CMSC 317: The Computational Image
Assignment 2: Filtering

Part One

As part of a Processing sketch, you should implement the following filters (each written as a function that takes a `PImage` and returns a new `PImage`):

- Blur (using the box or gaussian blur)

$$\frac{1}{9}\begin{bmatrix}1 & 1 & 1\\ 1 & 1 & 1\\ 1 & 1 & 1\end{bmatrix} \qquad \frac{1}{256}\begin{bmatrix}1 & 4 & 6 & 4 & 1\\ 4 & 16 & 24 & 16 & 4\\ 6 & 24 & 36 & 24 & 6\\ 4 & 16 & 24 & 16 & 4\\ 1 & 4 & 6 & 4 & 1\end{bmatrix}$$

- Horizontal Sobel (the resulting values may be negative, either add an offset or use the absolute value)

$$\frac{1}{8}\begin{bmatrix}-1 & -2 & -1\\ 0 & 0 & 0\\ 1 & 2 & 1\end{bmatrix}$$

- Vertical Sobel (the resulting values may be negative, either add an offset or use the absolute value)

$$\frac{1}{8}\begin{bmatrix}-1 & 0 & 1\\ -2 & 0 & 2\\ -1 & 0 & 1\end{bmatrix}$$

- Sobel (as the magnitude of the gradient from the horizontal and vertical sobel operators)

Part Two

Use your filters to display the webcam's images in a creative manner. Some possible ideas:

- Use a sequence of filters in some creative way
- Use different filters in different parts of the image
- Use a sequence of filters overlayed using an alpha layer on the original image

Part Three

Reimplement either the blur or sobel filters as two one-dimensional filters. Compare the computation time spent with the standard k^2 filter and the $2k$ implementation that exploits the linear separability of the filter.

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