

Name:

1. Graph the following 1D functions and their Fourier transform pair function.

1a. box function



1b. sinc function



2. Convolve the 4-neighbor Laplacian 3x3 filter with the given image, and show the value at every pixel in the output (assume zero-padding).

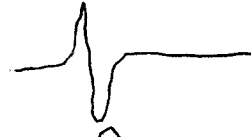
im	filter	convolved result
0 0 0 0 0 0 0		0 0 0 0 0 0 0
0 0 0 0 0 0 0		0 0 1 1 1 0 0
0 0 1 1 1 0 0	0 1 0	0 0 1 -2 -1 -2 1 0
0 0 1 1 1 0 0	1 -4 1	0 1 -1 0 -1 1 0
0 0 1 1 1 0 0	0 1 0	0 1 -2 -1 -2 1 0
0 0 0 0 0 0 0		0 0 1 1 1 0 0
0 0 0 0 0 0 0		0 0 0 0 0 0 0

3. Explain how subtracting the Laplacian of an image from the image will sharpen edges. In particular, give the details of line 4 of the image in problem 2 to demonstrate this.

An edge profile is like



The Laplacian there is like



So subtracting the two



makes the lower side  
of the edge even lower  
and the high side higher  
increasing the contrast

From 2:

im:	0	0	1	1	1	0	0
Laplacian:	0	1	-1	0	-1	1	0
subtracting	0	-1	2	1	2	-1	0

4. Write a Matlab function to create an MxN binary image of a circle with center  $(r_0, c_0)$ , and radius *radius* (see header).

```
function im = CS4640_make_circle(M,N,r0,c0,radius)
% CS4640_make_circle - make a circle in an image
% On input:
%   M (int): number of rows
%   N (int): number of cols
%   r0 (int): row of circle center
%   c0 (int): col of circle center
%   radius (double): radius of circle
% On output:
%   im (MxN binary image): with circle centered at (r0,c0)
% Call:
%   cir21 = CS4640_make_circle(101,101,51,51,21);
% Author:
%   T. Hendrerson
%   UU
%   Spring 2018
%
```

im = zeros(M,N);

for r = 1:M

for c = 1:N

        if  $(r-r_0)^2 + (c-c_0)^2 \leq \text{radius}^2$

            im(r,c) = 1;

end

end

end