Assignment 2

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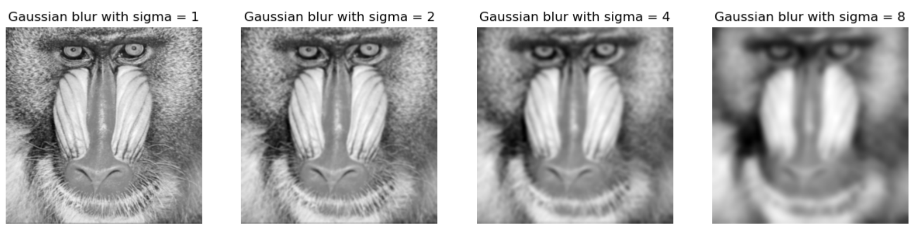
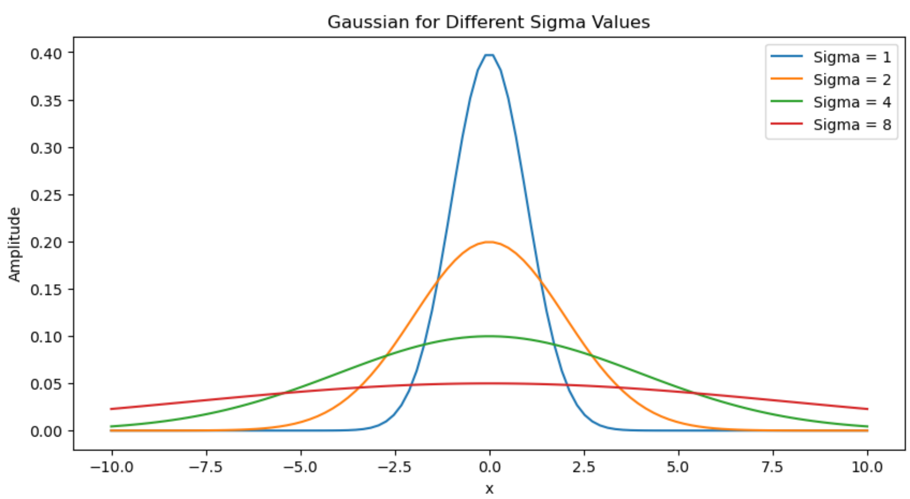
Gaussian Filtering

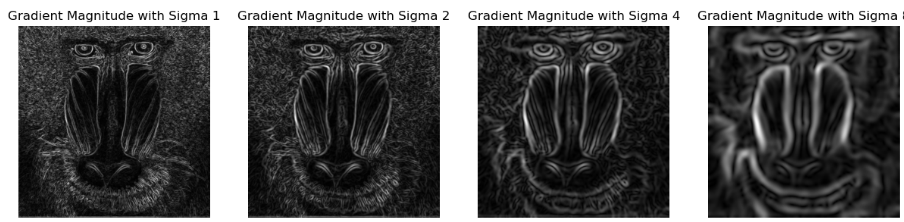


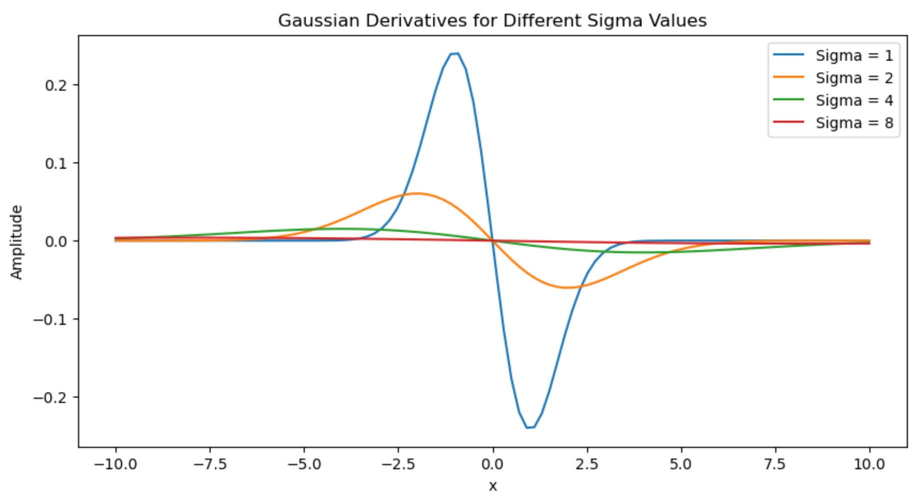


In this exercise, we used Gaussian filtering, which is a smoothing technique that uses a sliding-window approach to replace each pixel by the weighted average of all pixels in that window.
For a lower sigma, we observe fine textures, clearer edges, and higher frequency

noise. Looking at the plot, we can see a narrower bell curve with a higher amplitude that preserves a greater variety of pixel values.
For a higher sigma, we observe large-scale structures, blurred edges, and noise reduction, making the image appear smoother. As seen in the plot, there is a wider bell curve with a lower amplitude that preserves fewer pixel values.

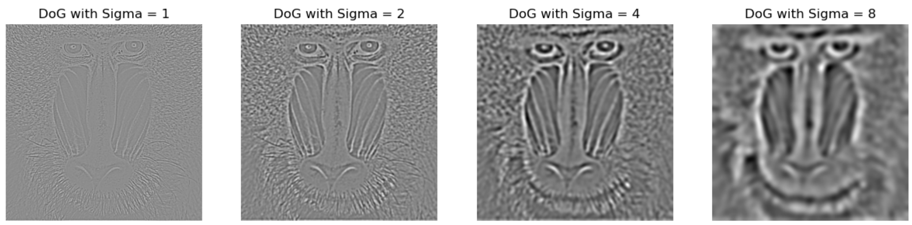
Gradient Magnitude Computation





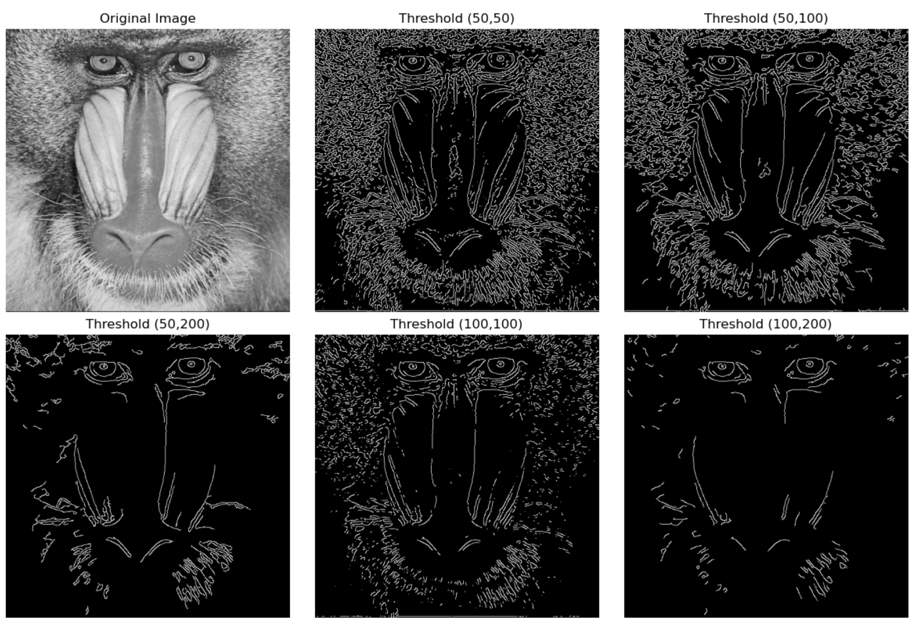
In this exercise, we computed the gradient magnitudes of the image, which are mainly used for edge detection. Unlike Gaussian filtering, it does not compute the pixel values but their rate of change.
For smaller sigma values, we observe higher frequency edges with a lesser gradient magnitude. As sigma increases, we start seeing more major boundaries with a high magnitude.
The same can be seen in the plot, where lower sigma values have narrower curves with a higher amplitude, which flatten with increasing sigma.

Laplacian-Gaussian Filtering



In this exercise, we implemented the difference of Gaussian, where we first computed two blurred images with scaled sigma values and then calculated the difference between the two images. It is commonly used for edge detection.
At smaller sigma values, the edges appear stronger since the difference between the two images is minimal. With increasing sigma, this difference grows, and fine edges disappear.

Canny Edge Detection



In this exercise, we performed Canny edge detection, where we filter out edges based on two thresholds. Any pixel that falls below the lower threshold is rejected, whereas any pixel that falls above the upper threshold is accepted.

Intermediate pixels are only accepted if they connect to a pixel that exceeds the upper threshold.
The higher we set the boundaries, the less pixel values are included, leading to less detected edges, as can be seen for (100,200). Very low values, such as (50,50), preserve too many edges, making the image cluttered. We choose (100,100) as appropriate parameters since they give us a good trade-off between too much noise and loss of important structures.