Homework #2

1. Let $f$ be an image with minimum intensity $m$ and maximum intensity $M$. Let $CH_f(c) = \#$ of pixels in $f$ that have intensity $\leq c$.

   (a) Explain why $CH_f(1) = CH_f(M) =$ total # of pixels in the image.
   (b) Find the equation of the line, $L(c)$, satisfying $L(0) = CH_f(m)$ and $L(1) = CH_f(M)$.
   (c) Solve $L(g_f(c)) = CH_f(c)$ for an equation for $g_f(c)$. Show this equation satisfies $g_f(m) = 0$ and $g_f(M) = 1$. What does this mean for the image $g_f \circ f$?

2. Write a program that takes an image $f$ and

   - chooses $N$ intensities ranging from 0 to 1 (including 0 and 1), equally spaced;
   - computes $r \circ f$, where $r(c)$ rounds the intensity $c$ to the nearest of the $N$ chosen intensities;
   - stores $g \circ r \circ f$ (as defined in problem #1) evaluated at those $N$ intensities; 1;
   - calculates and outputs the image $g \circ r \circ f$.

   (a) Run your program on one of “flower.bmp”, “bee.bmp”, or “cow.bmp” using $N = 4$ and turn in a print out of the original and resulting pictures. Also, find the four values $CH_f(c)$ takes.
   (b) Run your program on one of “landscape.bmp”, “cat.bmp”, “bird.bmp”, “city.bmp”, “road.bmp”, or “leaves.bmp” using $N = 128$ and turn in a print out of the original and resulting pictures.

3. Write a program that takes an image $f$ and

   - chooses $N$ intensities ranging from the min of $f$ to the max of $f$ (including these endpoints), equally spaced;
   - stores $g_f$ (as defined in problem #1) evaluated at those $N$ intensities;
   - calculates the piecewise linear interpolating polynomial $p$ approximating $g_f$ using those $N$ intensities as nodes;
   - calculates and outputs the image $p \circ f$.

   (a) Run your program on one of “flower.bmp”, “bee.bmp”, or “cow.bmp” (a different one from the one chosen in the previous problem) using $N = 4$ and turn in a print out of the original and resulting pictures.
   (b) Run your program on one of “landscape.bmp”, “cat.bmp”, “bird.bmp”, “city.bmp”, “road.bmp”, or “leaves.bmp” (a different one from the one chosen in the previous problem) using $N = 64$ and turn in a print out of the original and resulting pictures.