

**CS 4/791E Computer Vision**  
**Spring 2002 - Dr. George Bebis**

**Midterm Exam**

**Duration: 4:00 - 5:15pm**

**Name:**

1. **[3 pts each]** For each of the following statements, indicate whether it is true or false. To get credit, you must give brief reasons for your answer.

**T F** The first step to edge detection is computing the gradient in the  $x$ - and  $y$ -directions.

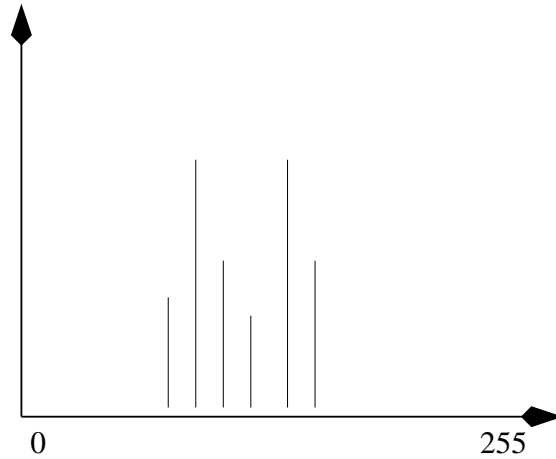
**T F** Convolution and correlation are exactly the same operators.

**T F** The mask shown below is appropriate for detecting horizontal edges.

$$\begin{array}{ccc} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{array}$$

**T F** The Hough transform of a point in the image space is a point in the Hough space.

**T F** The histogram shown below corresponds to a high contrast image.



**T F** The Laplacian of Gaussian operator performs both smoothing and differentiation.

**T F** Otsu's method assumes that the pixel values follow a Gaussian distribution.

**T F** The gradient magnitude is an isotropic edge detector.

**T F** The least-squares method is a robust estimation technique.

**T F** Variable thresholding is a technique for handling non-uniform intensity.

2. **[10 pts]** Discuss the optimal thresholding approach (you might want to draw a diagram to make your discussion more clear). What are the strengths and weaknesses of this method?

3. [10 pts] Suppose we are given a binary image and want to detect upright triangles with side length 5 pixels in the orientation shown below. How many dimensions are there in the Hough parameter space for this problem and what are they? If the Generalized Hough Transform is used for circle detection, how the *R-Table* will look like?

```
X
X X
X   X
X     X
X X X X X
```

4. **[10 pts]** There are two main difficulties in using region growing for segmentation (i) how to choose the seed(s) and (ii) how to define the similarity criteria (i.e., predicates). Discuss the main methods presented in class for dealing with these issues.

5. [10 pts] (a) Consider the simple case of a *step* edge. What is the response of the first derivative to step edges? What is the response of the second derivative to step edges? (draw some diagrams to illustrate your answers). (b) Compare the gradient magnitude operator with the Laplacian operator.

6. [10 pts] Discuss the steps of the Canny edge detector.

7. [10 pts] (a) What is the main advantage of using an edge detector with *small* support (size)? (b) What is the main advantage of using an edge detector with *large* support (size)? (c) Can you describe a scheme that deals with the issue of choosing the size of an edge detector more effectively?



8. [10 pts] Describe the "snakes" method. How is the position of the snake model being controlled? What about its shape?