CS 6475: Assignment 5

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Part 1. Functions

imageGradient

For imageGradientX and imageGradientY, we simply loop through all the indices of the output array, setting $output[x][y] = input[x+1][y] - input[x][y]$ for imageGradientX and $output[x][y] = input[x][y+1] - input[x][y]$ for imageGradientY.

computeGradient

For computeGradient, we go through each position from [1,1] to [height - 1, width - 1], choosing each as the center. At this point we perform a cross-correlation, by doing a point to point multiplication. We do this by looping from k = -1 to k = 1. We implement the following equation for k=1:

$G[i,j] = \sum_{u=-k}^{k} \sum_{v=-k}^{k} h[u+k, v+k] F[i+u, j+v]$, where h is the kernel and F is the image. The +k in h is to allow for indexing from 0 into the kernel.

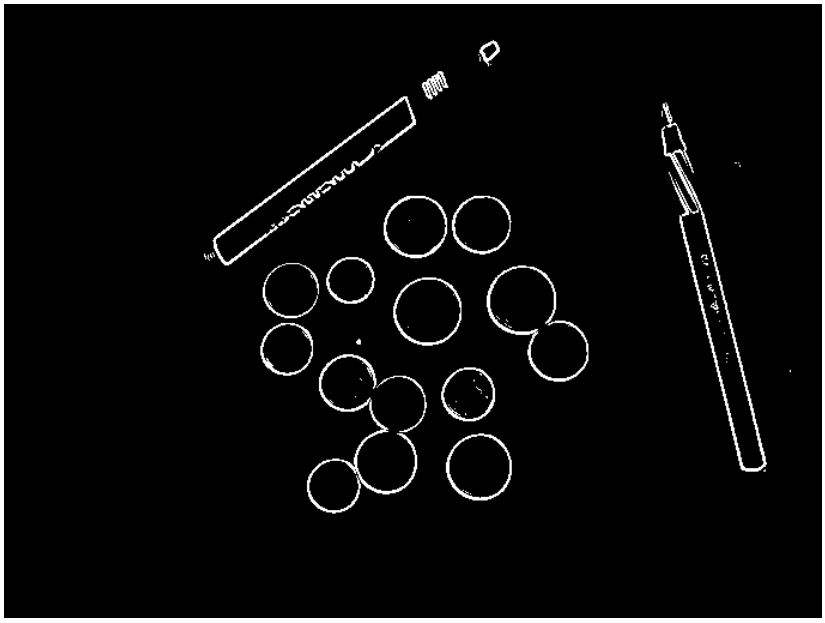
Part 2. Edge Detection

I use the following image for edge detection:

To start with, I read in the image in grayscale, and apply a Gaussian blur.
For edge detection, I tried simple image gradients, the Sobel operator and the Prewitt operator.

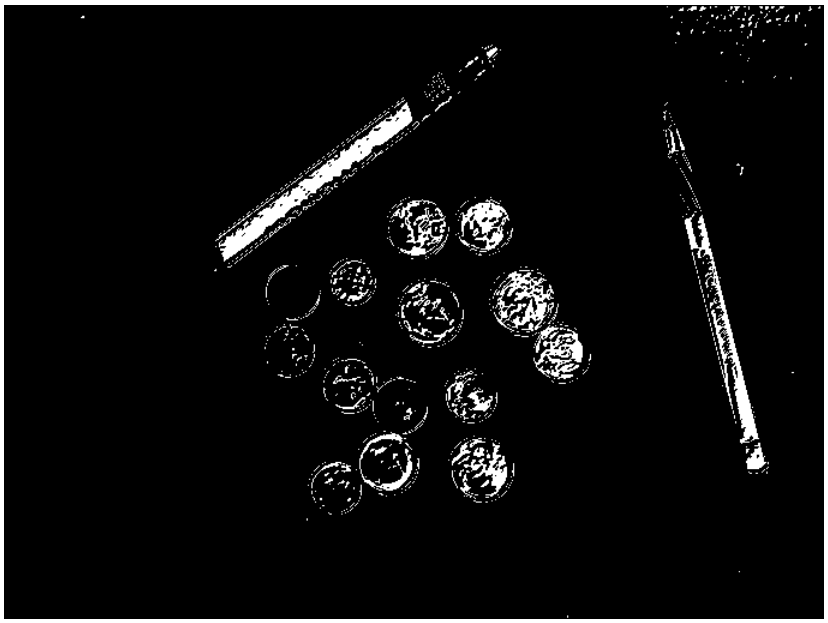
Image Gradients

For image gradients, I simply took the image gradient in the X and Y direction, and calculated the magnitude at each point. Then after normalizing, I tried different thresholds to see which worked best. The best results I got were at threshold 88.



Sobel Operator

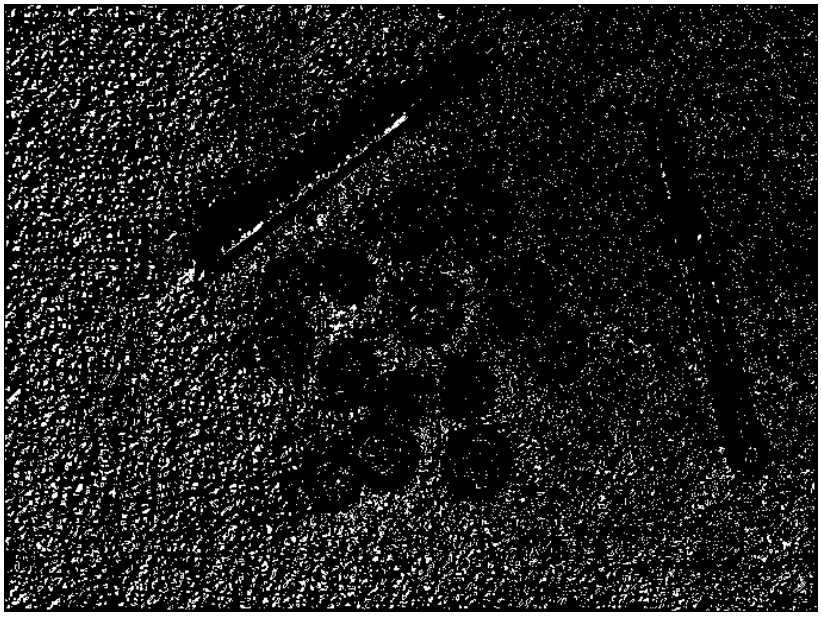
The results for Sobel operator were worse. We see a lot more noise in this case, both inside the objects and a little bit outside. The threshold we see here is 200, lower thresholds added more noise and higher thresholds would lose some of the edges of the pens and the coins.



We applied a similar technique, cross-correlating the image with the Sobel operator, and then computing the magnitude, normalizing and thresholding.

Prewitt Operator

The prewitt operator had by far the worst performance. We show a threshold of 250 here, and as we can see there is still a lot of noise. The method of generation is similar to the method for the Sobel operator.



Canny Edge Detection