ECE 5273
Homework 3

Spring 2025 Dr. Havlicek

1. Obtain the image "Mammogram.bin" from the course web site. This image has 256 $\times$ 256 pixels. Each pixel has 8 bits. **Note:** the server is Unix; the filename **is case sensitive**. Do not make the mistake of getting the **incorrect** 512 $\times$ 512 file "mammogram.bin."

   (a) There are two main regions in the input image: the imaged tissue and the dark background region on the left side of the image. Write a program to convert this gray scale image into a binary image by simple thresholding. In the binary image, use a value of 255 = 0xff for logical one and a value of 0 = 0x00 for logical zero. Select the threshold so that the binary image is equal to logical zero over the background region and logical one over the tissue.

   (b) Write a program to implement the *Approximate Contour Image Generation* algorithm given on page 2.104 of the notes. Your program should input the binary image and output a binary contour image. Run your program to generate an appoximate contour image from the binary image you obtained by thresholding Mammogram.bin.

   (c) Could a chain code be used to represent the main contour in your contour image? Why or why not?

2. Obtain the image "lady.bin" from the course web site. This is a 256 $\times$ 256 gray scale image with 8-bit pixels. Plot a histogram for the image. Write a program to perform a full-scale contrast stretch on the image and plot a histogram for the result.

3. Obtain the image "actontBin.bin" from the course web site. This image has 256 $\times$ 256 pixels with 8 bits each. It is a true binary image; the pixel value 255 represents logical one and the pixel value 0 represents logical zero.

   Write a program to find instances of the letter "T" in the image using the *Binary Template Matching* algorithm given on pages 2.92 - 2.97 of the notes. You will have to design the template yourself based on an analysis of the image. Apply the match measure M_2 at every pixel in the input image where a sufficiently large neighborhood exists. Construct an output image $\mathbf{J}_1$ where each pixel is equal to the match measure M_2 (set $\mathbf{J}_1$ equal to zero at pixels where a sufficiently large neighborhood does not exist in the input image).

   Threshold the image $\mathbf{J}_1$ to obtain a binary image $\mathbf{J}_2$ that should be equal to logical one at pixels where there is a high probability that the letter "T" is present in the input image.

4. Obtain the image "johnny.bin" from the course web site. This image has 256 $\times$ 256 pixels. Each pixel has 8 bits. Plot the histogram of the original image. Write a program to perform histogram equalization on this image. Show the equalized image and plot its histogram.

Be sure to turn in: program listings, printouts of all original, intermediate, and output images, histogram plots.

DUE: 2/18/2025