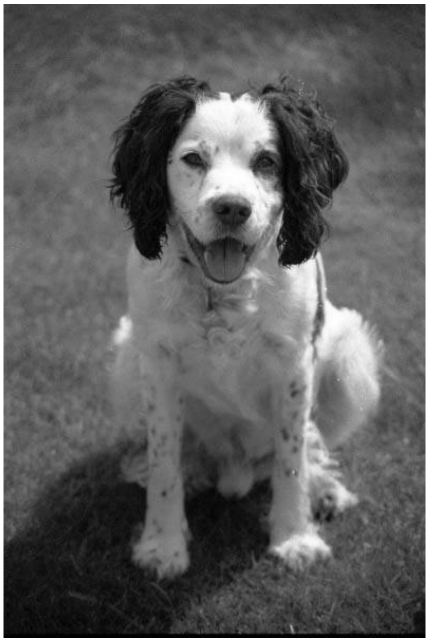
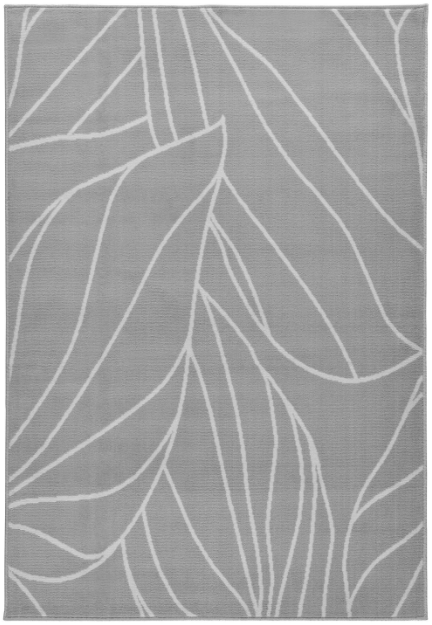
Brian Summers
CMSC427
Problem Set 5
4/21/15

Problem Set 5 Report

1. Greyscale function





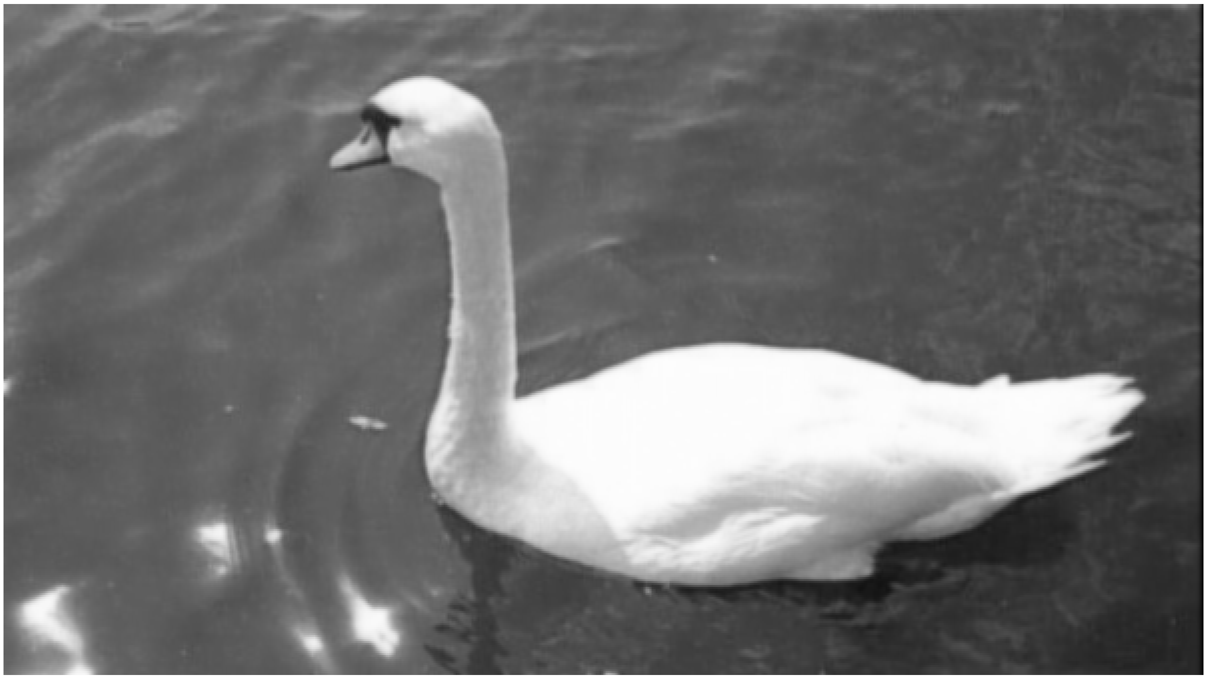
2. Correlation function. Note: I have two correlation functions, one that takes in a filter value and a dimension, and one that takes in a 1D array. Both are basically the same.

```
/* Correlates a filter value on an image. This function takes in a greyscale BMPImage,
and a separable filter with n x n dimensions and a uniform filter value. The filter
value parameter should be the value before separation. For instance, if the box filter
has all values of 1/49, then 1/49 should be used as input, as this function will
separate the box filter into two 1D filters with the value of 1/7. The function then
applies the two 1D filters to the image.*/

void correlationFunction(BMPImage *image, float filter, int n) {

	float readVal, writeVal, filterVal;

	filterVal = sqrt(filter);

	//for each pixel in the image

	for (int y = 0; y < image->getYSize(); y++) {

		for (int x = 0; x < image->getXSize(); x++) {

			writeVal = 0;

			readVal = 0;
```

```
            //filter across x
            for (int i = -1 * (n / 2); i <= (n / 2); i++) {
                int offsetXCoord = x + i;
                //padding left
                if (offsetXCoord <= 0) {
                    //use left most value in row
                    image->readPixel(0, y, readVal, readVal, readVal);
                    writeVal += readVal * filterVal;
                }
                //padding right
                else if (offsetXCoord >= image->getXSize() - 1) {
                    //use right most value in row
                    image->readPixel(image->getXSize() - 1, y, readVal,
readVal, readVal);
                    writeVal += readVal * filterVal;
                }
                else {
                    //use value at offset in row
                    image->readPixel(offsetXCoord, y, readVal, readVal,
readVal);
                    writeVal += readVal * filterVal;
                }
            }
            clampValues(&writeVal);
            image->writePixel(x, y, writeVal, writeVal, writeVal);
        }
    }
    //for each pixel in the image
    for (int y = 0; y < image->getYSize(); y++) {
        for (int x = 0; x < image->getXSize(); x++) {
            writeVal = 0;
            readVal = 0;
            //filter across y
            for (int i = -1 * (n / 2); i <= (n / 2); i++) {
                int offsetYCoord = y + i;
                //padding top
                if (offsetYCoord <= 0) {
                    //use top most value in column
                    image->readPixel(x, 0, readVal, readVal, readVal);
                    writeVal += readVal * filterVal;
                }
                //padding bottom
                else if (offsetYCoord >= image->getYSize() - 1) {
                    //use top most value in column
                    image->readPixel(x, image->getYSize() - 1, readVal,
readVal, readVal);
                    writeVal += readVal * filterVal;
                }
                else {
                    //use value at offset in column
                    image->readPixel(x, offsetYCoord, readVal, readVal,
readVal);
                    writeVal += readVal * filterVal;
                }
            }clampValues(&writeVal);
            image->writePixel(x, y, writeVal, writeVal, writeVal);
        }
    }
}
```

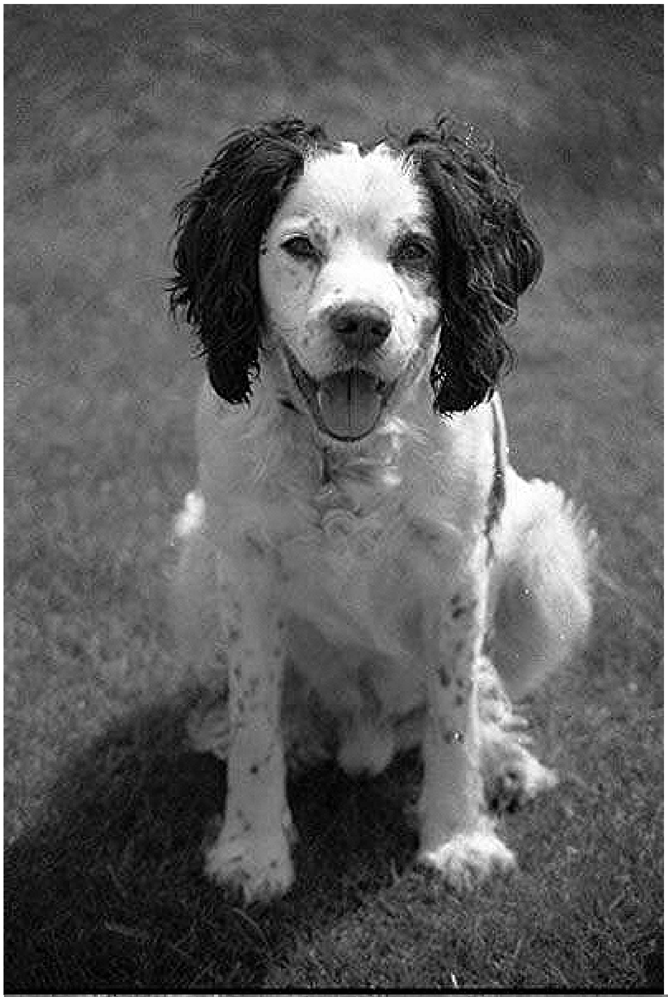
2. Gaussian function

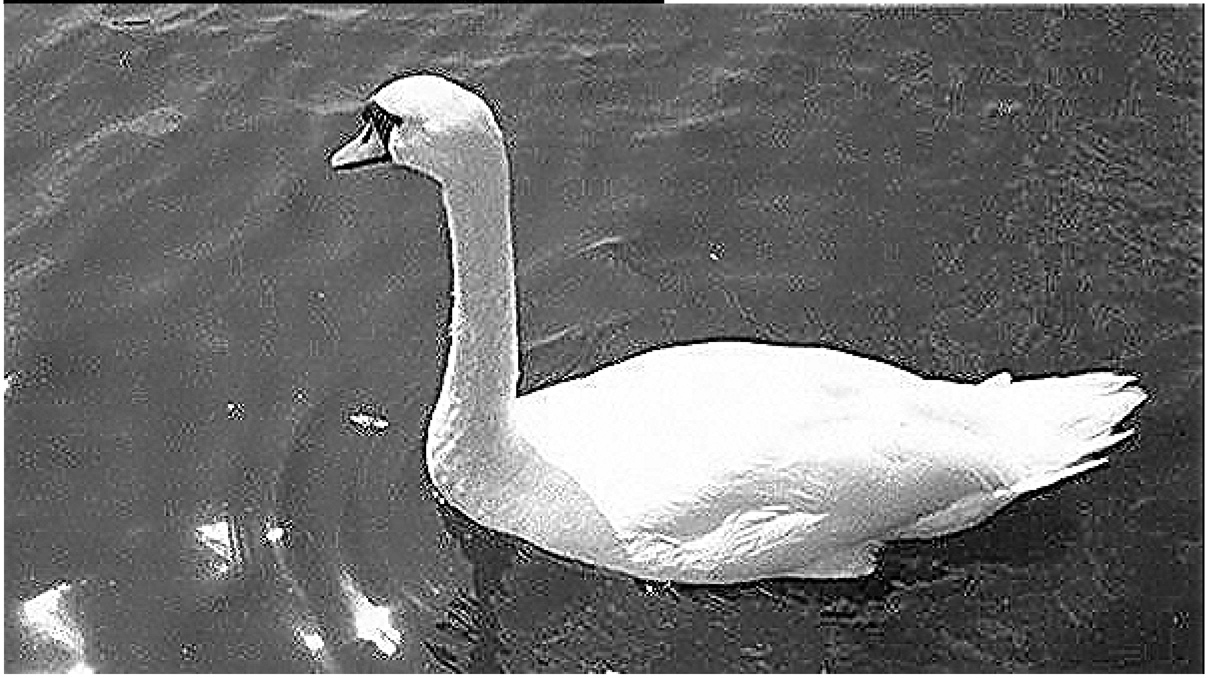
```
/* Creates a gaussian filter. This function takes in a value for sigma and a pointer
to an integer. The function will create a new 1D filter and populate it with values
for the gaussian filter. The function will return a pointer to the 1D filter, and will
modify the integer pointer to reflect the dimension of the filter. */

float* filterGaussianFunction(float sigma, int *dimen) {

        const float PI = 3.1415927;

        int filterDimen = 2 * (ceilf(3 * sigma)) + 1;

        float *filter = new float[filterDimen];

        int j = 0; //index in the filter

        //populate the filter

        for (int i = -1 * (filterDimen / 2); i <= (filterDimen / 2); i++) {

                //calculate filter value and place in filter

                filter[j] = sqrt(1 / (2 * sigma * sqrt(2 * PI))) *exp(-1 * (i * i) / (2 *
sigma * sigma));

                j++;

        }

        //normalize the filter values

        float sum = 0.0f;

        for (int i = 0; i < filterDimen; i++) {

                sum += filter[i];

        }

        for (int i = 0; i < filterDimen; i++) {

                filter[i] = (filter[i] / sum);

        }

        *dimen = filterDimen; //"return" the dimension of the filter

        return filter; //return the filter

}
```



3. Sharpening function

```
/* Creates a sharpening filter. This function takes in a value for sigma, a pointer to
a 1D Gaussian filter and the dimension of the filter. The function will subtract the
Gaussian filter from an all-pass filter with a center value of 2, with the rest being
zero. The function returns the filter T-G. */

float* filterSharpeningFunction(float sigma, float *filter, int dimen) {

	for (int i = 0; i < dimen; i++) {

		if (i == (dimen / 2)) {

			filter[i] = 2 - filter[i]; //center value of filter T is 2,
subtract the center gaussian filter value

		}

		else {

			filter[i] *= -1.0f; //all other values of T are 0, so subtract
gaussian filter value at this position

		}

	}

	return filter;

}
```





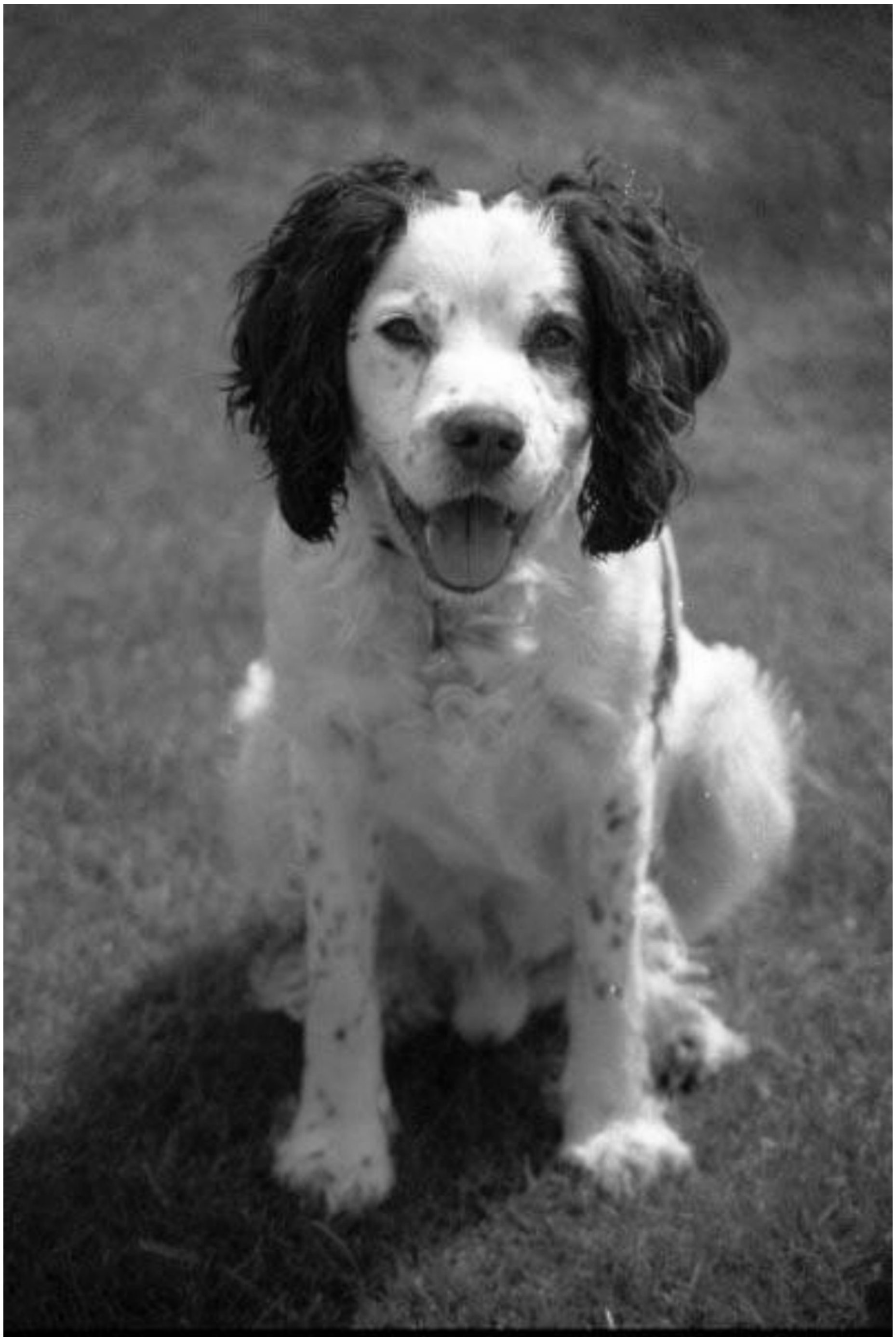
4. Resize function

```
/* Resizes an image using bilinear interpolation to fill in pixel values. The function
will look at surrounding pixels and interpolate the color for a given pixel. */

void resizeFunction(BMPImage *image, float scale, char *saveName) {

        float temp1 = image->getXSize() * scale;

        float temp2 = image->getYSize() * scale;

        /* compute the image size */

        int remainder = (int)fmodl(temp1, 4L);

        if (remainder != 0) {

                temp1 += (4 - remainder);

        }

        BMPImage scaledImage = BMPImage(temp1, temp2);

        int xLeft, xRight, yTop, yBot;

        float topLeftVal, topRightVal, botLeftVal, botRightVal;

        float weightX, weightY;

        float leftBorderVal, rightBorderVal;

        float finalVal;

        //for all pixels in the scaled image

        for (int scaledX = 0; scaledX < scaledImage.getXSize(); scaledX++) {

                for (int scaledY = 0; scaledY < scaledImage.getYSize(); scaledY++) {

                        //get coordinates of surrounding pixels in original image

                        xLeft = scaledX / scale;

                        //make sure we don't exceed bounds of image

                        if (xLeft == image->getXSize() - 1) {

                                xRight = xLeft;

                        }

                        else {

                                xRight = xLeft + 1;

                        }
```

```
                    yTop = scaledY / scale;
                    //make sure we don't exceed bounds of image
                    if (yTop == image->getYSize() - 1) {
                           yBot = yTop;
                    }
                    else {
                           yBot = yTop + 1;
                    }
                    //get color value at surrounding pixels in original image
                    image->readPixel(xLeft, yTop, topLeftVal, topLeftVal, topLeftVal);
//top left value
                    image->readPixel(xRight, yTop, topRightVal, topRightVal,
topRightVal);
 //top right value
                    image->readPixel(xLeft, yBot, botLeftVal, botLeftVal, botLeftVal);
//bot left value
                    image->readPixel(xRight, yBot, botRightVal, botRightVal,
botRightVal);
//bot right value
                    //get weight in the y direction
                    weightY = (scaledY / scale) - yTop;
                    //get color value on left border at the y value
                    leftBorderVal = (weightY * (botLeftVal - topLeftVal)) +
topLeftVal;
                    //get color value on right border at the y value
                    rightBorderVal = (weightY * (botRightVal - topRightVal)) +
topRightVal;
                    //get weight in the x direction
                    weightX = (scaledX / scale) - xLeft;
                    //get color between the two weighted border values
                    finalVal = (weightX * (rightBorderVal - leftBorderVal)) +
leftBorderVal;
```

```
                    scaledImage.writePixel(scaledX, scaledY, finalVal, finalVal, 
finalVal);

              }

       }

       scaledImage.save(saveName);

}
```

Dog scaled by 3:



Dog scaled by 0.75

Rug scaled by 0.05 Rug sigma 10 Gaussian and then scaled by 0.05