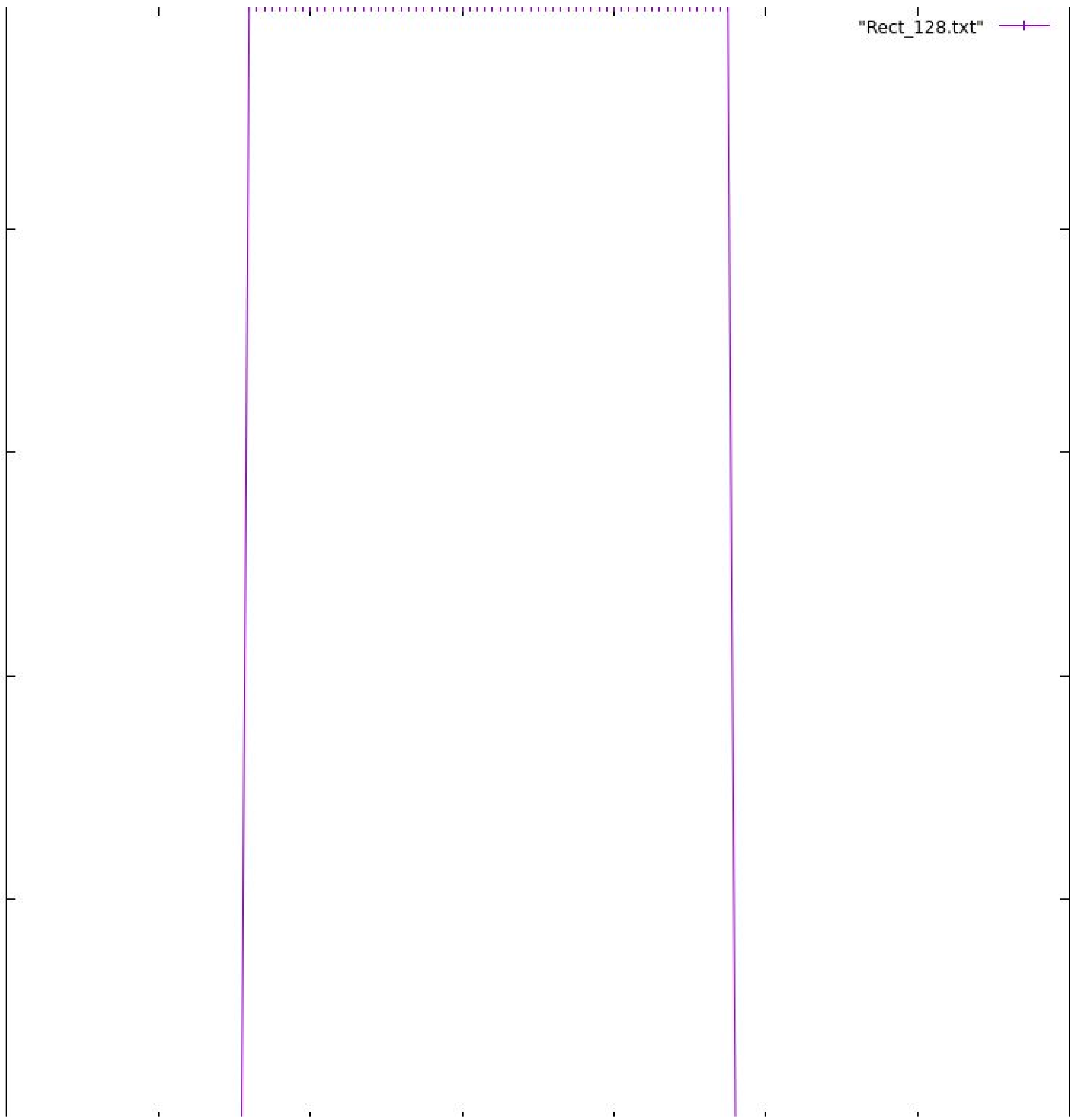
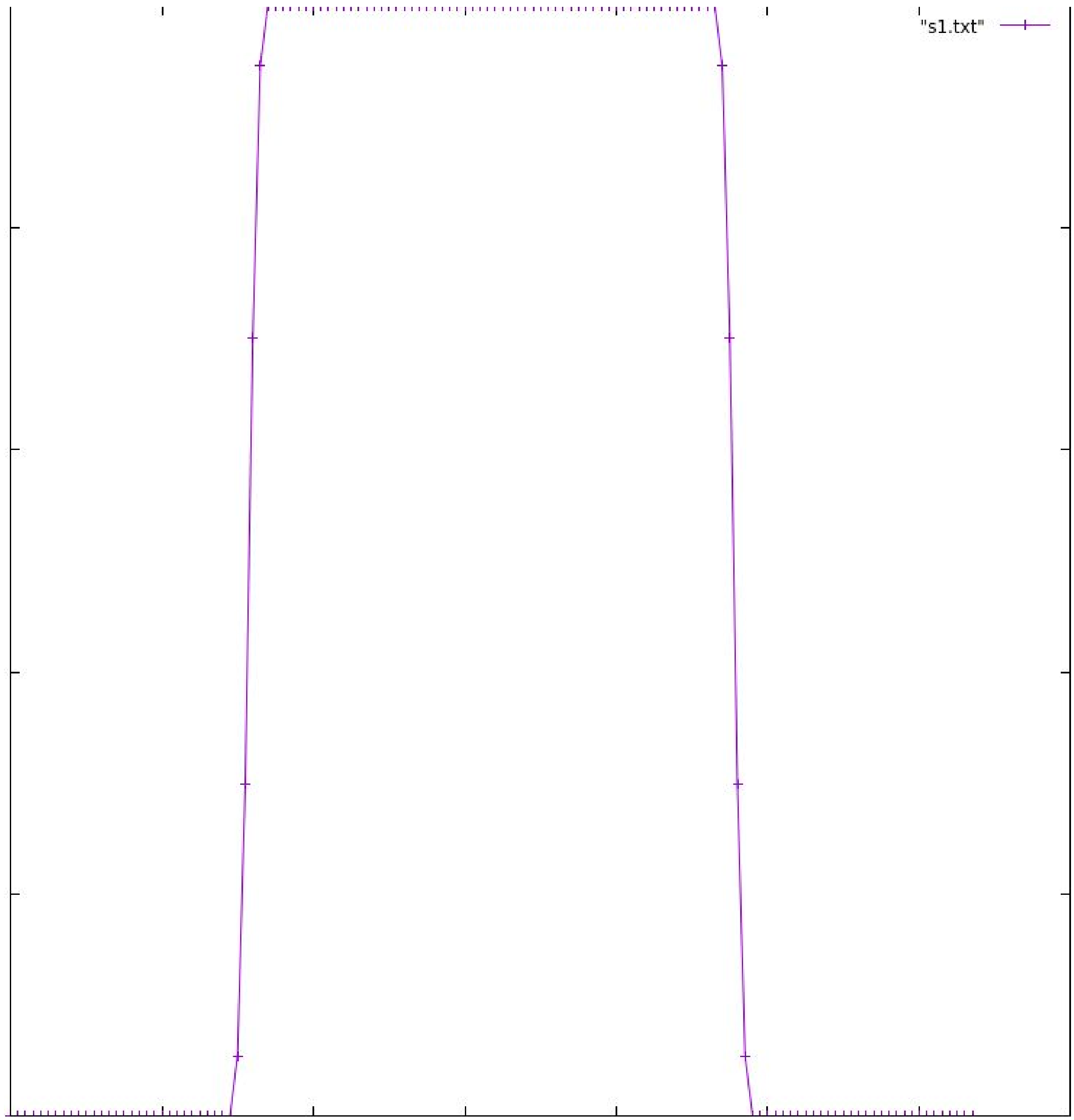
Jonathon Hewitt

PA1_pb1 Report

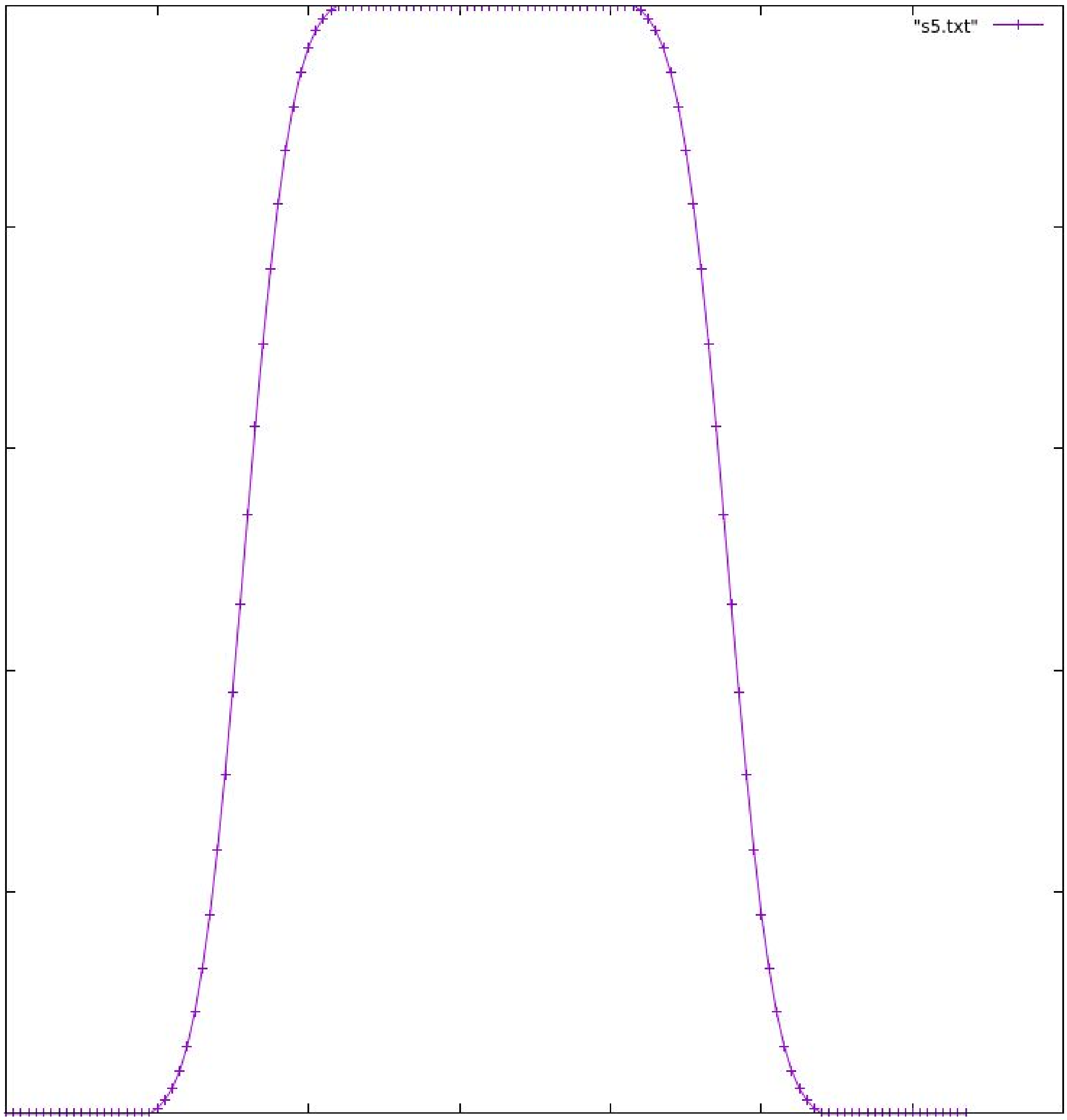
Gaussian Smoothing
Part 1:
Smoothing using a 1D Kernel on a 1D set of data points:
As an example input, we have a simple square wave. We then pass a 1D gaussian filter over it.
The filter is generated using a user inputted sigma, and the mask size is given by 5 * sigma.

Original Square Graph:


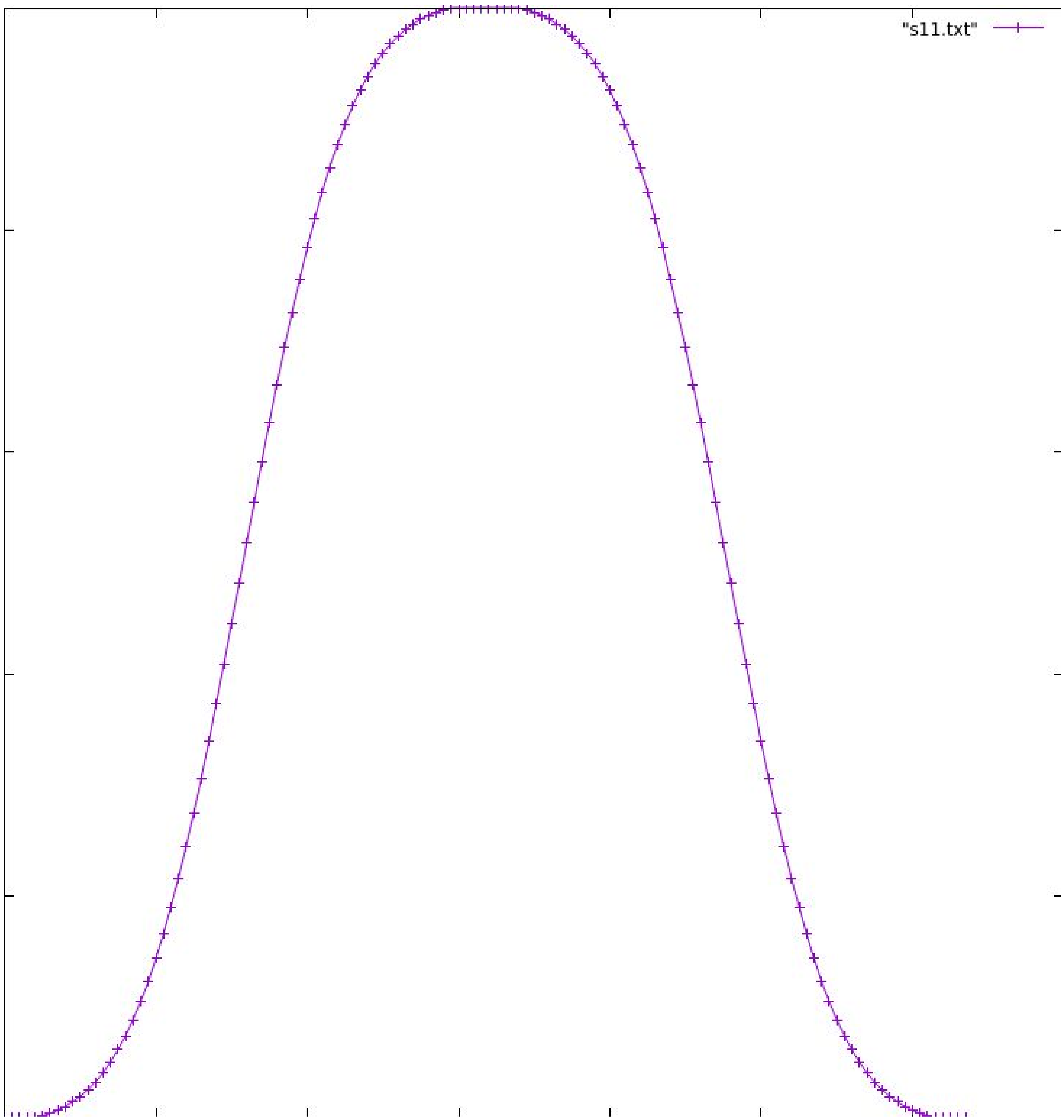
Graph Smoothed with Sigma = 1:



Graph Smoothed with Sigma = 5:



Graph Smoothed with Sigma = 11:



Results:
As we can see, the results from using a gaussian filter with larger sigma values on a square graph results in a rounder gaussian curve as sigma gets larger.

Part 2:
In part 2 I extended the Gaussian kernel generator to generate a 2D filter, and implemented a correlation function for 2D images. Below are the results of correlating this filter over the lenna image.

Original Image:

Image after filtering with sigma = 1:

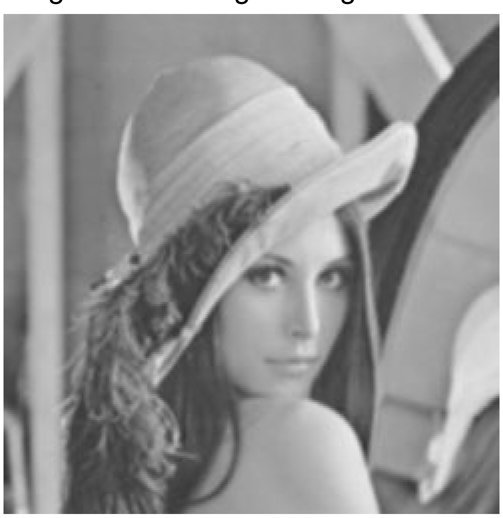


Image after filtering with sigma = 5:

Image after filtering with sigma = 11:

Results:
The higher the sigma value used, the more drastic the blur effect becomes.

Part 3:
Instead of correlating using a 2D gaussian mask, the mask was separated into two 1D masks. One for the x and then one for the y directions. These masks are applied separately, and the result is equivalent to using a 2D gaussian mask, however the time complexity of the correlation is much smaller than using a 2D mask. Results are shown with the lenna image.

Original Image:

Image after filtering with sigma = 1:

Image after filtering with sigma = 5:

Image after filtering with sigma = 11:

Results:
As we can see, the resulting images are identical when using a 2D kernel and 2 1D kernels. Below we can see the different in time it takes to run the original blur program versus the separated version.

```
[jonathon@t420]: ~/Documents/github/zotlann/cs485Hewitt/PA1/PA1_pb1/build>$ time ./blur -s 11 -i ../assets/lenna.pgm -o lenna.pgm

real    0m1.192s
user    0m1.161s
sys     0m0.023s
[jonathon@t420]: ~/Documents/github/zotlann/cs485Hewitt/PA1/PA1_pb1/build>$ time ./blur_separated -s 11 -i ../assets/lenna.pgm -o lenna.pgm

real    0m0.271s
user    0m0.241s
sys     0m0.028s
[jonathon@t420]: ~/Documents/github/zotlann/cs485Hewitt/PA1/PA1_pb1/build>$
```

On a image of 256x256, with sigma = 11, and kernel size = 55, the separated version is 4.4 times faster than the original 2D correlation version.