Medical Image Processing (Hieu Trung Huynh)

Problem Set 1 (Basic)

Solutions should include relevant images and original code of the algorithms developed along with any discussion requested.

1. Develop an algorithm that constructs a binary image (32 x 32 pixels) in which pixels are "on" if they belong to the locus of points a distance d from an arbitrary pixel (i_o,j_o) the coordinates of which are requested as input. Clearly, a closed contour will result. For each of the three distance metrics discussed (Euclidean, "city block," and "chessboard"), construct such a binary image that contains such equidistance contours for a range of distances, d. Discuss the appearance of the equidistance contours that result from the three metrics over the range of distances investigated. If the background is considered in 8-connectivity, which metric(s) produces equidistance contours that divide the image plane into two non-contiguous regions?

2. For each of the three distance metrics, construct an image in which the value of pixel (i,j) is proportional to the corresponding distance from an arbitrary pixel (i_o,j_o) the coordinates of which are requested as input. For the image constructed using Euclidean distance, define a region R such that all pixels $(i,j) \in R$ satisfy the distance condition $D[(i,j),(i_o,j_o)]<d_o$, where d_o is some reasonable distance. Produce the run-length code for region R (considered as a binary image).

3. Develop an algorithm that uses the run-length code from Problem 2 to create a binary image in which pixels in region R are "on" and other pixels are "off." Subsample this 32 x 32-pixel image to create an 8 x 8-pixel binary image, and develop an algorithm that derives the quadtree representation of this binary image.

4. Write a program that outputs the base-2 representation of any non-negative base-10 integer provided as input.