Convolution and Blurring

Problem 1 *Create a* MATLAB *script m-file with the following statements:*

```
I = imread('logo.tif');
In = imnoise(I, 'gaussian', 0, 0.1);
K3 = [0 -1 0;-1 4 -1;0 -1 0];
O3 = conv2(I, K3, 'same');
level3 = graythresh(O3);
O3 = im2bw(O3,level3);
On3 = conv2(In, K3, 'same');
level3n = graythresh(On3);
On3 = im2bw(On3,level3n);
subplot(2,2,1), imshow(I,[]),  title('Original Image')
subplot(2,2,2), imshow(In,[]), title('Noisy Image')
subplot(2,2,3), imshow(O3,[]), title('Edges of original image')
subplot(2,2,4), imshow(On3,[]), title('Edges of noisy image')
```

Run the script, and observe what happens to the performance of the Laplacian when used on the noisy image. Reduce the variance from 0.1 to 0.01, 0.001, etc., and determine the point at which the edges can be detected accurately, without additional objects appearing in the image.

Problem 2 *Try the following statements in* MATLAB*:*

```
K = fspecial('gaussian', [3,3], 0.5)
sum(K(:))
K = fspecial('gaussian', [5,5], 0.5)
sum(K(:))
K = fspecial('gaussian', [32,32], 2);
sum(K(:))
mesh(K)
```

Notice that each time you sum the entries in the kernel you get the same result. Why? In the last case, the kernel is too large to display all of the entries on the screen, so we use `mesh` *to plot it.*

Problem 3 *The Gaussian kernel can be used in detecting edges of noisy images by inserting the following statements into your script file:*

```
K = fspecial('gaussian', [32, 32], 2);
In = conv2(In, K, 'same');
```

You may have to play around with the value of `sigma` *for the various noise levels. We also should note that there are many other approaches that can be used for edge detection, which can be found in books on image processing.*

In MATLAB*, try the following:*

```
I = imread('logo.tif');
K1 = fspecial('gaussian', [32,32], 1);
K2 = fspecial('gaussian', [32,32], 2);
K3 = fspecial('gaussian', [32,32], 3);
K4 = fspecial('gaussian', [32,32], 4);
O1 = conv2(I, K1, 'same');
O2 = conv2(I, K2, 'same');
O3 = conv2(I, K3, 'same');
O4 = conv2(I, K4, 'same');
figure(1), clf
subplot(2, 2, 1), imshow(O1, [])
subplot(2, 2, 2), imshow(O2, [])
subplot(2, 2, 3), imshow(O3, [])
subplot(2, 2, 4), imshow(O4, [])
figure(2), clf
subplot(2, 2, 1), mesh(K1)
subplot(2, 2, 2), mesh(K2)
subplot(2, 2, 3), mesh(K3)
subplot(2, 2, 4), mesh(K4)
```

How does the value of `sigma` *affect the* `mesh` *plot of the Gaussian kernel? How does it affect the convolved image?*