Final Lab

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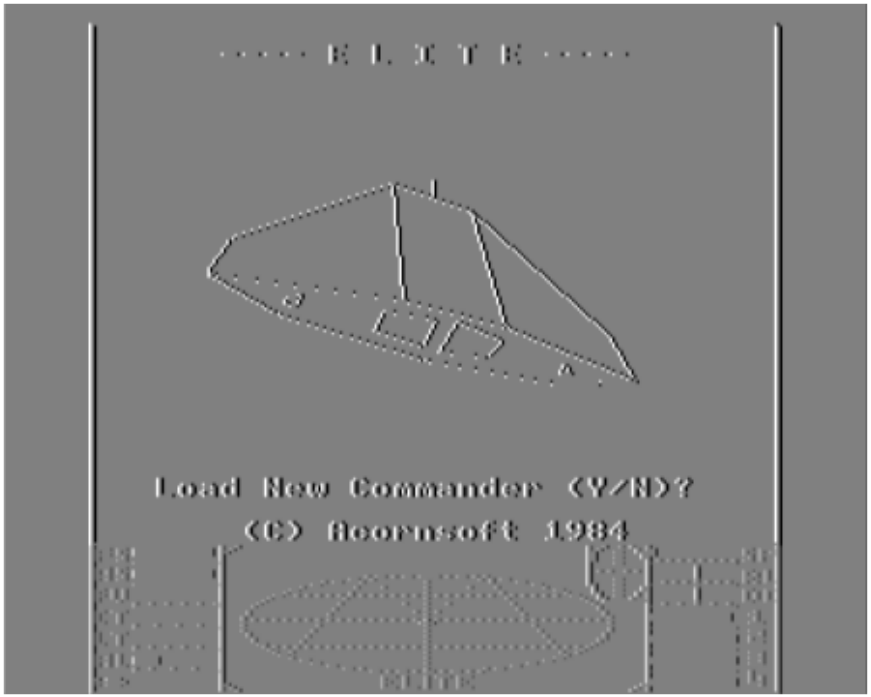
Image Kernels

By convulsing images with one of the following kernels, the resulting image's features are accentuated, as a's matrix derives the vertical features, especially from the top, and b's features derive the left side features, as well as horizontal features. Changing the values in the matrix would change the resulting output.

$$a = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}$$

$$b = \begin{bmatrix} 1 & 0 & -1 \\ 2 & 0 & -2 \\ 1 & 0 & -1 \end{bmatrix}$$

Images



The one on the left uses the a matrix while the one on the right uses the b matrix

Timing

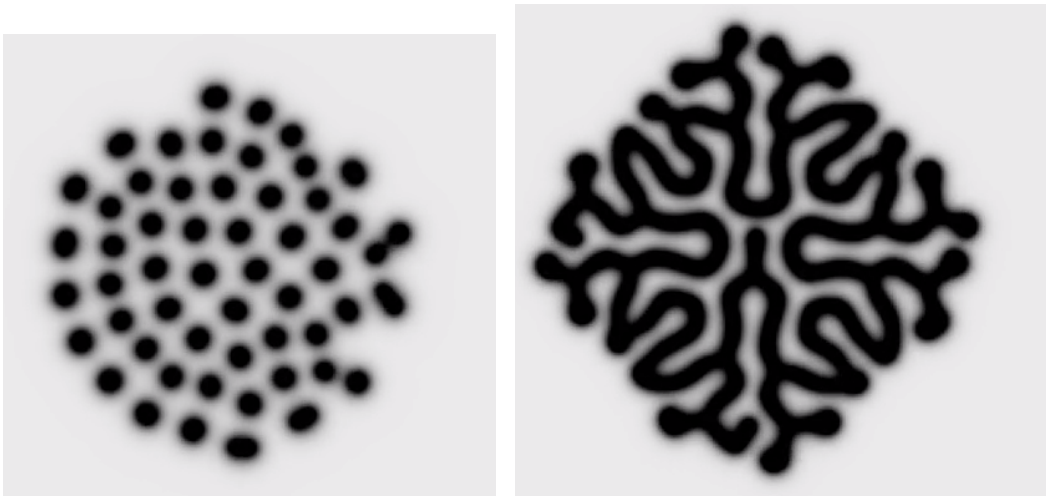
While having a convolution method is important, it is arguably more important to actually be able to use the system in day to day life. This is why computational speed is so important and why we have to make sure that the items we are using are the most efficent possible. In our testing, we found that using the optimized version on the GPU was the best way to go, processing convolutions at just over $\frac{1}{100}$ of a second!

Automata and Simulations

The following processes were modeled in this lab: The Game of Life, Surface Tension model, Forest Fire model, Nonlinear Waves, Wireworld Wire and Oscillator, Fitzhugh-Nagumo Reaction Diffusion and Gray Scott Reaction Diffusion. The first 6 were models with simple rules defining progression, while the last 2 modeled PDE's with complex graphical frames.

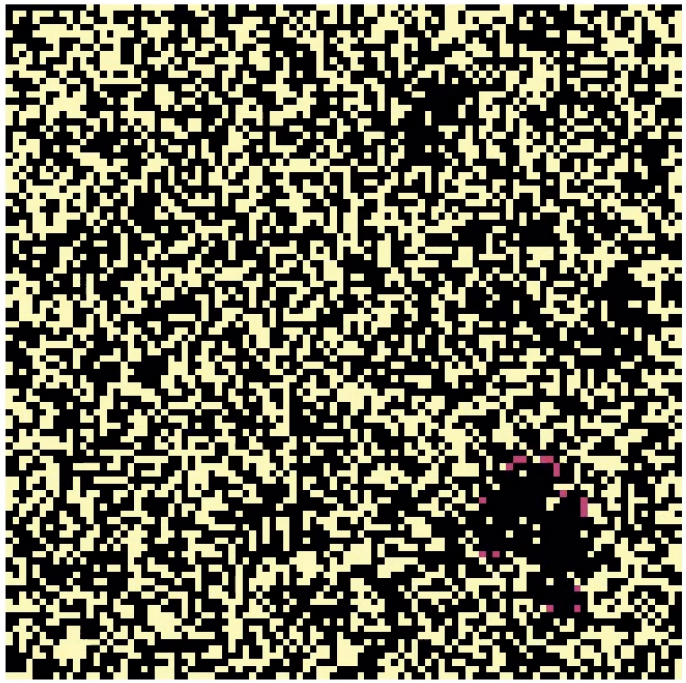
Gray Scott Reaction Diffusion

A great example of the Gray Scott Reaction Diffusion is the bacteria setup which naturally represents a dividing bacteria. While seemingly unrelated to mathematics, one can model the bacteria's actions through mathematics with startling accuracy.



Another example would be the worm2 function. This is a more complex version of things like the game of life.

Forest Fire Model



The randomness of the forest fire directly relates to the presence of forest area, which is the primary condition for a lightning strike to start a fire, this basic condition provides for such an intriguing interaction that results in beautiful images.