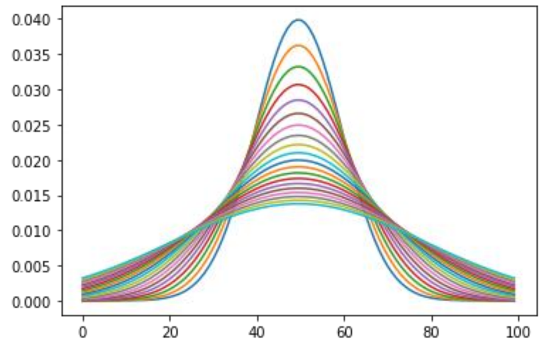
Homework 06 Report

2

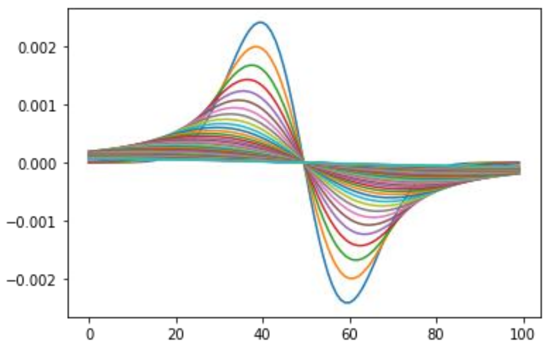
2.1 Given the standard deviation and the number of points sampled, the 1D Gaussian filter is calculated based on the following math formula:

$$g(x,\sigma) = \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{x^2}{2\sigma^2}}$$



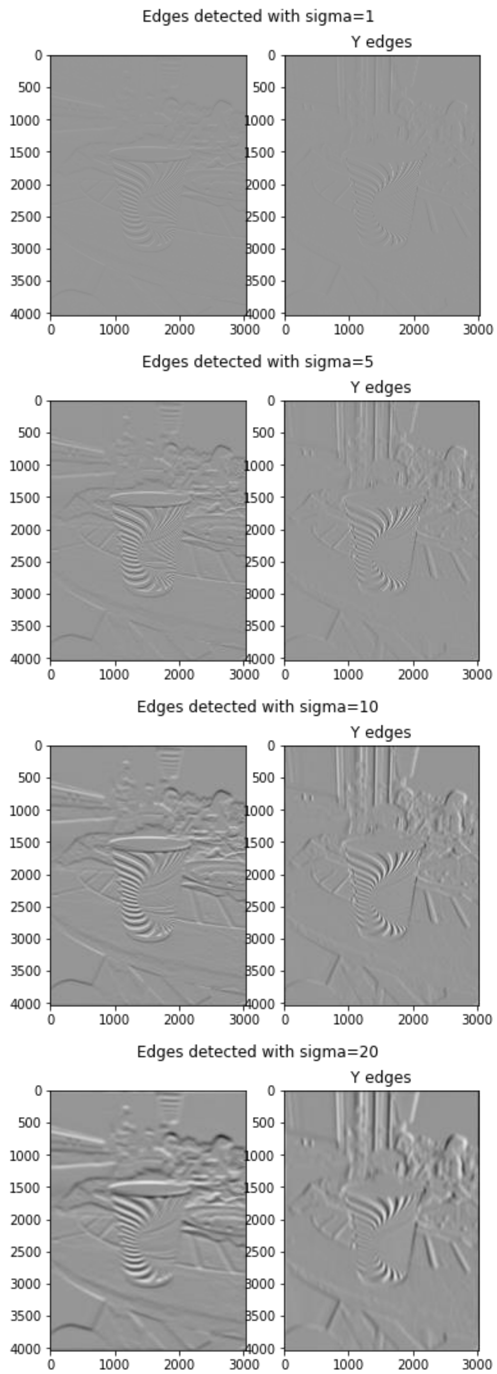
2.2 Given the standard deviation and the number of points sampled, the 1D Gaussian filter is calculated based on the following math formula:

$$\frac{\partial g(x,\sigma)}{\partial x} = -\frac{x}{\sigma^3\sqrt{2\pi}}e^{-\frac{x^2}{2\sigma^2}}$$



2.3 The 1D filter was stacked vertically to detect the edges in y direction. It was transposed and stacked horizontally to detect the edges in x direction.

2.4 Applying torch library to the image to detect edges.

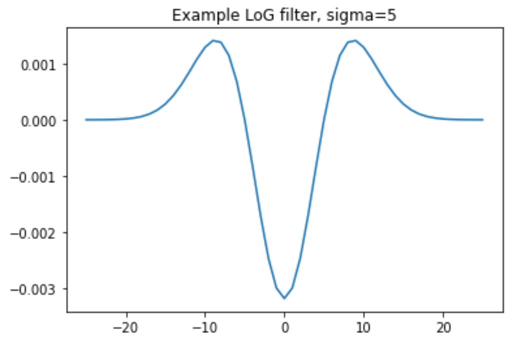


2.5 From the image, it could be told for the edges in x direction were more emphasized by applying edge filter in x dimension and vise versa. Also, as Gaussian filter is a low pass filter and sigma controls the variance around the mean. As sigma increases, more variance was allowed and thus the edge has become blurrier.

3.

3.1 The Laplacian of Gaussian is generated by :

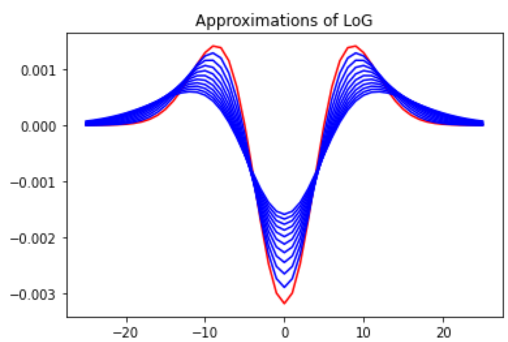
$$\frac{\partial g(x,\sigma)}{\partial^2 x} = -\frac{\sigma^2 - x^2}{\sigma^5\sqrt{2\pi}} e^{-\frac{x^2}{2\sigma^2}}$$

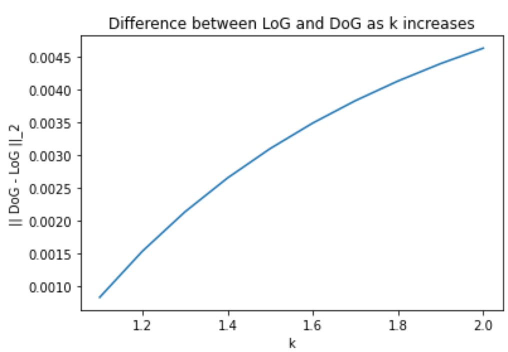


3.2

(a) Please refer to the code. As the plots have shown, as k gets closer to 1, the difference between LoG and DoG gets smaller.

(b) DoG is an approximation of LoG by using finite difference. As k gets closer to 1, kσ gets closer to σ, thus the approximation is more accurate.





(c) The plot shows that as k tends to 1, DoG would get closer to LoG.

(d) Since we are going to find the maxima across the whole scale space, another normalizing factor for different scales would be required. For LoG, the scale factor would be σ^2, which would cancel out the σ^2 in the denominator of DoG and the remaining part is just a constant across the scales. Thus we could forget the normalizing factor.

3.3