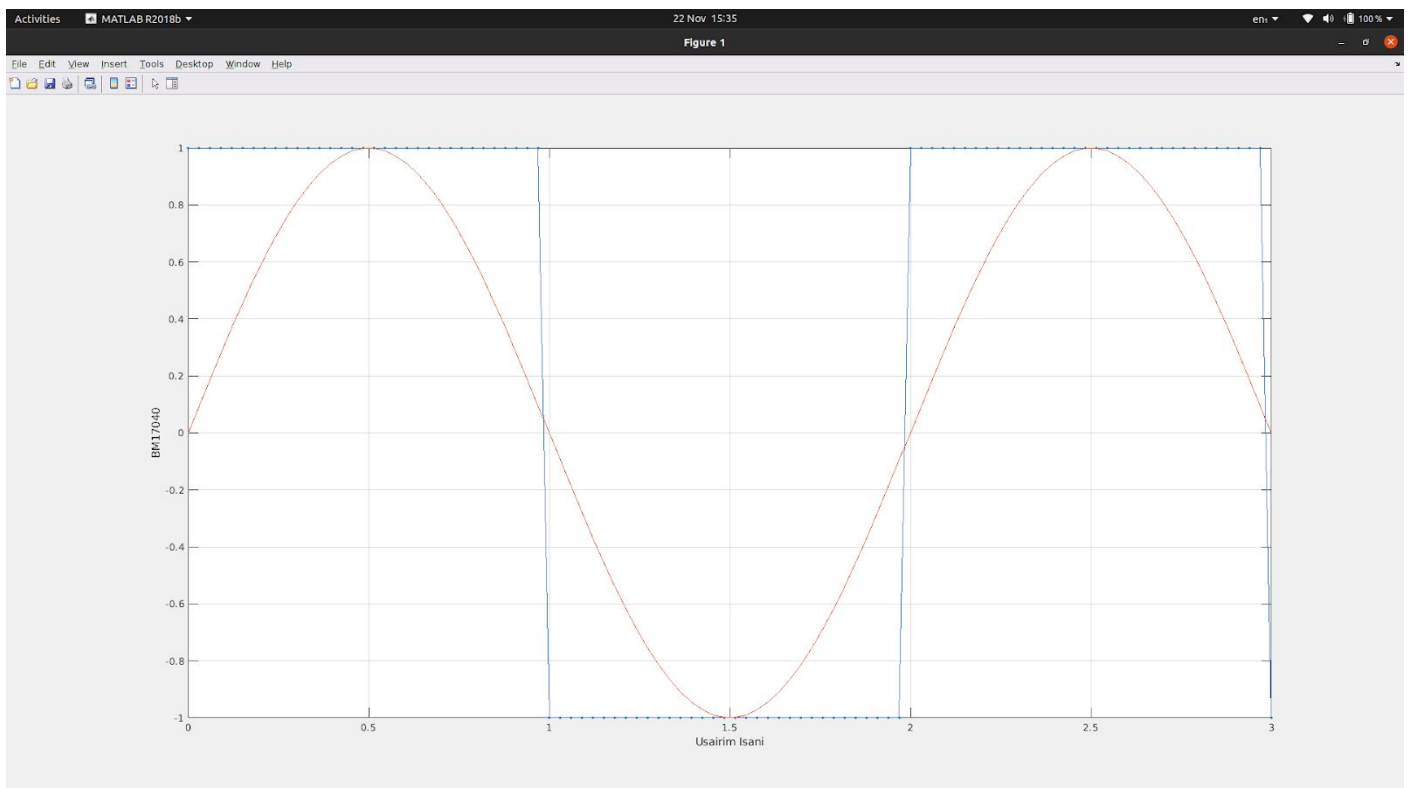



Task # 2

```

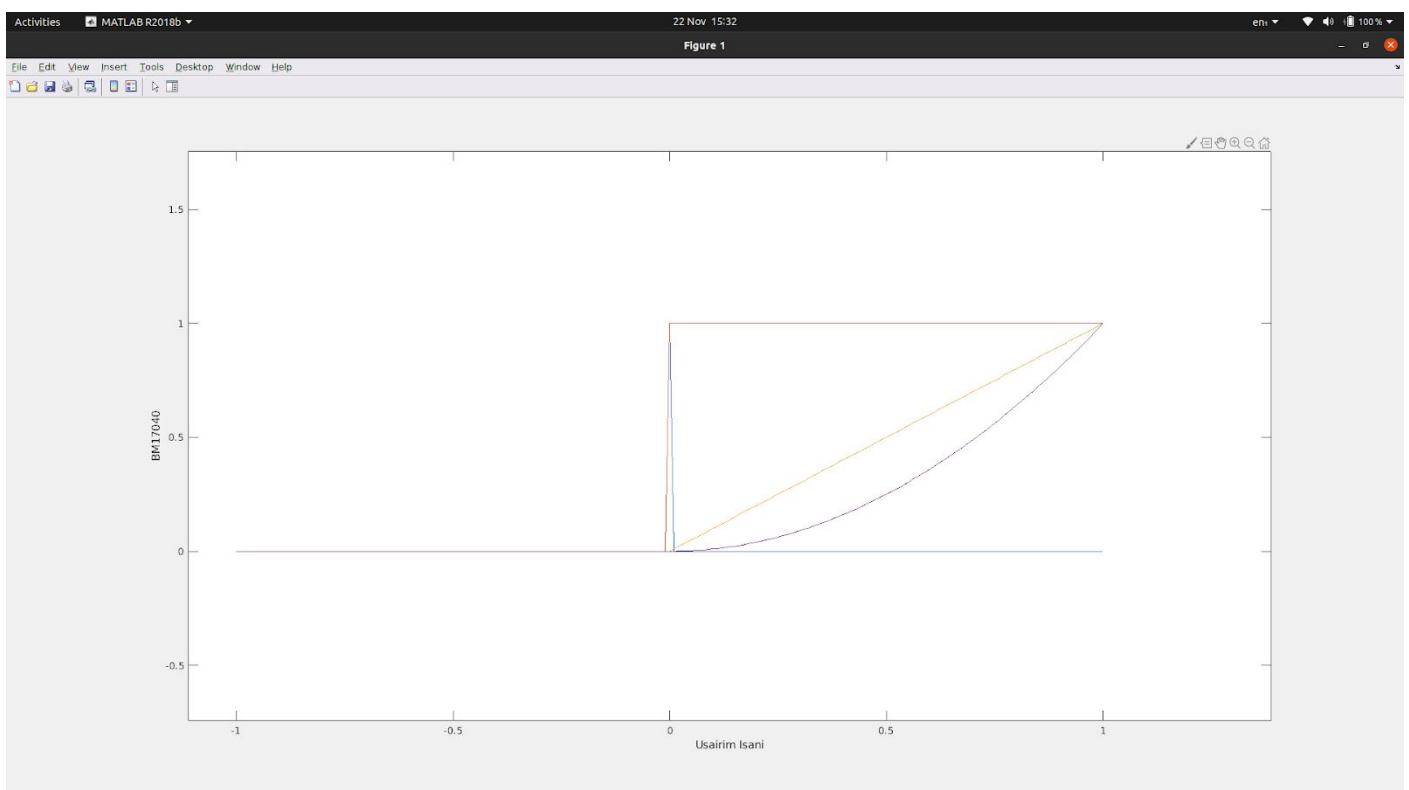
clc;
close all;
clear all;
t = linspace(0,3*pi)';
x = square(t);
plot(t/pi,x,".-",t/pi,sin(t));
xlabel("t / \pi")
grid on
xlabel("Usairim Isani")
ylabel("BM17040")

```



Task # 3

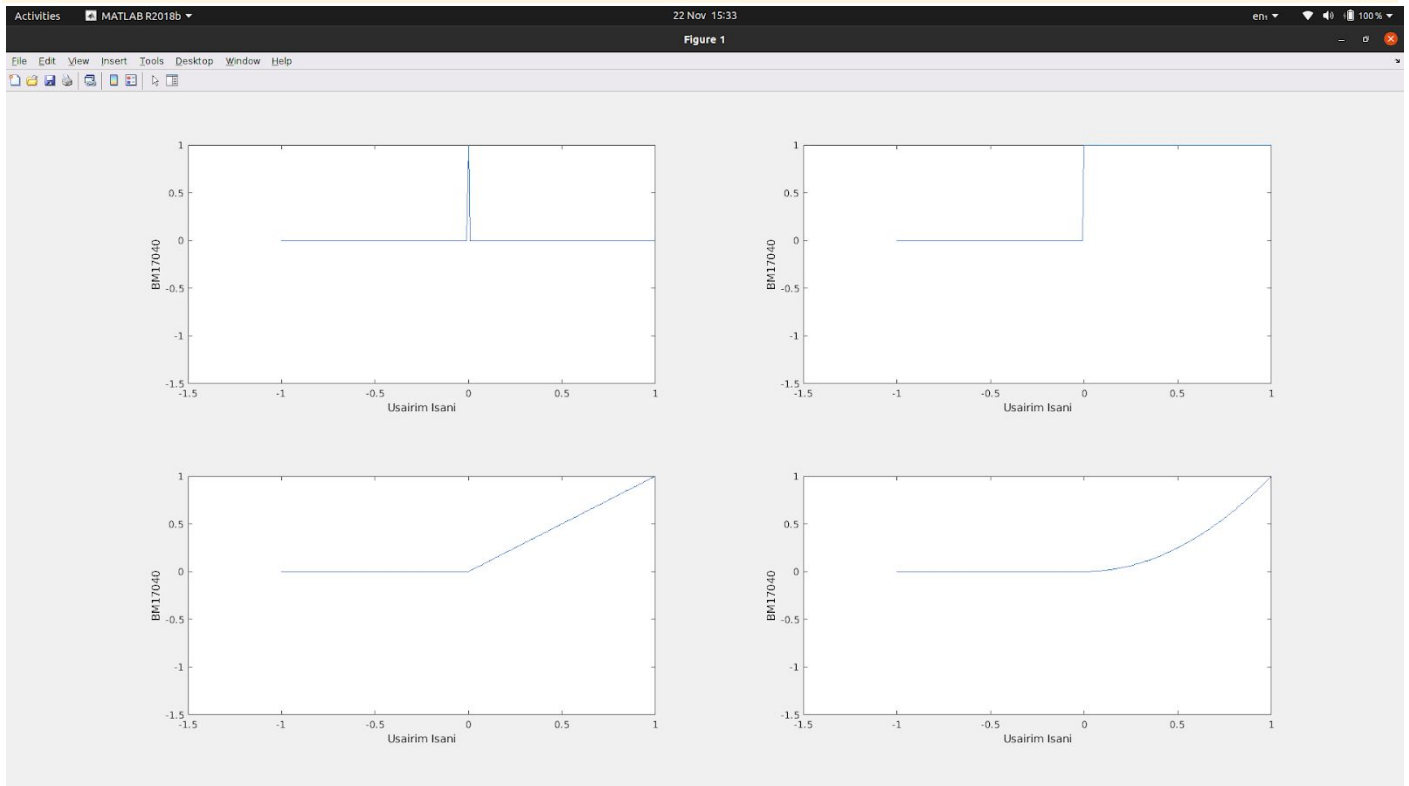
```
close all;
clear all;
clc;
t = (-1:0.01:1)';
impulse = t == 0;
unitstep = t >= 0;
ramp = t.*unitstep;
quad = t.^2.*unitstep;
plot(t,impulse,t,unitstep,t,ramp,t,quad)
axis([-1.5 1 -1.5 1])
xlabel("Usairim Isani")
ylabel("BM17040")
```



Homework

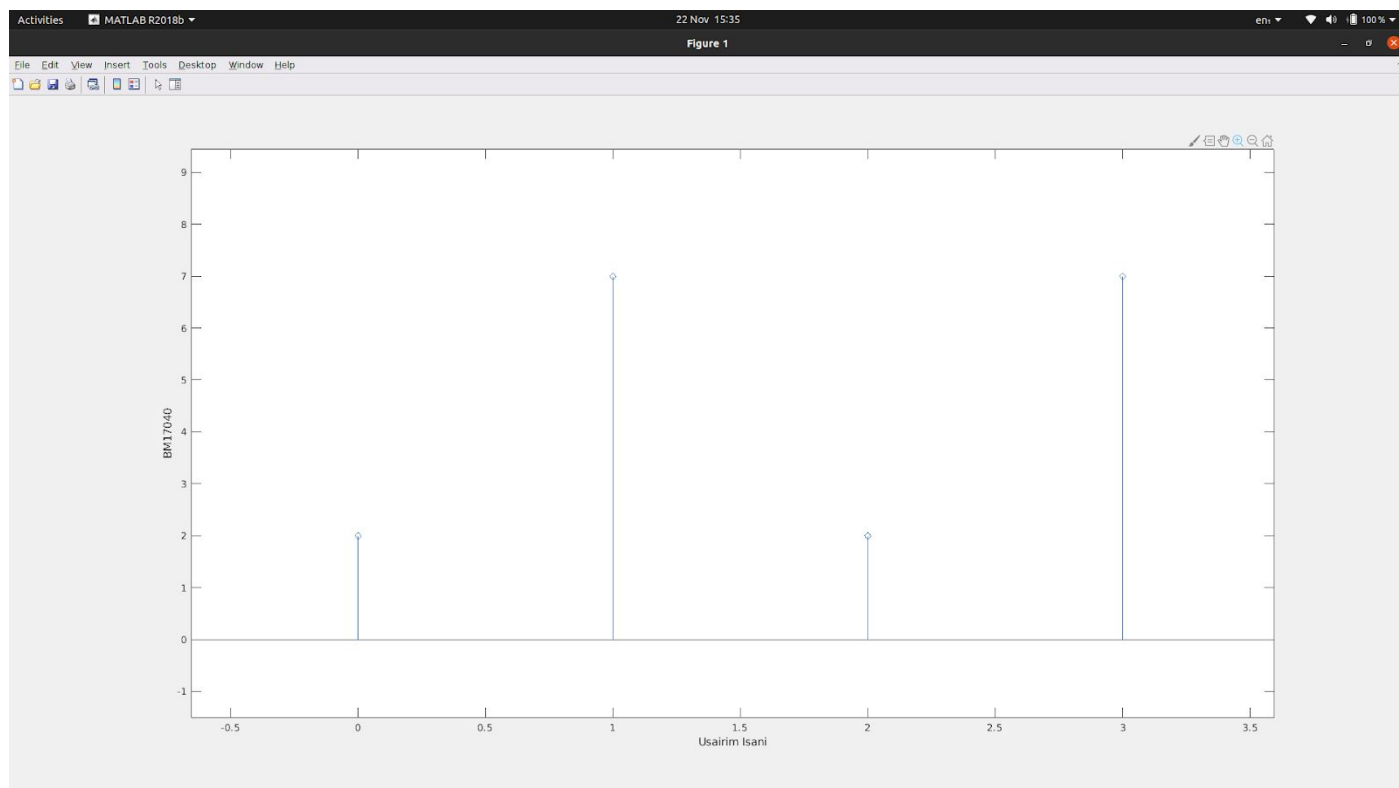
```
close all;
clear all;
clc;
t = (-1:0.01:1)';
impulse = t == 0;
unitstep = t >= 0;
ramp = t.*unitstep;
quad = t.^2.*unitstep;
subplot(2,2,1)
plot(t,impulse)
axis([-1.5 1 -1.5 1])
subplot(2,2,2)
```

```
plot(t,unitstep)
axis([-1.5 1 -1.5 1])
subplot(2,2,3)
plot(t,ramp)
axis([-1.5 1 -1.5 1])
subplot(2,2,4)
plot(t,quad)
axis([-1.5 1 -1.5 1])
```



Task # 4

```
close all;
clc;
clear all;
u = [1 0 1];
v = [2 7];
w = conv(u,v);
m = length(w)-1;
n = 0:1:m;
stem(n,w)
%axis([-1 1 -1 1])
xlabel("Usairim Isani")
ylabel("BM17040")
```

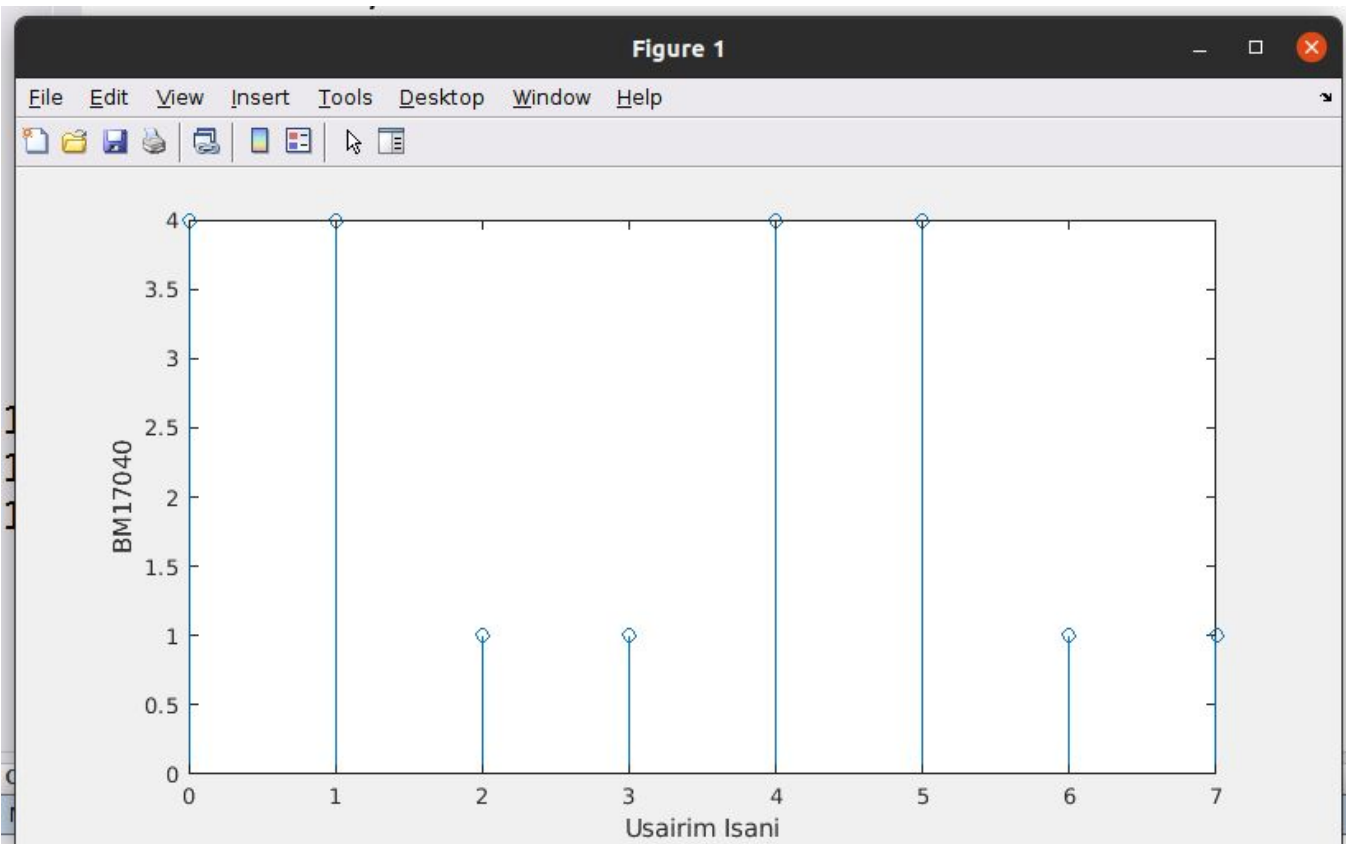


Assignment # 1

Two signals u and v are given by the sequences $[4 \ 0 \ 1]$ and $[1 \ 1 \ 0 \ 0 \ 1 \ 1]$ respectively. Convolve the two signals and write down the final polynomial coefficients.

Moreover plot the new polynomials using stem command.

```
close all;
clc;
clear all;
u = [4 0 1];
v = [1 1 0 0 1 1];
w = conv(u,v)
m = length(w)-1;
n = 0:1:m;
stem(n,w)
%axis([-1 1 -1 1])
xlabel("Usairim Isani")
ylabel("BM17040")
```



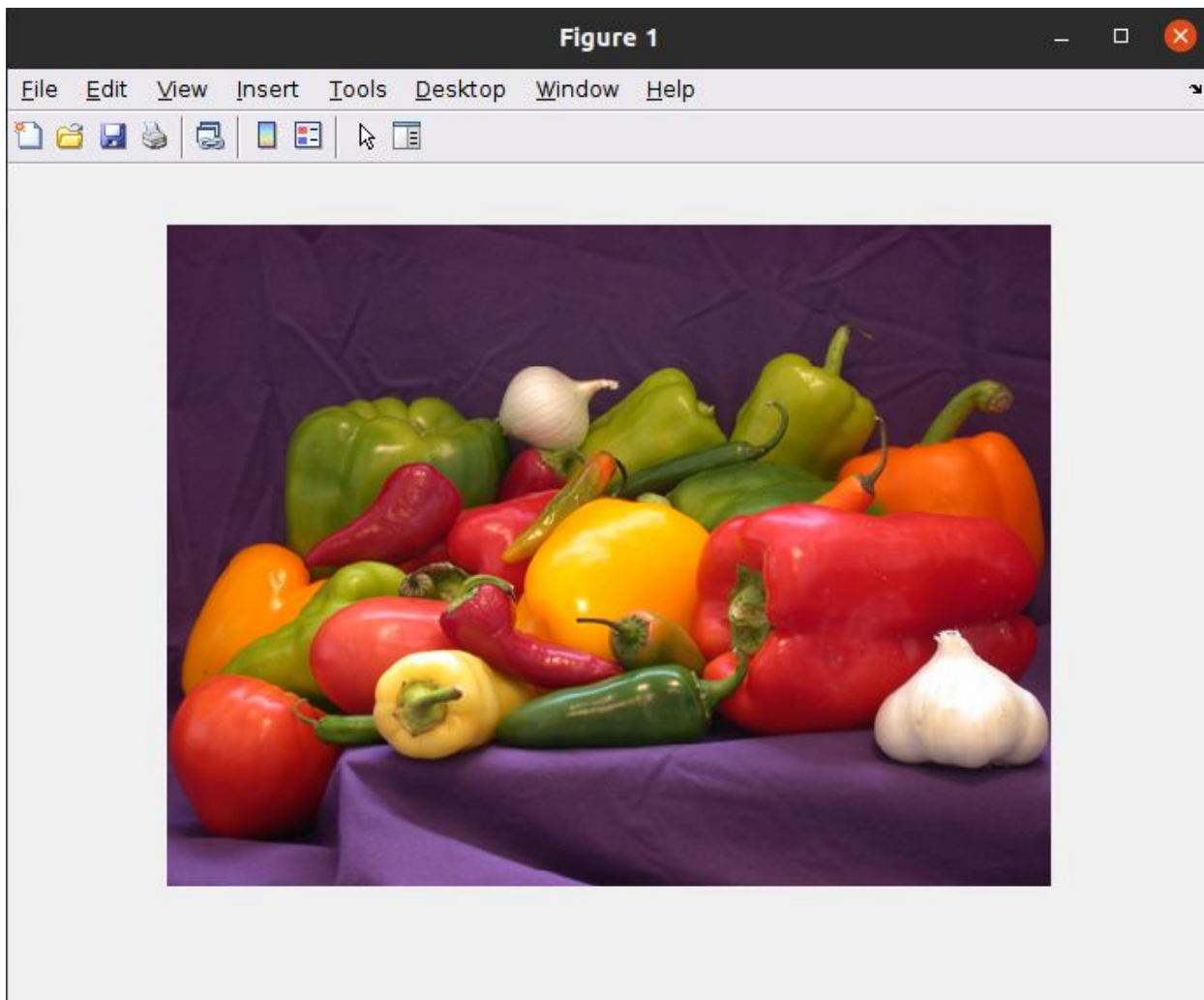
$w =$

4 4 1 1 4 4 1 1

Lab 5: Image Blurring

Task 1

```
originalRGB = imread("peppers.png");  
imshow(originalRGB)
```



Task 2

```
close all;  
clc;  
clear all;  
  
originalRGB = imread("peppers.png");  
subplot(3,2,1);  
amount = 30;  
theta = 90;  
h = fspecial('motion', amount, theta);  
filteredRGB = imfilter(originalRGB, h);  
% filteredRGB = imfilter(originalRGB, h, 30, 'replicate');  
% filteredRGB = imfilter(originalRGB, h, 'conv');  
imshow(filteredRGB);
```



```

tit = "Motion filter with len = %d and theta = %d";
title(sprintf(tit, amount, theta));

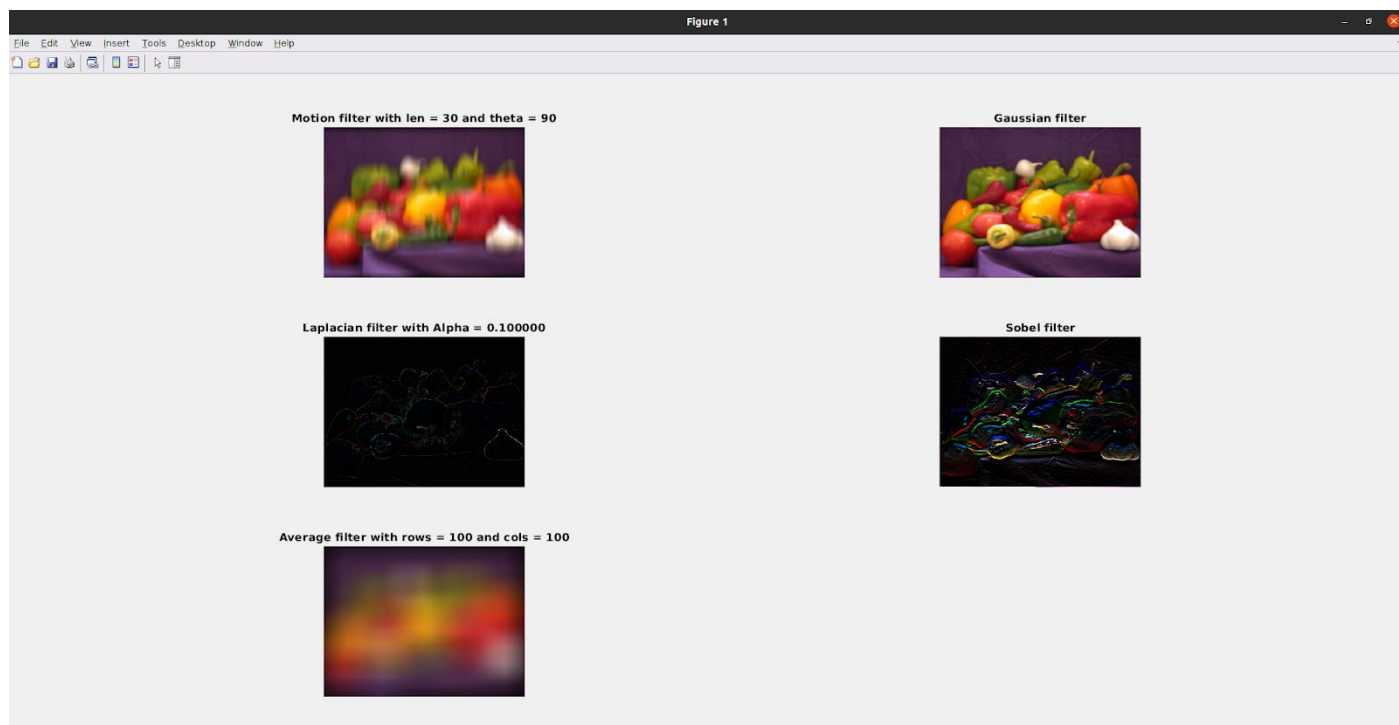
subplot(3,2,2);
h = fspecial('gaussian',[5 6],4);
% h = imgaussfilt3(originalRGB,2.0);
filteredRGB = imfilter(originalRGB, h);
imshow(filteredRGB);
title("Gaussian filter");
% h = fspecial('gaussian');

subplot(3,2,3);
alpha = 0.1;
h = fspecial('laplacian',alpha);
filteredRGB = imfilter(originalRGB, h);
imshow(filteredRGB);
title(sprintf("Laplacian filter with Alpha = %f",alpha));

subplot(3,2,4);
h = fspecial('sobel');
filteredRGB = imfilter(originalRGB, h);
imshow(filteredRGB);
title("Sobel filter");

subplot(3,2,5);
rows = 100;
cols = 100;
h = fspecial('average', [rows cols]);
filteredRGB = imfilter(originalRGB, h);
% filteredRGB = imfilter(originalRGB, h, 30,'replicate');
% filteredRGB = imfilter(originalRGB, h,'conv');
imshow(filteredRGB);
tit = "Average filter with rows = %d and cols = %d";
title(sprintf(tit, rows, cols));

```



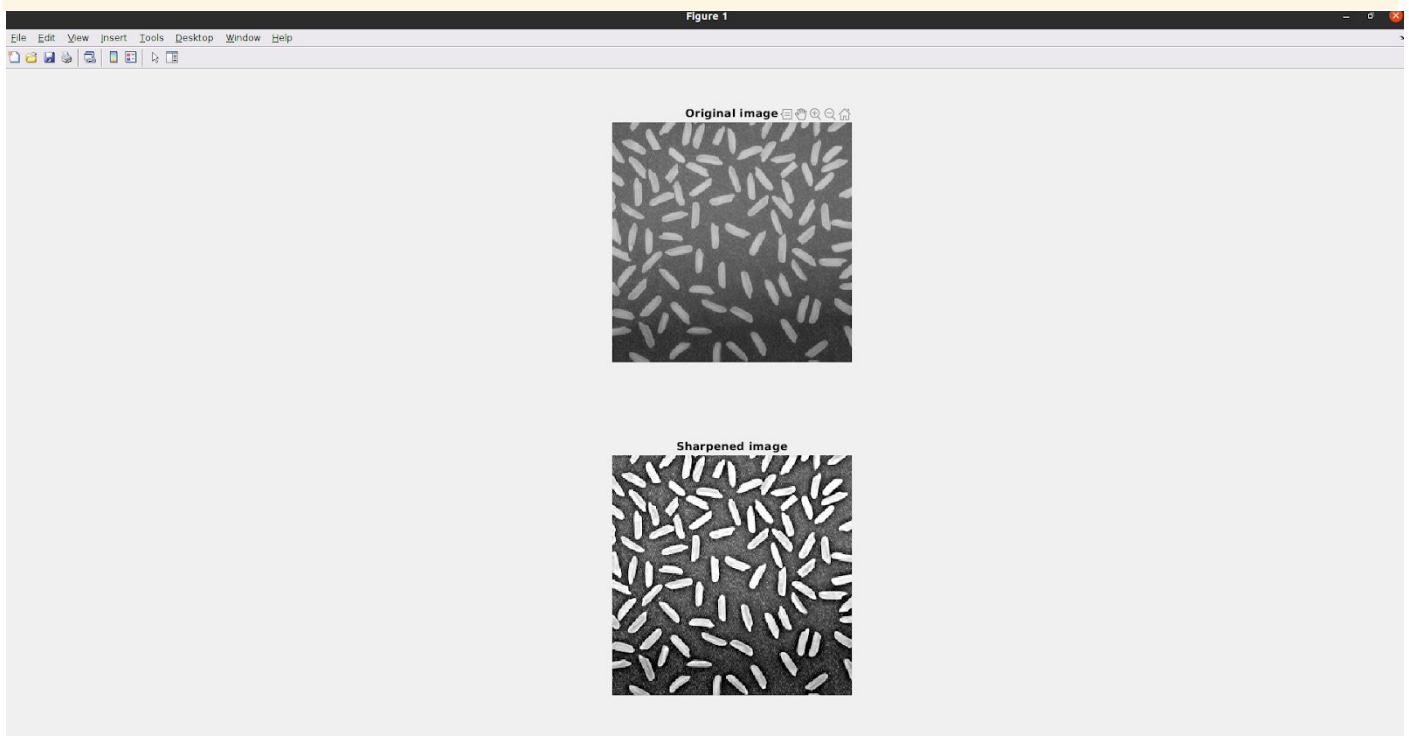
Lab 6: Image Sharpening

Task 1

```
clc;
clear all;
close all;

a = imread("rice.png");
subplot(2,1,1);
imshow(a)
title("Original image")

radius = 4;
amount = 2;
b = imsharpen(a, "Radius",radius,"Amount",amount);
subplot(2,1,2);
imshow(b)
title("Sharpened image")
```

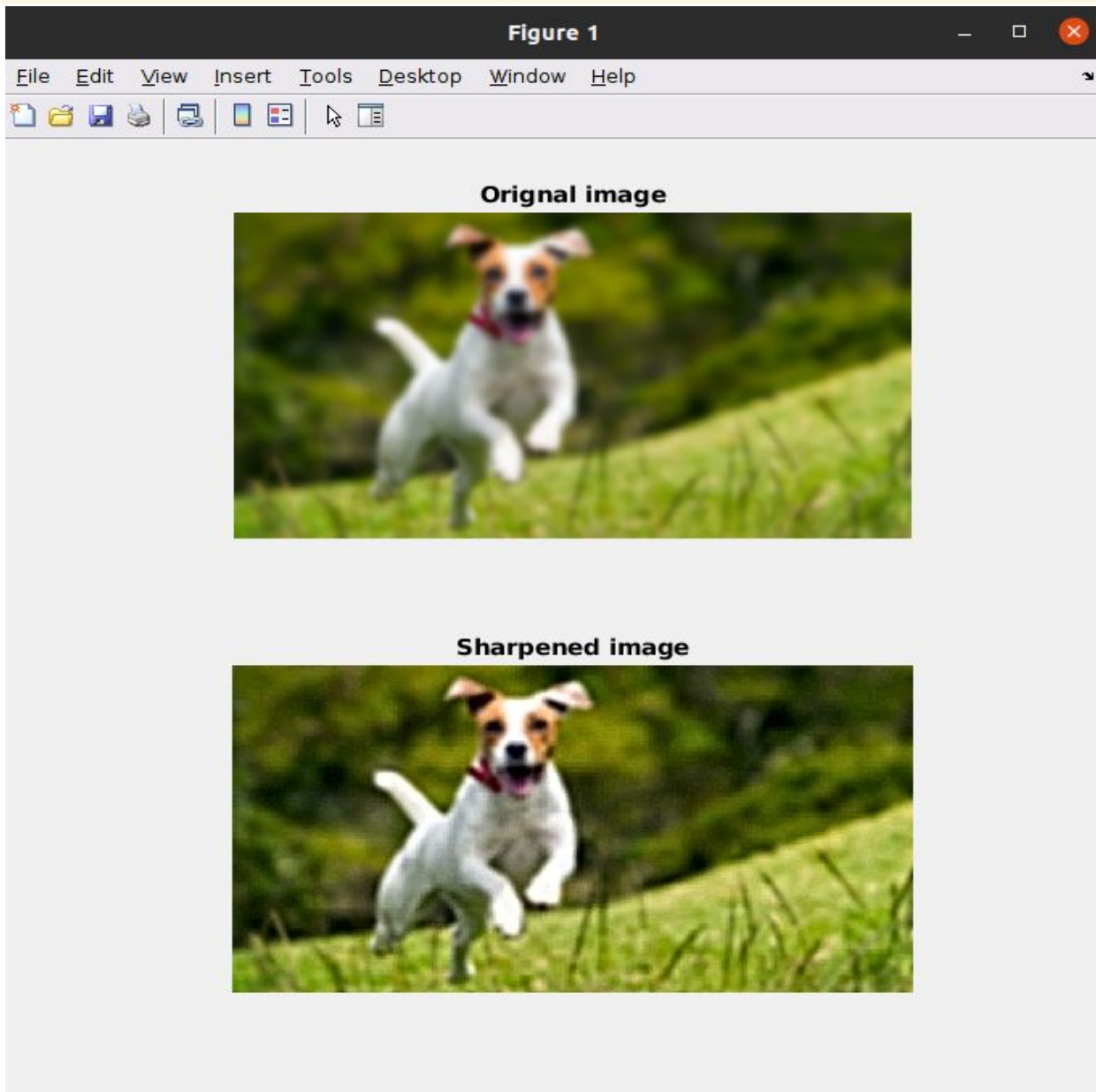


Practice Task

```
a = imread("rice.jpg");
subplot(2,1,1);
imshow(a)
title("Original image")

b = imsharpen(a, "Radius",4,"Amount",2);
```

```
subplot(2,1,2);  
imshow(b)  
title("Sharpened image")
```



Lab 7: Image Blurring and Sharpening

Task 1

```
clc;
close all;
clear all;

image = imread("test.jpg");
subplot(2,2,1);
imshow(image)
title("Original Image");

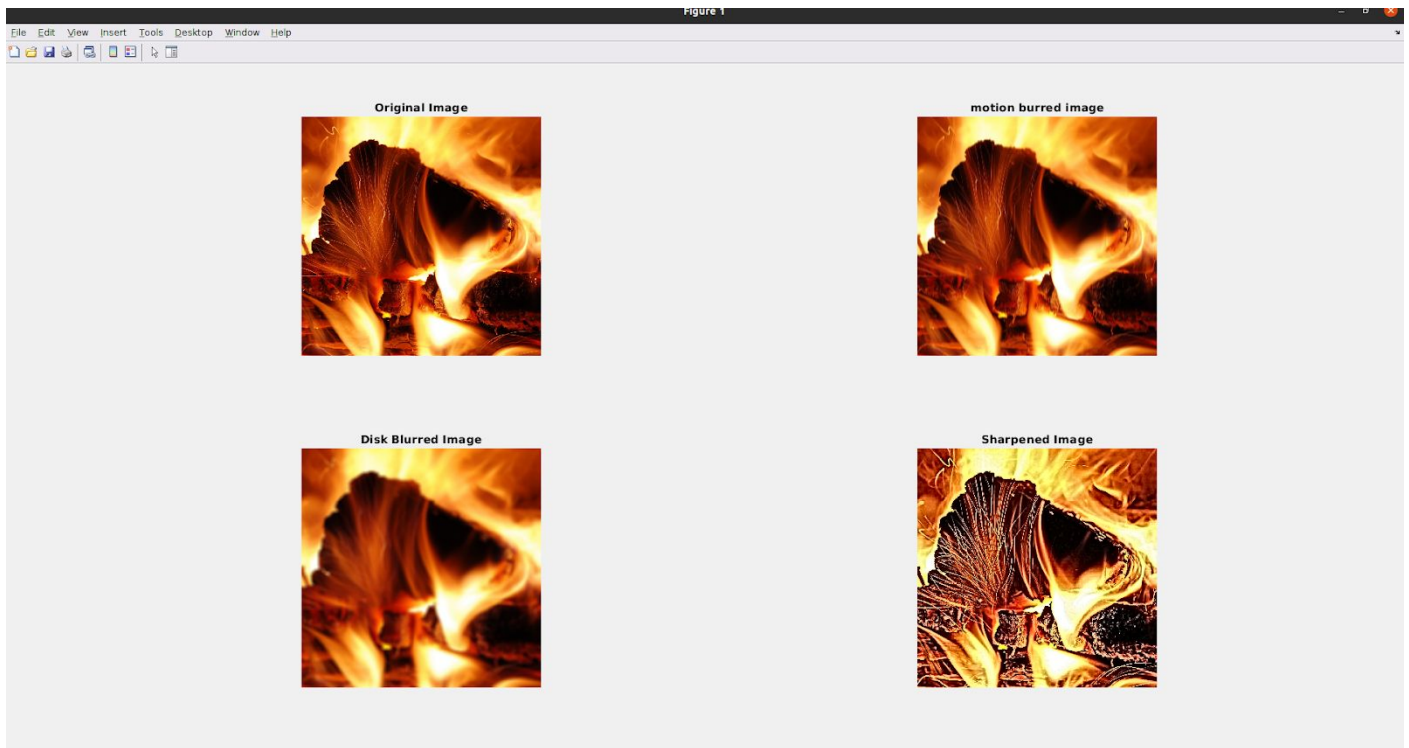
amount = 10;
theta = 90;

h1 = fspecial("motion", amount, theta);
motion_blur = imfilter(image, h1, "replicate"); % replicate takes the same pixels on
edges
subplot(2,2,2);
imshow(motion_blur)
title("motion burred image");

disk = 10;
h2 = fspecial("disk",disk);
disk_blurred = imfilter(image,h2,"replicate");
subplot(2,2,3);
imshow(disk_blurred)
title("Disk Blurred Image");

radius = 8;
amount = 8;

b = imsharpen(image, "Radius",radius, "Amount",amount);
subplot(2,2,4);
imshow(b)
title("Sharpened Image");
```



Practice Task

```

clc;
clear all;
close all;

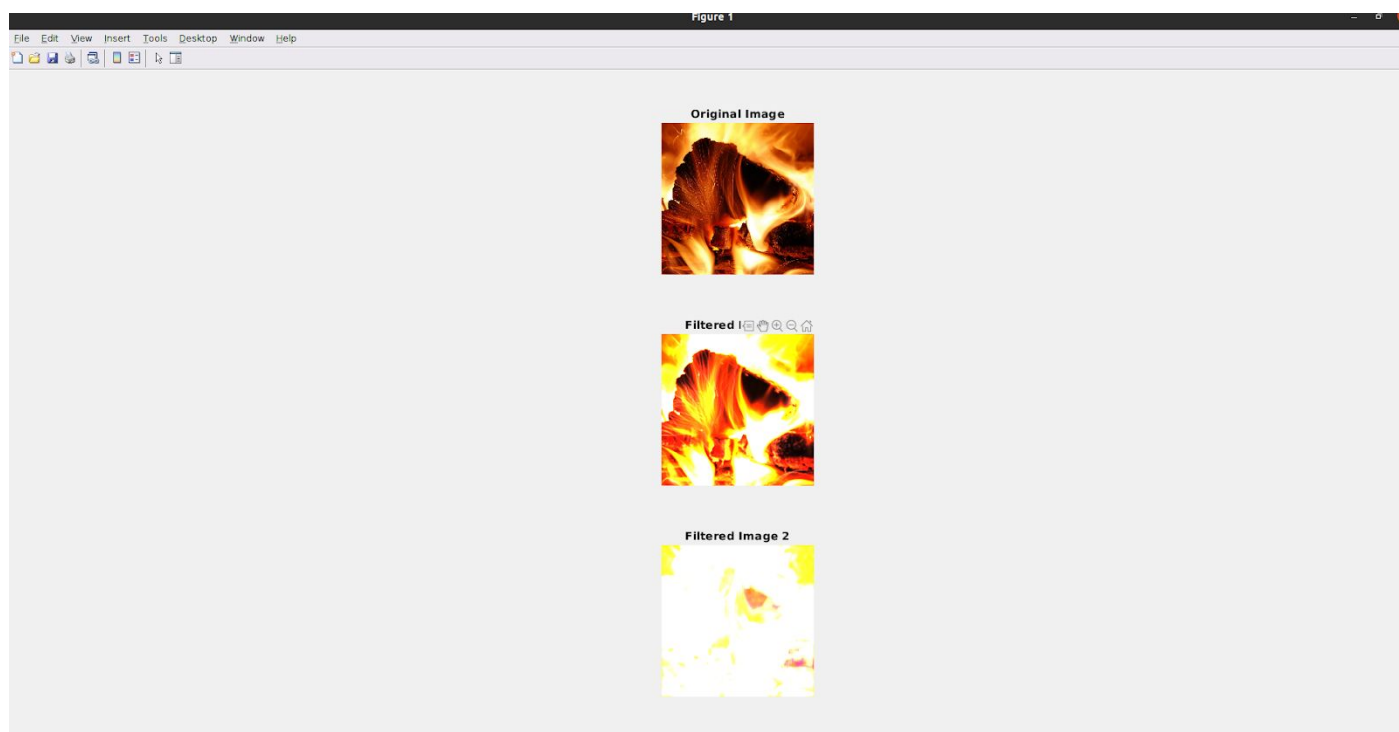
I = imread("test.jpg");
h1 = ones(10,10)/25;
h2 = ones(27,27)/9;
I1 = imfilter(I,h1);
I2 = imfilter(I,h2);

subplot(3,1,1);
imshow(I);
title("Original Image");

subplot(3,1,2);
imshow(I1);
title("Filtered Image 1");

subplot(3,1,3);
imshow(I2);
title("Filtered Image 2");

```



Lab 8: Histogram Equalization

Task 1

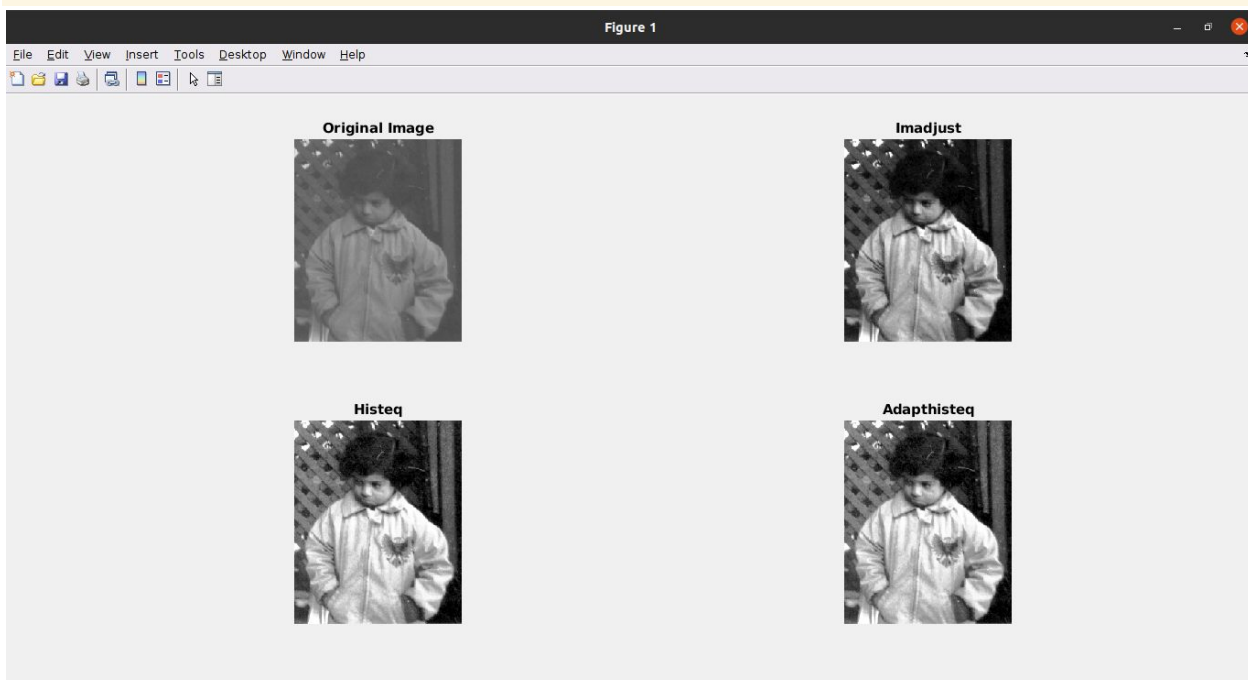
```
clc;
clear all;
close all;

usairim = imread("pout.tif");
subplot(2,2,1);
imshow(usairim)
title("Original Image");

usairim_imadjust = imadjust(usairim);
subplot(2,2,2);
imshow(usairim_imadjust);
title("Imadjust");

usairim_histeq = histeq(usairim);
subplot(2,2,3);
imshow(usairim_histeq);
title("Histeq");

usairim_adapthisteq = histeq(usairim);
subplot(2,2,4);
imshow(usairim_adapthisteq);
title("Adapthisteq");
```



Practice Task

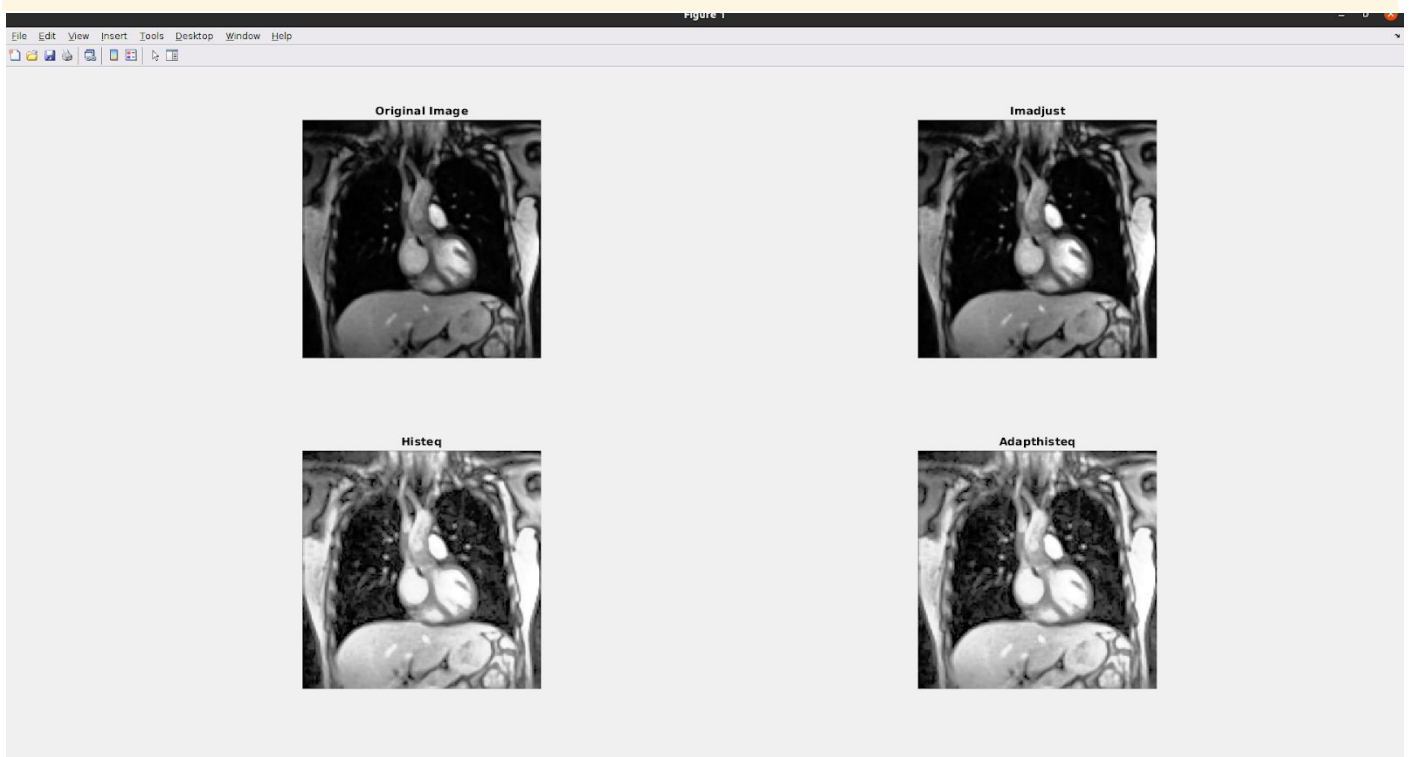
```
clc;
close all;
clear all;

mri = imread("mri.jpg");
% mri = rgb2gray(mri);
subplot(2,2,1);
imshow(mri)
title("Original Image");

mri_imadjust = imadjust(mri);
subplot(2,2,2);
imshow(mri_imadjust);
title("Imadjust");

mri_histeq = histeq(mri);
subplot(2,2,3);
imshow(mri_histeq);
title("Histeq");

mri_adapthisteq = histeq(mri);
subplot(2,2,4);
imshow(mri_adapthisteq);
title("Adapthisteq");
```



Assignment # 2

```
clc;
close all;
clear all;

% Original Image
i_org = imread("peppers.png");

% Convert the Color image to Grayscale.
i = rgb2gray(i_org);

% Show original Image
subplot(3,3,1);
imshow(i);
title("Peppers Original Image");

% Show histogram of image
subplot(3,3,2);
imhist(i);
title("Image Histogram");

% Equalize the image histogram
subplot(3,3,3);
hi = histeq(i);
imshow(hi)
title("Histogram Equalized Image");

% Show histogram of equalized image
subplot(3,3,4);
imhist(hi);
title("Equalized Image Histogram");

% Filter to get the Fine Details
subplot(3,3,5);
alpha = 0.1;
h = fspecial('laplacian',alpha);
i_filt = imfilter(i_org, h);
imshow(i_filt);
title("Filtered Image for Fine details");

% Sharpen the Image
radius = 4;
amount = 2;
i_sharp = imsharpen(i, "Radius",radius,"Amount",amount);
subplot(3,3,6);
imshow(i_sharp);
title("Sharpened image");

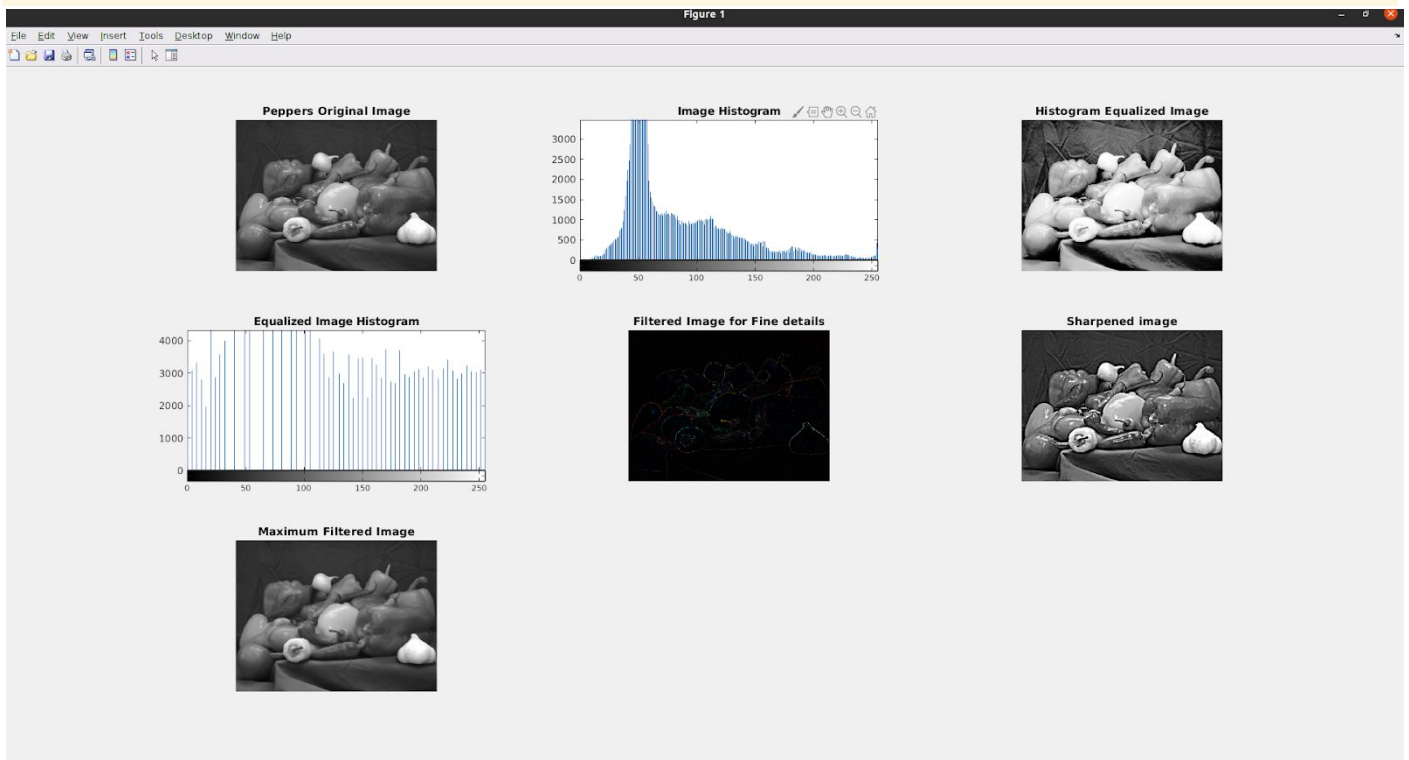
% Maximum symmetric Filter
% Type
max = 9;
```

```

% min = 1;
% median = 5;
type = max;

kernel = ones(5,5); %[[1;5],[1;5],[1;5],[1;5],[1;5]]
% kernel = [0 1 0; 1 0 1; 0 1 0];
max_filt_sym = ordfilt2(i,type,kernel,'symmetric');
subplot(3,3,7)
imshow(max_filt_sym);
title("Maximum Filtered Image");

```



Lab # 9

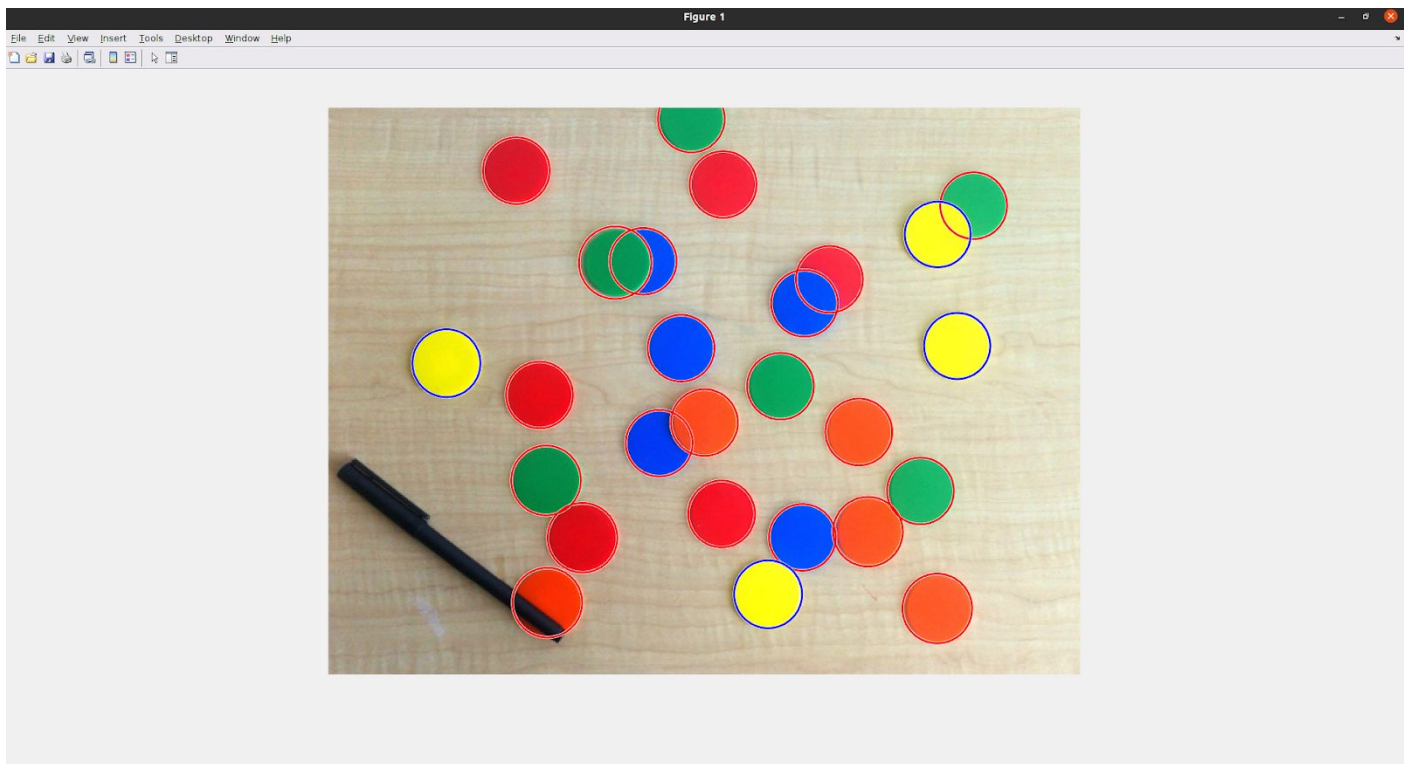
Task 1

```
clc;
clear all;
close all;

rgb = imread("coloredChips.png");
% d = imdistline;
% delete(d); % For terminal
gray_image = rgb2gray(rgb);

imshow(gray_image);

% [centers, radii] = imfindcircles(rgb,[20
25],'ObjectPolarity','dark','Sensitivity',0.9);
% [centers, radii] = imfindcircles(rgb,[20
25],'ObjectPolarity','dark','Sensitivity',0.92);
[centers, radii] = imfindcircles(rgb,[20
25],'ObjectPolarity','dark','Sensitivity',0.92,'Method','twostage');
% [centers_bright, radii_bright] = imfindcircles(rgb,[20
25],'ObjectPolarity','bright','Sensitivity',0.92,'Method','twostage'); % also works
with rgb
% [centers_bright, radii_bright] = imfindcircles(gray_image,[20
25],'ObjectPolarity','bright','Sensitivity',0.91,'Method','twostage'); % Works
without EdgeThreshold
[centers_bright, radii_bright] = imfindcircles(gray_image,[20
25],'ObjectPolarity','bright','Sensitivity',0.91,'EdgeThreshold',0.08);
imshow(rgb);
h = viscircles(centers,radii);
h_b = viscircles(centers_bright,radii_bright, 'Color','b');
```



Task 2

```

clc;
clear all;
close all;

rgb = imread("ci.jpg");
% delete(d); % For terminal
gray_image = rgb2gray(rgb);
imshow(gray_image);

% [centers, radii] = imfindcircles(rgb,[20
25],'ObjectPolarity','dark','Sensitivity',0.9);
% [centers, radii] = imfindcircles(rgb,[20
25],'ObjectPolarity','dark','Sensitivity',0.92);
[centers, radii] = imfindcircles(rgb,[40
350],'ObjectPolarity','dark','Sensitivity',0.94,'Method','twostage','EdgeThreshold',
0.1);
% [centers_bright, radii_bright] = imfindcircles(rgb,[20
25],'ObjectPolarity','bright','Sensitivity',0.92,'Method','twostage'); % also works
with rgb
% [centers_bright, radii_bright] = imfindcircles(gray_image,[20
25],'ObjectPolarity','bright','Sensitivity',0.91,'Method','twostage'); % Works
without EdgeThreshold
[centers_bright, radii_bright] = imfindcircles(gray_image,[40
350],'ObjectPolarity','bright','Sensitivity',0.90,'Method','twostage','EdgeThreshold',
0.1);
imshow(rgb);

```

```
d = imdistline;  
h = viscircles(centers,radii);  
h_b = viscircles(centers_bright,radii_bright, 'Color','b');
```

