Filtering in Spatial Domain

Sharpening an image

1. Apply the following Laplacian to the image

```
1 1 1
1 -8 1
1 1 1
```

What do you observe about high and low frequencies (intensity variations) in the resulting image?

2. Blur the original image using a 2\textsuperscript{nd} derivative filter
3. Subtract the blurred image from the original to generate the mask
4. Add the mask to the original
5. Use equation (1) to perform step 4 and generate images for
   a. $k=1$ and
   b. $k>1$

\[
g(x,y) = f(x,y) + k g_{\text{mask}}(x,y) \quad (1)
\]

where $g(x,y)$ is the generated image, $f(x,y)$ is the original and $g_{\text{mask}}(x,y)$ is the mask.

What do you observe for images resulting from 5a and 5b?

Filtering Noise

1. Given the following noisy image, apply to it:

   ![Noisy Image]

   a. An average 3x3 filter
   b. An average 5x5 filter
   c. A 1\textsuperscript{st} derivative 3x3 filter
   d. A 2\textsuperscript{nd} derivative 3x3 filter
   e. A 3x3 median filter
   f. A 5x5 median filter

What do you observe? Which one of the filters removed the noise? Try to justify the reasons…