Problem 1: Edge detection in space domain

For this problem, you can use Matlab commands `imfilter` or `filter2`, or the convolution code you wrote last time (this is the preferred option). Do not use commands 'edge' or 'fsepcial' in this problem. Pick an image with visible horizontal and vertical edges. Show your work and discuss your results.

1) Apply the horizontal Sobel mask to the image. Show the result.
2) Apply the vertical Sobel mask to the image. Show the result and compare with the previous question. Discuss your results.
3) Use the magnitude to combine horizontal and vertical edges. Show the result.
4) In the Sobel mask, the constant $c = 2$. We want to see the effect of $c$ on the edge detection process, try different values and see what happens.
5) Use the Laplacian mask to perform edge detection on the same image. Compare with the results of question 3).
6) Compare between the Laplacian and Sobel masks in terms of the computation time, use Matlab command `tic` - `toc`. For the Sobel mask, you need to consider the complete implementation, that is edge detection in both directions.

Problem 2: Edge detection in the frequency domain

For an image similar to the image of figure 1, do the following:

1) Obtain the FFT of the horizontal and vertical Sobel masks. You need to perform zero padding.
2) Perform filtering in the frequency domain using the horizontal Sobel mask.
3) Perform filtering in the frequency domain using the vertical Sobel mask.
4) Obtain the FFT of the Laplacian mask. You need to perform zero padding.
5) Perform filtering in the frequency domain using Laplacian to detect the edges.
6) Construct a 3 by 3 mask for the Laplacian of Gaussian (LoG) and then obtain its FFT. You can use fspecial for this question.
7) Perform filtering in the frequency domain using LoG to detect the edges.
8) Show and discuss your results.
Problem 3

Harris corner detector was introduced in 1988 for corner detection. An illustration is shown in figure 2. Apply the Harris detector to an image of your choice. Pick an image with visible corners. Mark all corners on the image in a similar way to figure 2. You can use commands

```matlab
C=corner(image); % to find corner points
imshow(image);hold on, plot(C(:,1),C(:,2),'ro') % to display image with corners marked by small red circles.
```

Do you think the Harris corner detector is a linear filtering operation? Explain

Hint

The following code can be used to display an image after performing the inverse FFT:

```matlab
imageD = ifft2(X);
dmin = min(min(abs(imageD)));    
dmax = max(max(abs(imageD)));    
figure(454) imshow( ( ifftshift(imageD)), [dmin dmax]),
```