Prince of Songkla University

Faculty of Engineering

Department of Computer Engineering

Midterm Examination: Semester 2   Acadimic Year: 2006

Friday, 22 December 2006   Duration: 13.30-16.30

Subject: 240-382 Image Processing   Room:

- There are **9 questions, 10 pages and 35 marks.** Answer all questions.

- Calculator, dictionary and writing stationery are allowed.

- **Books or documents are not allowed.**

- Write an answer on this examination paper. If there is not enough space, use the back page.

- Write your name and student code on all pages.

Name: …………………………………………… Student ID:……………………………

ทุจริตในการสอบ โทษขั้นต่ำคือ

ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

1. An image has color model RGB size 6x6 pixels, each channel is an 8 - bit unsigned integer as follow:

(3,15,9)	(3,15,9)	(11,5,9)	(2,6,9)	(11,11,9)	(10,16,10)
(3,15,9)	(14,6,8)	(13,12,8)	(15,8,8)	(11,11,9)	(10,16,10)
(3,15,9)	(14,6,8)	(15,12,7)	(14,6,8)	(14,10,9)	(10,16,10)
(3,15,9)	(1,5,19)	(14,6,8)	(14,6,8)	(14,10,9)	(13,16,9)
(3,15,9)	(1,5,19)	(11,5,9)	(11,5,9)	(11,10,9)	(13,16,9)
(3,15,9)	(1,5,19)	(11,5,9)	(11,5,9)	(11,10,9)	(13,16,9)

Transform this image to HLS color model that each channel is an 8 - bit unsigned integer by using the

following information: **(3 marks)**

```
RGB<=>HLS (CV_BGR2HLS, CV_RGB2HLS, CV_HLS2BGR, CV_HLS2RGB)

// In case of 8-bit and 16-bit images
// R, G and B are converted to floating-point format and
scaled to fit 0..1 range
```

V_{max} <- max(R,G,B)
V_{min} <- min(R,G,B)

L <- (V_{max} + V_{min})/2

S <- (V_{max} - V_{min})/(V_{max} + V_{min})   if L < 0.5
     (V_{max} - V_{min})/(2 - (V_{max} + V_{min}))   if L ≥ 0.5

```
          (G - B)*60/S,   if Vmax=R
H <- 180+(B - R)*60/S,   if Vmax=G
      240+(R - G)*60/S,   if Vmax=B
if H<0 then H<-H+360
```

```
On output 0≤L≤1, 0≤S≤1, 0≤H≤360.
The values are then converted to the destination data type:
    8-bit images:
        L <- L*255, S <- S*255, H <- H/2
    16-bit images (currently not supported):
        L <- L*65535, S <- S*65535, H <- H
    32-bit images:
        H, L, S are left as is
```


2. For the following situation, which property/ies of camera is/are important for taking a picture? Why? **(2 marks)**

    a. Plat number of a car that running pass through a gateway.

    b. A star.

    c. Banknote or paper money for checking counterfiet.

    d. A face for making a big bill board.

3. Write a C function for transform and RGB color image into a gray level image that does not use other function or library. Using the following equation. (**3 marks**)

$$Gray = 0.299R + 0.587G + 0.114B$$

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Let's consider the following image f (x, y) which has 10 rows and 10 columns and 256 gray levels for each pixel :

0	1	2	3	4	5	6	7	8	9
1	2	3	3	4	5	6	8	9	10
2	4	4	5	5	6	7	8	10	11
4	5	5	6	7	8	8	9	10	11
6	6	7	7	8	9	9	10	11	12
8	7	8	8	9	10	10	11	12	12
10	9	9	9	10	11	11	12	13	13
10	10	10	10	11	12	13	13	14	14
11	11	11	11	12	13	14	14	15	16
12	12	12	12	13	13	14	15	17	18

4. Calculate and draw the histogram of the image f (x, y). (2 marks)

(Answer the question on the following drawing)

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22   255   Gray level
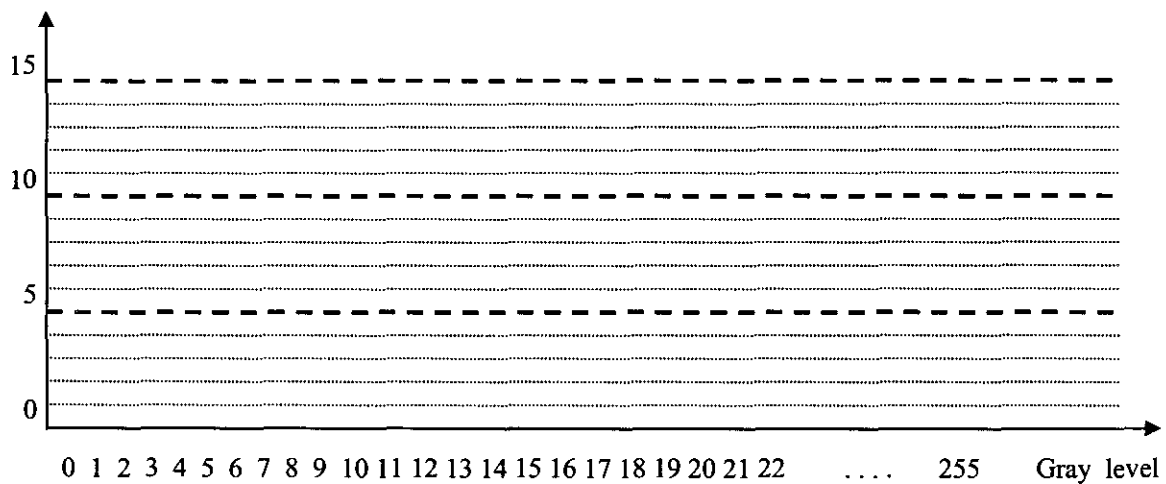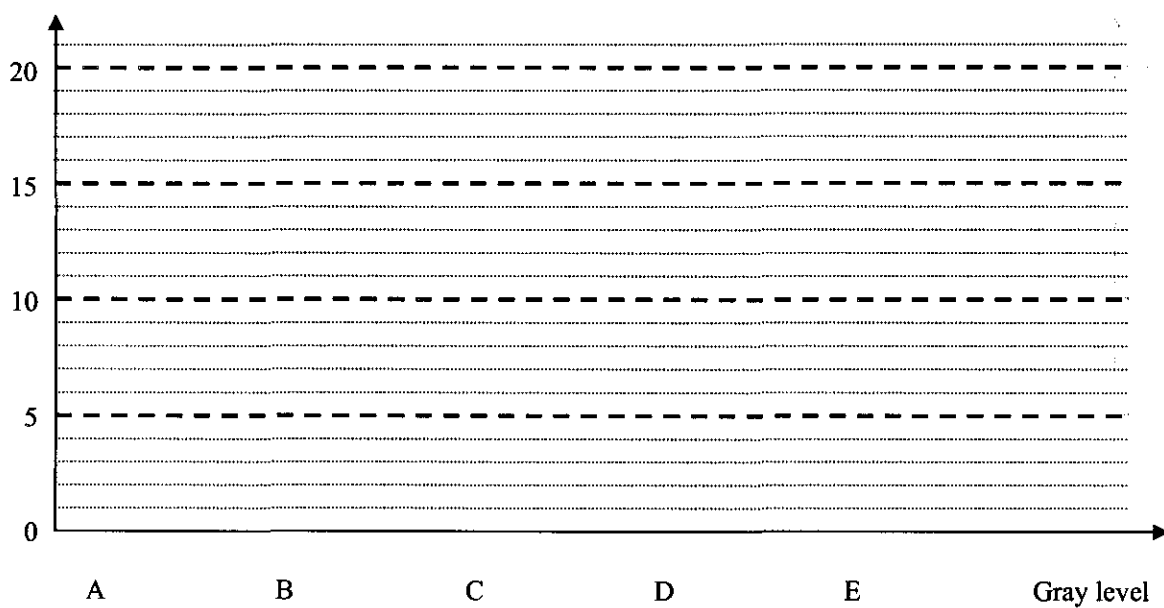
5. Equalize the histogram of question 6. The new image will have only 5 grey levels A, B, C, D and E.

   Tell which grey levels you group to make the new grey levels A, B, C, D and E. **(4 marks)**

A = {   }   B = {   }
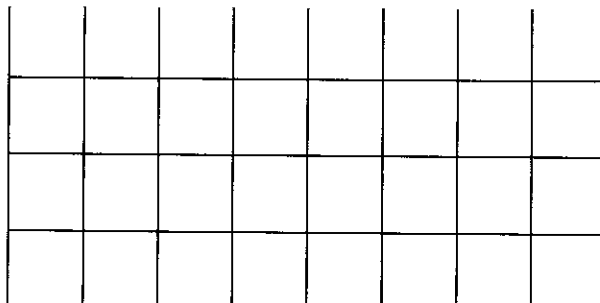
C = {   }   D = {   }

E = {   }

Draw the new histogram on the following drawing. **(2 marks)**

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6. We want to apply a threshold operation to the image f (x, y).

Choose the threshold value T such that the probability P (f ≤ T) = 0.50 and write the result of the threshold operation on the following drawing. **(2 marks)**

What is the value T ?   T = ...   **(3 marks)**
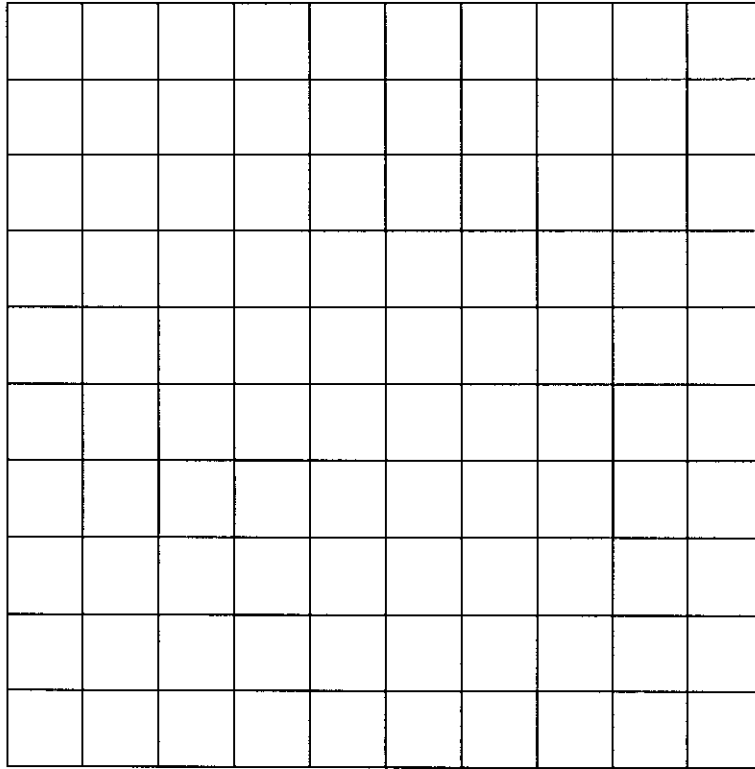
7. We consider the following 3 x 3 discrete mask m (x, y) and the image k (x, y) :

k (x, y)

0	0	0	0	0	0	0	0
0	0	100	100	100	100	100	0
0	0	100	100	100	0	0	0
0	0	100	100	100	0	0	0
0	0	100	100	100	100	100	0
0	0	100	100	100	0	0	0
0	0	100	100	100	100	100	0
0	0	0	0	0	0	0	0

m (x, y) = 1/10

1	1	1
1	2	1
1	1	1

Compute a new image l (x, y) which is obtained by the convolution of k (x, y) and m (x, y) :

$$ l (x, y) = k (x, y) \otimes m (x, y) $$

Draw the new image l (x, y) in the following array. (**5 marks**)

8. We consider now a 5 x 5 image i (x, y).

19	21	25	21	19
27	33	25	20	12
10	15	32	28	27
2	8	9	25	3
1	3	4	2	1

Apply a 3 x 3 median filter to the image i (x, y) and draw the new image in the following array :

(4 marks)

9. Write a C program which creates a 512 x 512 image such that : **(5 marks)**

    - the background of the image has a constant value equal to 250.

    - at pixel (50, 100), there is a rectangle of width 100 and height 300 with grey level 10.