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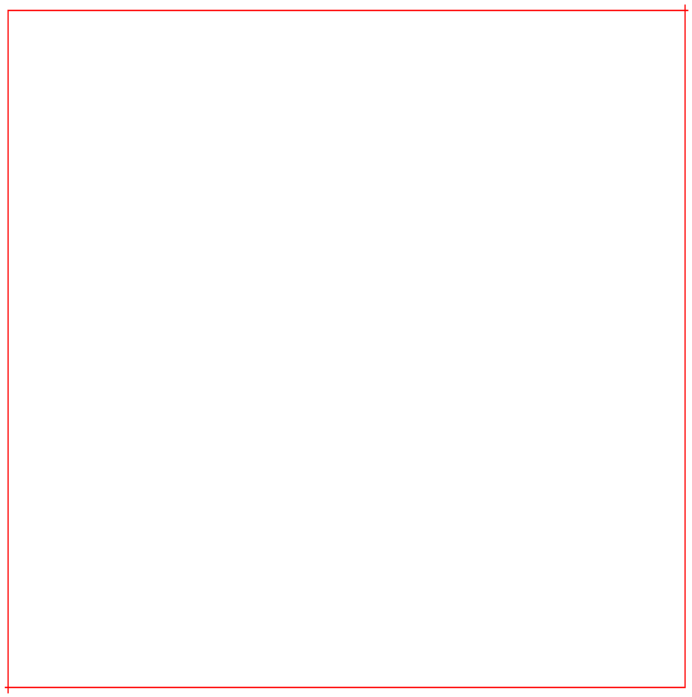
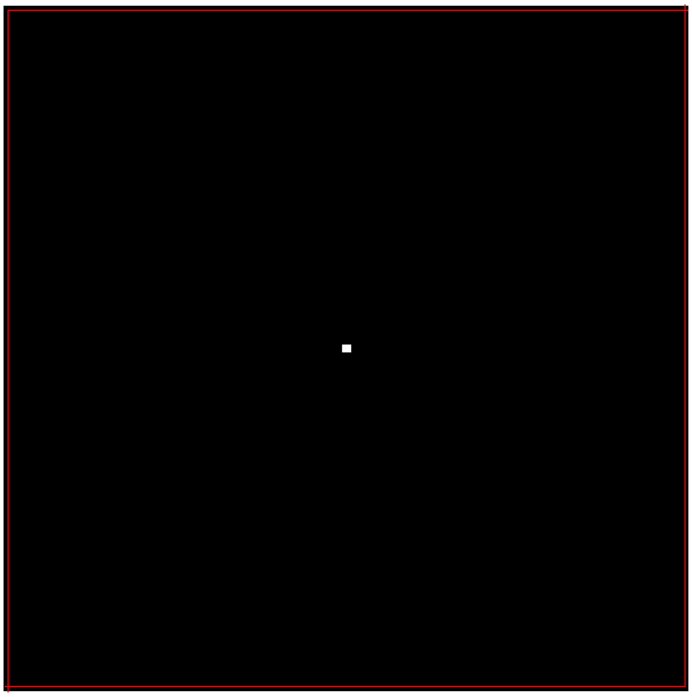
2167054 EXPERIMENT 7 PRELIMINARY WORK

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

Q2a

```
A=ones(81,81);
figure
imshow(A)
s = size(A);
rectangle('position',[1 1 s(2) s(1)], 'edgecolor', [1 0 0])
rectangle('position',[0 0 s(2) s(1)], 'edgecolor', [1 0 0])
AFFT=fft2(A);
AFFT=AFFT/max(max(abs(AFFT)));
figure
imshow(fftshift(abs(AFFT)))
rectangle('position',[1 1 s(2) s(1)], 'edgecolor', [1 0 0])
rectangle('position',[0 0 s(2) s(1)], 'edgecolor', [1 0 0])
```





Comment on the magnitude of 2FFT of the image A.

Image A is all ones, in other words, like a DC signal. When we look at the magnitude of 2D FFT, we see that there is an impulse at the zero, which is kinda similar to 1D version.

Why do we scale AFFT in line 5?

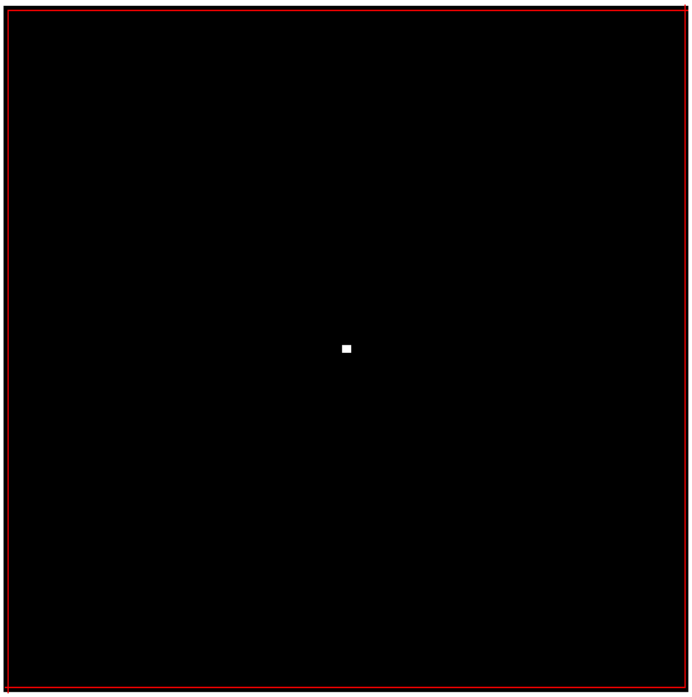
When the value of a pixel and its closest neighbours are added, resulting value may exceed the image depth leading to clipping. In order to prevent clipping, normalization is done.

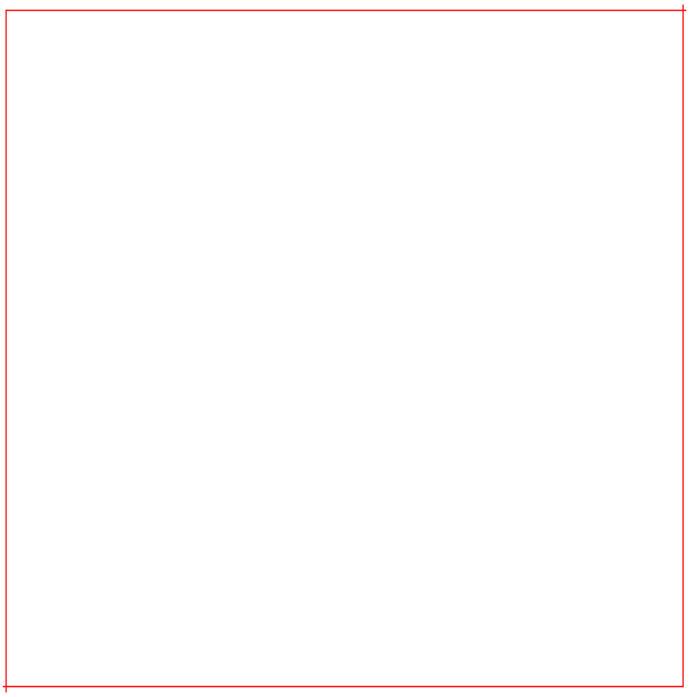
Why do we use fftshift to plot the magnitude of 2FFT?

Without the fftshift, the location of the impulse is not clear, fftshift is used to center the zero frequency at the output.

Q2b

```
B=zeros(81,81);
B(41,41)=1;
figure
imshow(B)
rectangle('position',[1 1 s(2) s(1)], 'edgecolor', [1 0 0])
rectangle('position',[0 0 s(2) s(1)], 'edgecolor', [1 0 0])
BFFT=fft2(B);
BFFT=BFFT/max(max(abs(BFFT)));
figure
imshow(fftshift(abs(BFFT)))
rectangle('position',[1 1 s(2) s(1)], 'edgecolor', [1 0 0])
rectangle('position',[0 0 s(2) s(1)], 'edgecolor', [1 0 0])
```



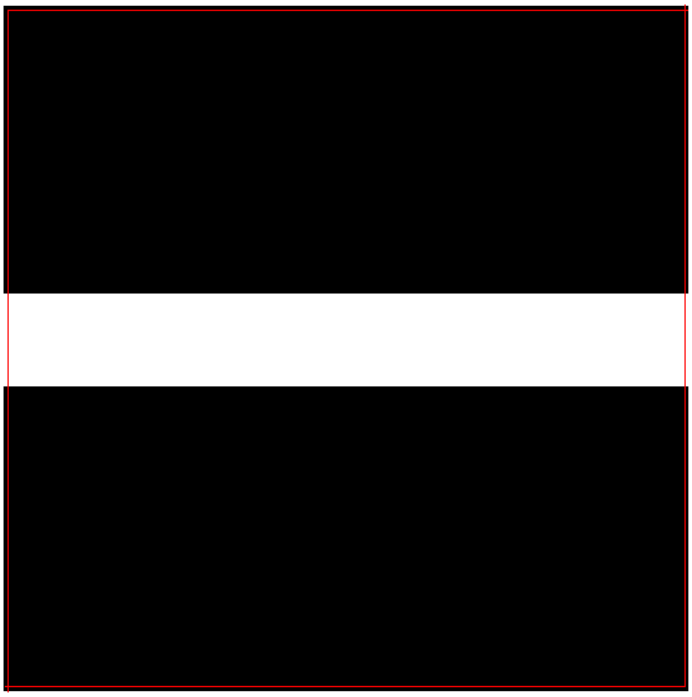


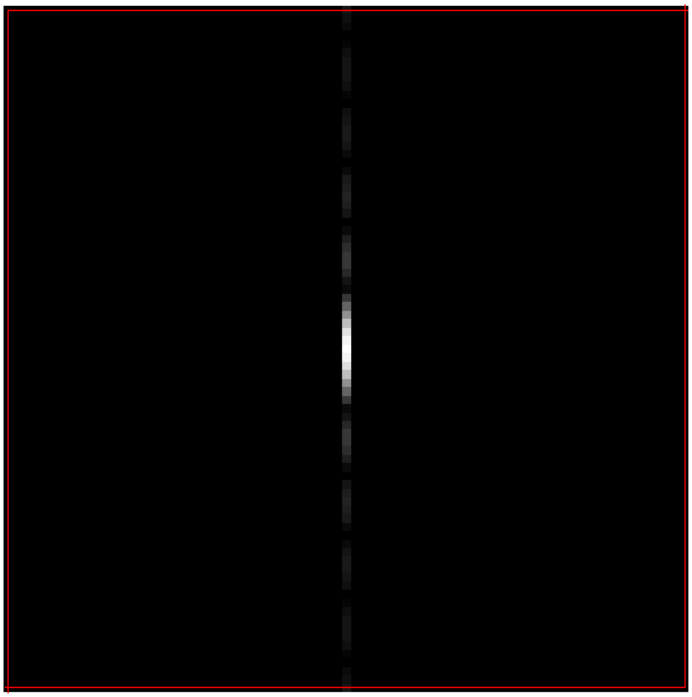
Comment on the magnitude of 2FFT of the image B.

In this question, we are expected to observe duality of 2D FFT. Input is the output of Q2a. From the duality, we have observed a flat frequency response.

Q2c

```
C=zeros(81,81);
C(35:45,:) = 1;
figure
imshow(C)
rectangle('position',[1 1 s(2) s(1)], 'edgecolor', [1 0 0])
rectangle('position',[0 0 s(2) s(1)], 'edgecolor', [1 0 0])
CFFT=fft2(C);
CFFT=CFFT/max(max(abs(CFFT)));
figure
imshow(fftshift(abs(CFFT)))
rectangle('position',[1 1 s(2) s(1)], 'edgecolor', [1 0 0])
rectangle('position',[0 0 s(2) s(1)], 'edgecolor', [1 0 0])
```



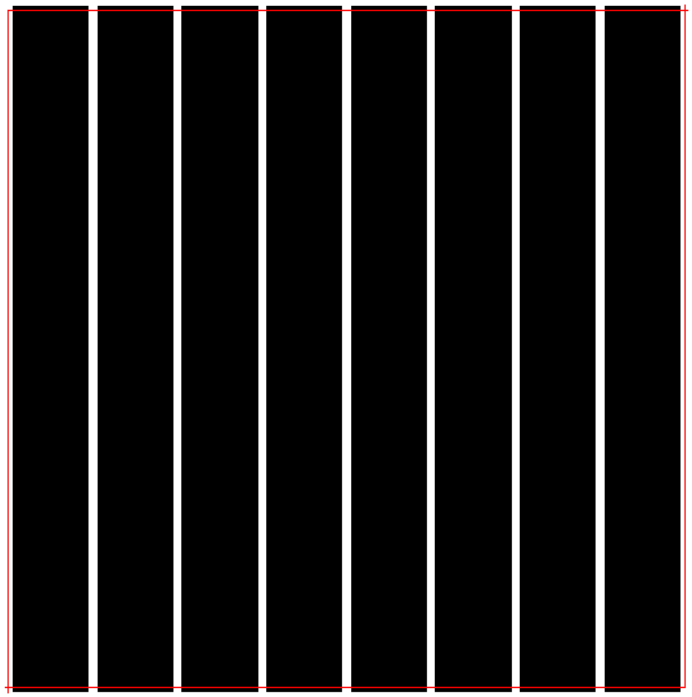


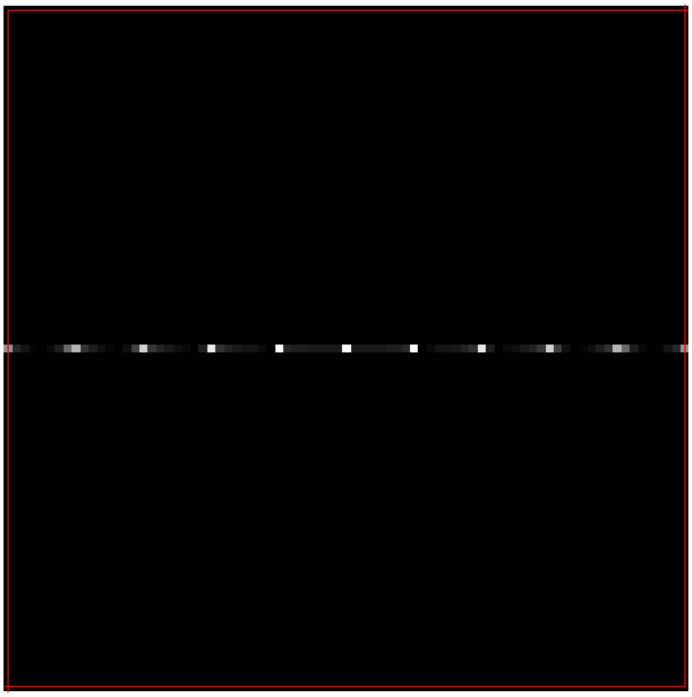
Comment on the magnitude of 2FFT of the image C.

We can consider the input image in the x and y axis seperately by considering 2D FFT as two seperate 1D FFT's fro each dimension. Input image in x axis is a DC signal. Thus, FFT in x axis should be an impulsive signal. Input image in y axis is a rectangular signal. Thus, FFT in y axis should be an sinc signal. Both are observed in the magnitude of our 2D FFT.

Q2d

```
D=zeros(81,81);
for dd=0:8
    D(:,10*dd+1)=1;
end
figure
imshow(D)
rectangle('position',[1 1 s(2) s(1)], 'edgecolor', [1 0 0])
rectangle('position',[0 0 s(2) s(1)], 'edgecolor', [1 0 0])
DFFT=fft2(D);
DFFT=DFFT/max(max(abs(DFFT)));
figure
imshow(fftshift(abs(DFFT)))
rectangle('position',[1 1 s(2) s(1)], 'edgecolor', [1 0 0])
rectangle('position',[0 0 s(2) s(1)], 'edgecolor', [1 0 0])
```



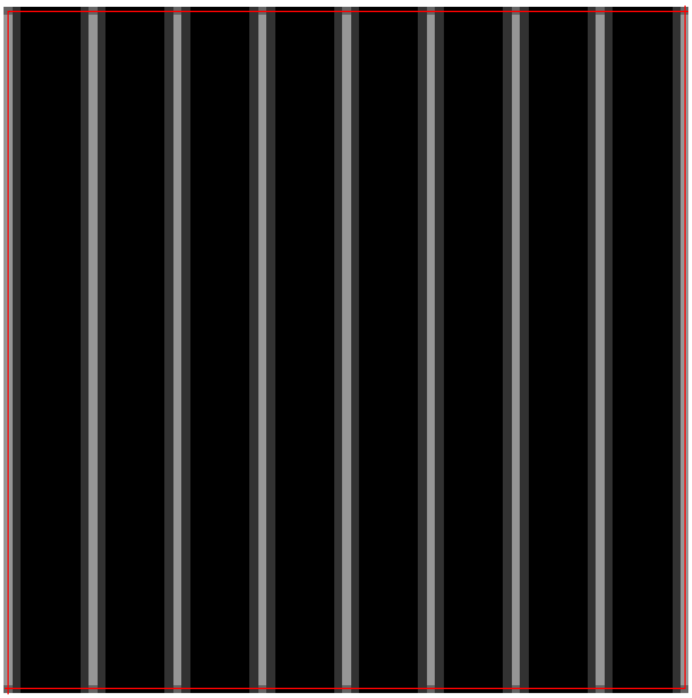


Comment on the magnitude of 2FFT of the image D.

The duality principle of Fourier Transform and the seperability of 2D transform into two 1D transforms are observed. Input image in x axis is an impulse train. Thus, FFT in x axis should be an impulse train. Input image in y axis is a number of DC signals. Thus, in FFT in y axis impulses at the x axis are observed.

Q2e

```
F1=[0 1/5 0; 1/5 1/5 1/5; 0 1/5 0];
DF=filter2(F1,D);
figure
imshow(DF)
rectangle('position',[1 1 s(2) s(1)], 'edgecolor', [1 0 0])
rectangle('position',[0 0 s(2) s(1)], 'edgecolor', [1 0 0])
```



What is the type of the filter F1, i.e, lowpass or highpass?

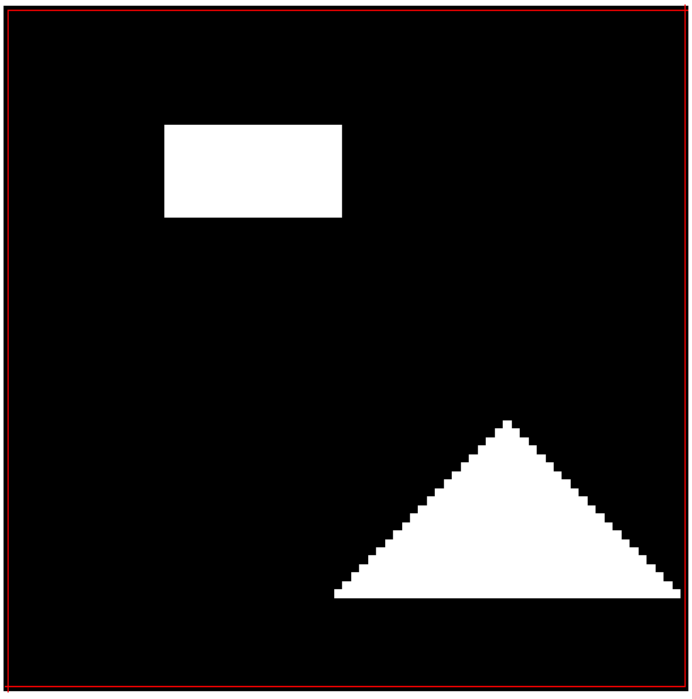
The type of the filter F1 is a lowpass filter. The similarity of patterns of a Gaussian lowpass filter and the F1 filter tells that they are very similar. Besides, it can be observed from the magnitude response of the filter.

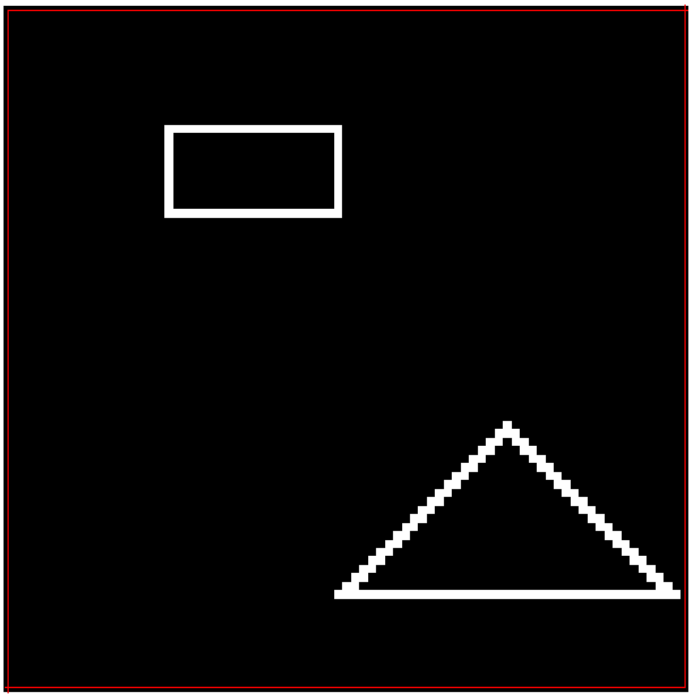
Comment on the effect of the filter F1 on the image D.

It is observed that highpass components of the Image D are suppressed. It smooths the sharp changes from black to white and white to black.

Q2f

```
E=zeros(81,81);
E(15:25,20:40)=1;
for ee=50:70
    E(ee,60+50-ee:60-50+ee)=1;
end
figure
imshow(E)
rectangle('position',[1 1 s(2) s(1)], 'edgecolor', [1 0 0])
rectangle('position',[0 0 s(2) s(1)], 'edgecolor', [1 0 0])
F2=[-1 -1 -1; -1 8 -1; -1 -1 -1];
EF=filter2(F2,E);
figure
imshow(EF)
rectangle('position',[1 1 s(2) s(1)], 'edgecolor', [1 0 0])
rectangle('position',[0 0 s(2) s(1)], 'edgecolor', [1 0 0])
```





What is the type of the filter F2, i.e, lowpass or highpass?

The type of the filter F2 is a highpass filter. If the difference between the central pixel of the image and the others is high, this filter will give a high value and vice versa. Thus, the filter eliminates low frequencies.

What is the special name of the filter F2?

This is a Laplacian filter, which is used to detect edges.

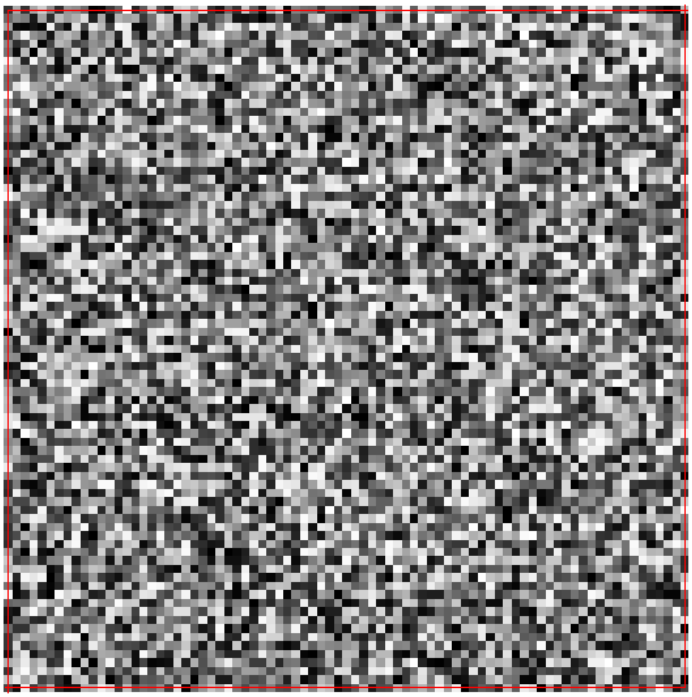
Comment on the effect of the filter F2 on the image E.

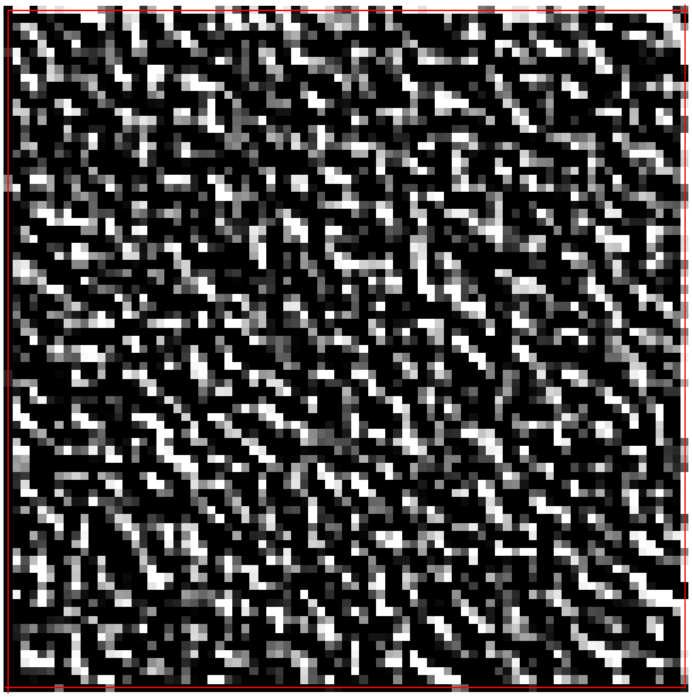
It is seen that edges of the objects in the image are found by the filter, which was expected since the filter is a highpass filter and the edges has high frequency components.

Q2g

```
G=rand(81,81);
figure
```

```
imshow(G)
rectangle('position',[1 1 s(2) s(1)], 'edgecolor', [1 0 0])
rectangle('position',[0 0 s(2) s(1)], 'edgecolor', [1 0 0])
F3=[0 -1 -1; 1 0 -1; 1 1 0];
GF=filter2(F3,G);
figure
imshow(GF)
rectangle('position',[1 1 s(2) s(1)], 'edgecolor', [1 0 0])
rectangle('position',[0 0 s(2) s(1)], 'edgecolor', [1 0 0])
```





What is the special name of the filter F3?

The special name of this filter is Gradient Filter. This filter is especially useful when intensity variations along a certain axis are enhanced.

Comment on the effect of the filter F3 on the image G.

We see that light intensity variations are enhanced, where the enhancement is being done in the x=y line.

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