Homework 1

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After passing the test cases, I ran the `hw1.py` on two images with varying parameters as shown below.

Original Image	***Filtered image with*** $k = 5, \sigma = 1$	***Filtered image with*** $k = 5, \sigma = 4$
Original Image	***Filtered image with*** $k = 3, \sigma = 4$	***Filtered image with*** $k = 7, \sigma = 4$

Struggles

I personally had most of my troubles implmenting the formula. First, the gaussian function at page 50 in the slide is probabily incorrect. The formula is listed as

$$H[u,v] = 2\pi\sigma^2 e^{-\frac{u^2+v^2}{\sigma^2}}$$

But the correct formula should be

$$H[u,v] = \frac{1}{2\pi\sigma^2} e^{-\frac{u^2+v^2}{2\sigma^2}}$$

Second, the following convolution formula at page 60 was also somehow problematic.

$$H * F = \sum_{u=-k}^{k} \sum_{v=-k}^{k} H[u,v]F[i-u, j-v]$$

The issue is that $H[-k,-k]$ is really refering to $H[0,0]$ in the implementation, but if you just write $H[-k,-k]$ in the code, it will still run as python interprets it as the last k element in the array, which basically results in correlation instead of convolution. This is a subtle bug that was difficult to detect.

In any case, I eventually draw a picture and figured out what convolution actually means. It suggests you should do $H[0,0] * F[k,k] + H[0,1] * F[k,k-1] \cdots$, almost multiplying elements on a "circle" at opposite direction.

> Written with StackEdit.