Final Examination: Semester II   Academic Year: 2003
Date: 19 February 2004   Time: 13:30-16:30
Subject: 240- 373 Image Processing   Room: R200

Instructions:

This exam has 9 problems, 11 pages and 70 points. Write your answers on this exam sheets. Please show all your work for full credit. This exam is closed book and closed notes. No calculators are allowed.

Name:_____ Student code:_____

1 (23 pts) _____   5 (5 pts) _____

2 (12 pts) _____   6 (5 pts) _____

3 (4 pts) _____   7 (4 pts) _____

4 (3 pts) _____   8 (4 pts) _____

9 (10 pts) _____

TOTAL _____

"ทุจริตในการสอบ โทษขั้นต่ำ คือ พักการเรียน 1 ภาคการศึกษา และปรับตกในรายวิชาที่ทุจริต"

Part I Image Compression

1. From the following gray-level image (intensity range of 0-7)

```
1  1  1  1  1  1  1  1  1  1
1  2  2  3  3  4  4  4  2  1
1  2  2  5  5  5  5  1  5  1
1  2  2  5  5  5  5  5  2  1
1  3  3  1  1  1  1  3  3  1
1  3  2  0  1  1  6  6  0  0
```

a) Compress the image using the "**run-length encoding**" technique. (4 points)
b) Compress the result obtained in a) using "**Huffman coding**" and show the code representing each gray level. (15 points)
c) Calculate the number of bits used for storing the compressed image in part a) and in part b). Which method uses less memory? (4 points)

Part II Image Recognition

2. Determine a linear decision function that separates the two classes of 2-dimensional patterns which are defined below: (12 points)

Class A	Class B
(-1,1)	(5,6)
(3,-1)	(6,4)
(1,3)	(1,8)

X2

Class B

Class A

X1
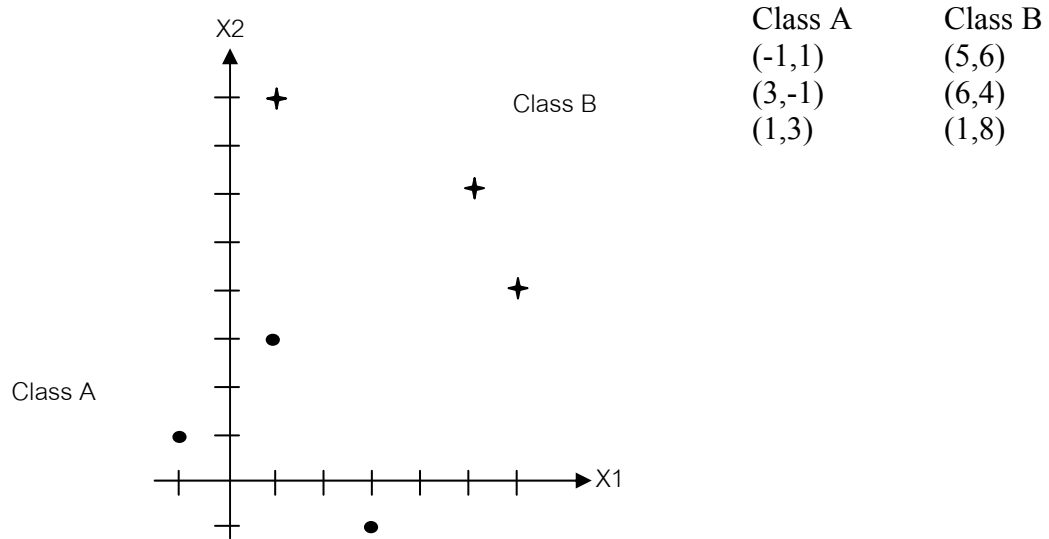
Part III   Finding Basic Shapes

3. Why is it necessary to use polar coordinates to represent lines when determining a straight line using the Hough transform? (4 points)

4. What is an accumulator array used for? (3 points)

5. Explain how to find a circle of known radius from an edge image using the Hough transform. (5 points)

Part IV   Three Dimensional Image Processing

6. Based on the principle of stereometry, is it possible to measure object distance using only one camera? If your answer is yes, explain how? (5 points)

Part V Frequency Domain Processing

7. What are the advantages and disadvantages of processing an image in the frequency domain? (4 points)

8. Can we perform frequency domain convolution if the image and the template have different sizes? Why? (4 points)

Part VI Applications

9. Suppose you are responsible for designing an automatic helmet (หมวกกันน็อค) detection system using image processing techniques. The system consists of a color video camera and a computer. The video camera is used to capture an image of the motorcycle and its rider. The image from the camera is digitized and sent to the computer. The computer runs an image processing program to determine whether or not the rider wears a helmet. Explain in detail on how you would design this system. What image processing techniques could be used? (10 points)

_____End of Exam_____