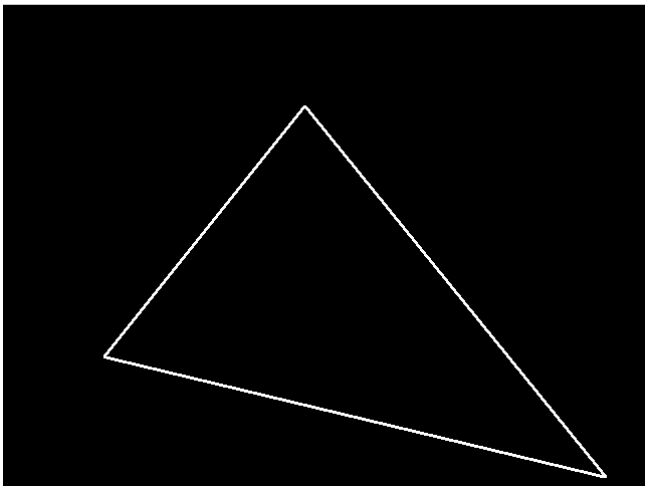
EECS101: HOMEWORK #5 SOLUTION

a) Threshold = 20. It may be various for students' choices.
Thresholded binary SGM image



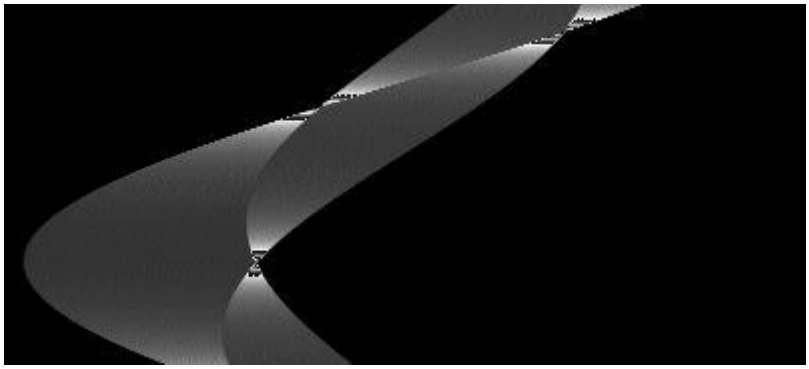
b) For pixels on edges, they satisfy Hough line equation given by

$$x\sin(\theta)-y\cos(\theta)+\rho = 0, \theta \in [0,\pi], \rho \in R$$

Given (x,y) and the equation, we need to find out θ and ρ. One way to do this is to fix one variable and solve for the other, eg. fix θ and solve for ρ. Since we don't know which value to use for θ, we will uniformly sample θ and then solve for ρ using the sample value. Therefore, we will get a series of (θ, ρ) pairs which will be used to locate the position to vote in the voting array for each pixel on the edge.

c) The voting array has two dimensions so a 2D array is used to represent it. The first dimension represents the angle in degrees and has 180 bins representing 0 to 180 degrees. The second dimension represents the distance. The largest possible ρ given the image size is 800 and considering it can be positive or negative, the dynamic range is from -800 and 800. 400 bins are used to represent the range and the step size is therefore 4.

d) The original voting array displayed as an image



Hough transform threshold = 779 . It may be various for different SGM thresholds.
Binary voting array displayed as an image

The three largest votes and their parameters are

$(129^o, -472)$ 1349

$(166^o, -153)$ 1077

$(51^o, 4)$ 779

theta may be various for different coordinate system. rho may be various for different thetas. Votes may be various for different SGM_threshold.

e) To reconstruct image from the voting array, for each parameter pair, we need to find out all (x,y) that satisfy the line equation. It is done by fixing one and solve for the other. Specifically, for each row y, find out x.

Image reconstructed from the voting array.