Theory questions

Question 1. Each point = 2 points (4 points for dilation and 4 points for erosion)

For dilation: (a) The dilated image will grow without bound till filling the entire image. (b) A one-element set (i.e., a one-pixel binary image)

For erosion: (a) The image will be empty. (b) A one-element set (i.e., a one-pixel binary image)

Question 2. (8 points: First part=2 points; second part: 6 points)

Students can find the answer of this question in Chapter 10, section 2 of the textbook.

If Hough transform is carried out in the Cartesian (x, y) coordinate system, we use the slope-intercept form of the equation of a straight line:

$$y = ax + b$$

However, it does not represent vertical lines (i.e. m → ∞) well. The general form of equation of a line (i.e. $ax + by + c = 0$ may represent vertical lines but it requires a Cartesian (x, y, z) 3D coordinate system which is a more complex space.

***Note: mentioning the slope parameter, a in the Cartesian coordinate goes to infinity for a vertical line = 2 points;**

For the second half of question, the student should summarize the steps for Hough transform in the class notes:

1. Sub-divide the $\rho\theta$-parameter plane into bins
2. Accumulate the total number of sinusoids that cross each bin
3. Threshold the value of the bins in the parameter plane to declare the presence of lines

***Note: Each step = 2 points**

Question 3. (8 points: for a selected method, clear elaboration of the steps for shape identification=7 points, mentioning of how the number of shapes is counted = 1 point)

Several methods can work. The student may choose to use "hit-or-miss transform", or image erosion with a kernel same to the bigger squares. Note that for these methods, the number of the coordinates for the centers will help determine the counts.

Part II: Programming questions

Question 1. (10 points: part a=5 points, part b = 5 points)

Part (a): correct implementation of the algorithm = 3 points; demonstration of the result = 2 points;

Part (b): Demonstration of the results =3 points; comments on the differences before and after averaging filtering = 2 points.

After applying the averaging filtering, the segmentation result should be improved. Specifically, the "speckles" within each segmented region are reduced.

Question 2. (16 points)

Part(a) Correct demonstration of the results = 5 points
Part(b) Correct demonstration of the results = 5 points
Part(c) Appropriate comments = 6 points.

Suggested comments for Part c: The Haar wavelet is supposed to produce less smooth approximation images as its power to represent higher order polynomials is weaker than the Daubechies-4 wavelet.