

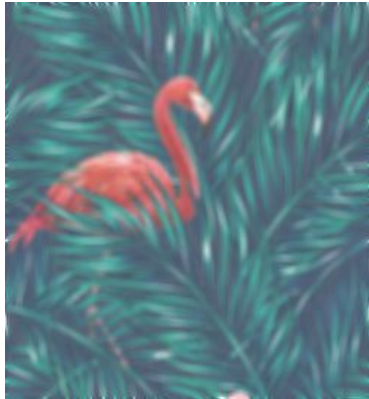





Homework 1

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

| | | |
|---|---|---|
| <i>Original Image</i> | <i>Filtered image with $k = 5, \sigma = 1$</i> | <i>Filtered image with $k = 5, \sigma = 4$</i> |
|  |  |  |
| <i>Original Image</i> | <i>Filtered image with $k = 3, \sigma = 4$</i> | <i>Filtered image with $k = 7, \sigma = 4$</i> |
|  |  |  |

Struggles

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

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

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 $H[0, 0] * F[k, k] + H[0, 1] * F[k, k - 1] \dots$, almost multiplying elements on a “circle” at opposite direction.

Written with [StackEdit](#).