

**PRINCE OF SONGKHLA UNIVERSITY**  
**FACULTY OF ENGINEERING**  
**Department of Computer Engineering**

Final Examination: Semester 2  
Date: March 1<sup>st</sup>, 2007  
Subject: 240-382 Digital Image Processing

Academic Year: 2006  
Duration: 3 hours  
Room:

- There are **10 questions, 11 pages and 45 marks**. Answer all questions.
- Calculator, dictionary and writing tools are allowed.
- **Books or documents are not allowed.**
- Answer on these examination papers. If there is not enough space, use the back page.
- Write your name and student code on all pages.

Name:.....ID:.....

Question No.		Mark(s)	Sum
1.a	2		
1.b	2		
2.	3		
3.a	2		
3.b	1		
3.c	2		
3.d	1		
4.	3		
5.a	3		
5.b	1		
6.	4		
7.	3		
8.a	2		
8.b	2		
9.a	3		
9.b	3		
10.	8		
Total	45		

ทูลจรทในการสอบ โทษขันต่ำค่อ

ปรบตคในรายวษาที่ทูลจรท และพัทการเรยน 1 ภาคการศกษา

1. Consider the following 6 x 6 image and the following 3 x 3 mask :

1	1	1	1	1	1
1	8	8	8	8	1
1	8	8	8	8	1
1	8	8	8	8	1
1	8	8	8	8	1
1	1	1	1	1	1

-1	0	1
-2	0	2
-1	0	1

a. Apply convolution with this mask to the image and draw the result below. ( 2 marks )


b. Explain why we obtain this result and what is the meaning. ( 2 marks )

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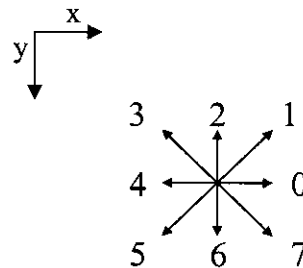
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2. Consider the following image of local edges. Local edges are represented by x.

	0	2	4	6	8
0					
2	x	x	x	x	
4	x		x	x	x
6		x	x	x	x
8				x	x



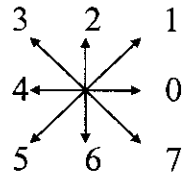
Apply the algorithm of edge linking by testing the neighbours according to the order above and write the coordinates of the pixels in the array, the first pixel first, then the second and so on... ( 3 marks )

x															
y															

3. Consider the following image :

	0	2	4	6	8	10	12	14
0								
					x	x		
2		x			x			
		x		x		x		
4	x			x				
		x						x
6			x					x
			x					x
8				x				x
			x					x
10				x				x
					x			x
12					x	x	x	
14								

a. Represent the boundary of the following image by a chain-code according to the following coding and give the coordinates of the first pixel. ( 2 marks )



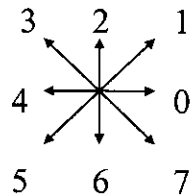
Coordinates of the first pixel:.....

Chain-Code: .....

b. Give the derivative of the chain-code. ( 1 mark )

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c. Re-sample the image and keep only the pixels on the even rows and even columns. Give the new chain-code when using the same coding : ( 2 marks )



( even means  $i = 2p$  , not  $2p + 1$  )

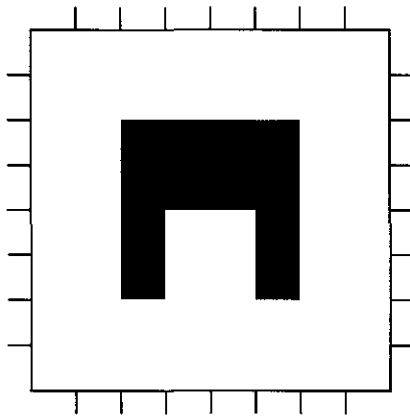
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Name:.....ID:.....

d. Normalize this chain-code to obtain a shape number ( smallest number ). ( 1 mark )

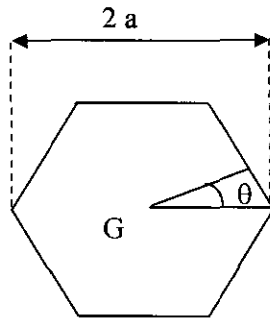
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4. Segment the following image using the split-and-merge procedure. Take the homogeneity criterion :  $P ( R ) = \text{TRUE}$  if all the pixels in R have the same intensity. Show the quad-tree corresponding to your segmentation. ( 3 marks )

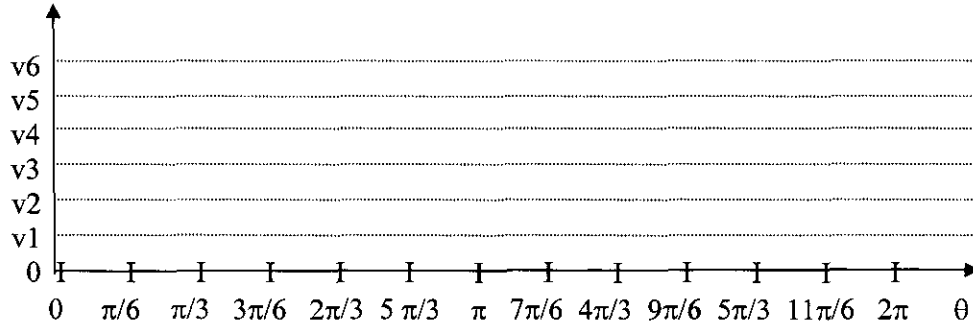


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5. Consider a regular hexagon of length equal to  $2a$  and with centroid  $G$ .



a. Plot the angle of the tangent line depending on the angle  $\theta$  from  $0$  to  $2\pi$ . ( 3 marks )

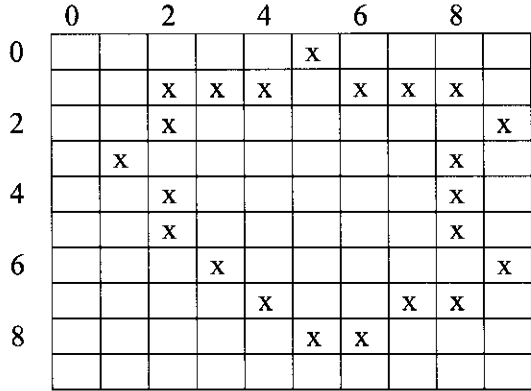


b. Give the values  $v1$  to  $v6$ . ( 1 mark )

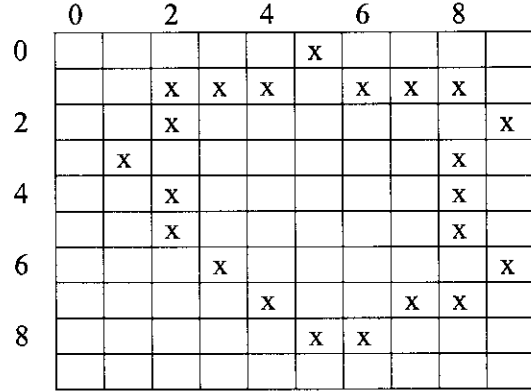
$v1 = \dots\dots v2 = \dots\dots v3 = \dots\dots v4 = \dots\dots v5 = \dots\dots v6 = \dots\dots$

6. Use the successive division method to approximate the following contour by a polygon with 7 vertices (vertices = pixels).

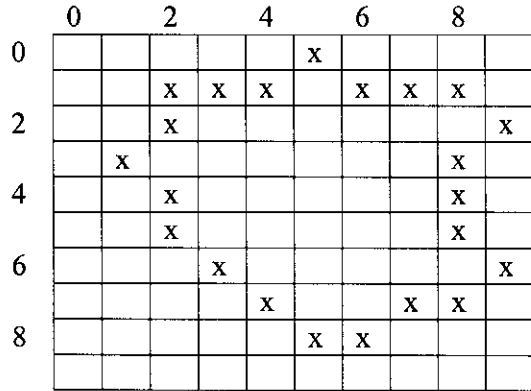
Draw the construction of the polygon and explain each step of the processing. ( 4 marks )



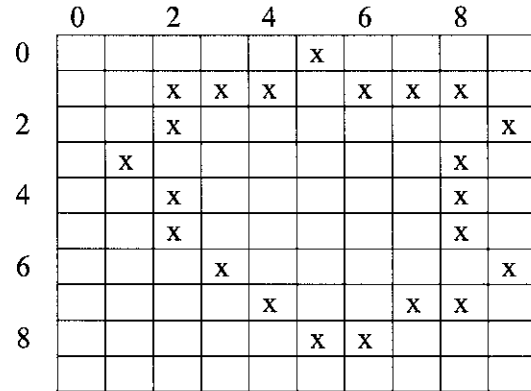
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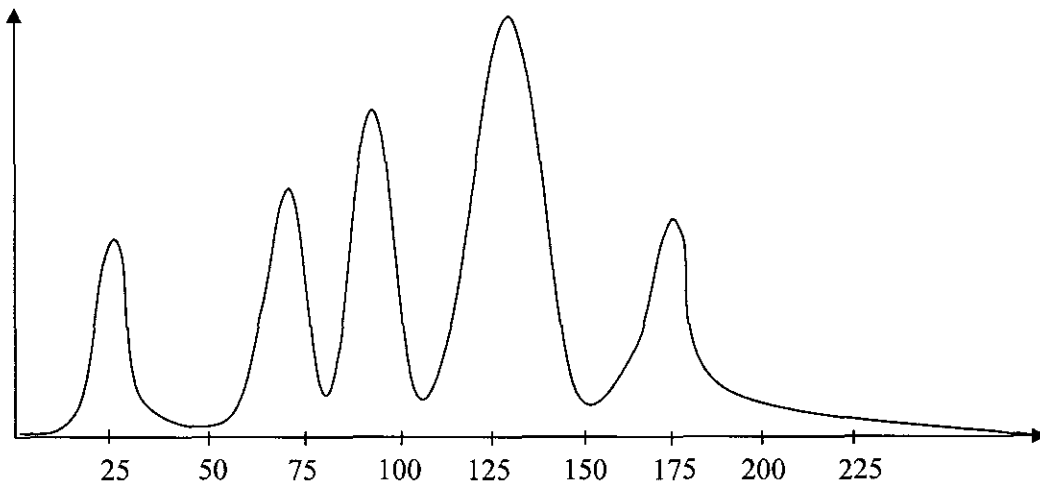


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7. Consider the following histogram of an image containing several homogeneous objects with background values around 25. We want to segment this image into the background and the different homogeneous objects.



Which values will you choose to perform a multiple (multi-level) thresholding?  
How many objects will you obtain? ( 3 marks )

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8. Consider the following binary image containing an object X represented by "1" values :

0	0	0	0	0	1	0	0
0	0	1	1	1	1	1	0
0	1	1	1	1	1	1	0
0	1	1	1	1	1	1	0
0	0	1	1	0	1	1	0
0	0	0	0	0	1	0	0

	1	
1	1	1
	1	

B1

1	1	1
1	1	1
1	1	1

B2

a. Apply an erosion processing to the image with the two structuring elements B1 and B2 and draw the result on the following arrays. ( 2 marks )


$X \ominus B1$


$X \ominus B2$

b. Draw the result of the opening processing of the image by the two structuring elements. ( 2 marks )


$X_{B1}$


$X_{B2}$



Name:.....ID:.....

9.a. Write the **algorithm** of the erosion operation by the structuring element B1 of the question 8. ( **3 marks** )

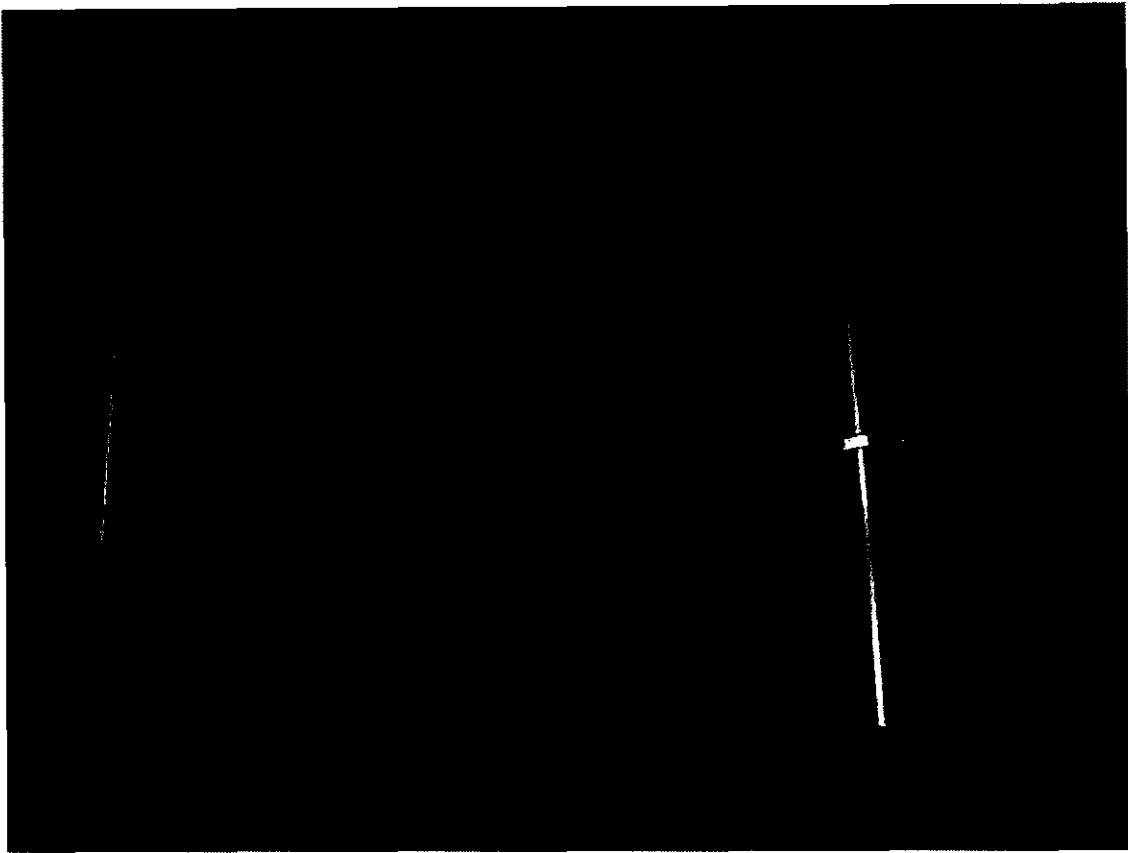
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b. Write the **program** of the erosion operation by B1 in C language. ( **3 marks** )

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10. Consider the following image of a pen and a diskette : ( 8 marks )



The image above is represented by a 19x19 image with values :

64	69	71	73	75	76	89	91	96	103	105	112	113	119	121	121	124	126	129
78	81	86	95	102	105	106	115	116	118	121	123	124	126	127	129	130	131	131
87	89	100	105	115	116	129	131	129	127	131	132	135	136	18	12	140	141	142
95	102	118	124	132	134	134	135	136	137	139	140	141	142	18	12	149	157	159
89	95	8	7	6	3	4	4	5	130	121	124	123	141	18	11	145	152	160
85	86	8	7	6	4	5	5	5	130	120	125	123	122	18	10	141	145	158
74	80	8	75	75	5	5	5	5	129	121	125	127	118	18	9	124	146	159
72	85	80	5	5	75	6	6	6	129	123	126	127	117	17	9	125	135	157
42	86	80	5	5	75	7	6	6	122	121	122	122	113	14	8	125	126	155
41	85	80	79	79	7	7	7	7	126	125	122	123	123	14	8	115	124	158
41	42	80	79	79	7	7	8	7	98	102	103	105	106	14	7	125	135	141
40	43	80	78	75	7	7	8	8	82	86	98	102	103	14	7	110	120	122
39	41	9	9	9	8	7	8	7	79	83	85	89	94	13	7	103	105	111
35	36	9	9	8	8	7	9	8	65	69	73	79	84	13	7	94	97	99
28	29	8	8	8	8	8	9	8	65	57	72	76	84	13	6	91	92	92
25	26	8	8	8	8	8	8	8	45	48	68	65	67	13	6	78	81	83
21	22	22	24	26	30	31	32	32	35	36	49	48	54	56	57	61	67	74
19	21	22	23	24	26	27	29	30	31	32	34	39	39	41	42	45	51	55
19	12	15	19	21	24	29	28	30	31	34	35	35	36	37	39	41	42	43

