Exam 2010-Dec-17

P1.1:

$$T(r) = 0 \quad 0 \le r \le 0.2$$

$$T(r) = a(r - 0.2) \quad 0.2 \le r \le 0.3$$

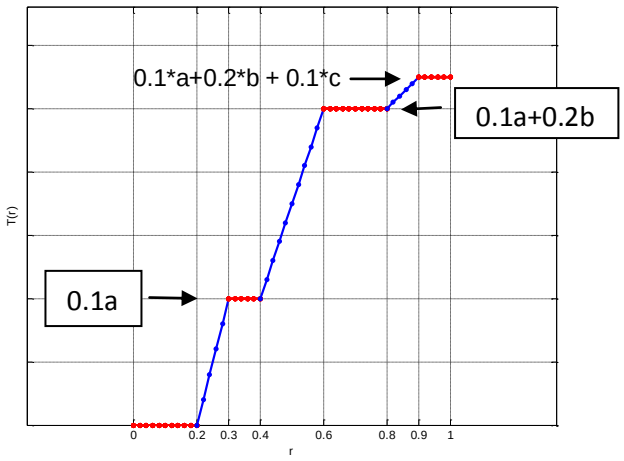
$$T(r) = 0.1a \quad 0.3 \le r \le 0.4$$

$$T(r) = 0.1a + b(r - 0.4) \quad 0.4 \le r \le 0.6$$

$$T(r) = 0.1a + 0.2b \quad 0.6 \le r \le 0.8$$

$$T(r) = 0.1a + 0.2b + c(r - 0.8) \quad 0.8 \le r \le 0.9$$

$$T(r) = 0.1a + 0.2b + 0.1c \quad 0.9 \le r \le 1$$



P1.2:

fx = [-1 0 1;
-1 0 1;
-1 0 1]/6

fy = [1 1 1;
0 0 0;
-1 -1 -1]/6

R = [17 18 13
14 16 12
13 14 12]

gradRx = imfilter(R,fx); gRx = gradRx(2,2); % and in the same way for G and B color bands

(a simplified) color gradient magnitude =
sqrt(gRx^2 + gRy^2 + gGx^2 + gGy^2 + gBx^2 + gBy^2) = 4.9 ≈ 5
// see Lecture 4, page 58

P1.3: See Sonka p.662, Note: you should demostrate how you calculated the result. (The result itself was known from the previous exam :-)).

P2.1: 6 bits, 2^6 = 64

P2.2: GLCM=

	2	4	5
2	0	0	1
4	0	2	0
5	1	0	0

Contrast = 3*3*1 + 3*3*1 =18 or
using normalized GLCM: contrast = 9*(1/4) + 9*(1/4) = 18/4

P2.3: Easier to construct a robust classifier using invariant features. Using noninvariant features we can still construct a decision system/classifier but the decision rule will be more complex and less robust.
P2.4: (a), (c), (e), (f)
P2.5: Optical flow estimation, in case of 3x3 neighbourhood we use 9 pixels //See Lab4, last page

P3: (1-b) or (1-a), (2-f), (3-e),(4-j),(5-g)

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P4.1: For two clusters we need a kernel size (bandwith) $h_r \geq 6$, otherwise the datapoints will converge to three clusters. With uniform kernel, hr=7, the points (3,2,5,3) will converge to (3,2,5,3), (9,2,1,8) --> (9, 6.5, 1, 8), (9,8,1,8)--> (9, 6.5, 1, 8). Final segmentation (labels):
1 1 1
2 2 1
2 2 1

P4.2: 3 bits and uniformly random image -> 8 levels, 8x8--> 64 entries, every entry = ca 1/64 --> gray image with all pixels = ca 1/64

P5.1: Voting matrix:

x y	0	10	20	30	40
25	0	1	0	1	0
35	1	0	3	0	1
45	0	2	0	2	0
55	0	0	1	0	0

maximum votes = 3, for entry with (x,y)=(20,35) <-- center of the circle

P5.2
Brightness matrix

10	2	4
4	6	8
6	4	2
4	4	6

Accumulation matrix

10	7	11
4	10	16
6	9	11
4	8	14

Optimum paths (5):

10	7	11
4	10	16
6	9	11
4	8	14

P5.3 3^9
P6

(a) T1=0.3, T2=0.9
(b) B(under blue area) = 0.5 R(under red area) = 1.6 A=R+B = Total area=2.1
Errors: E1 = 0.1 (blue/object area) E2 = (T1-0.2)/2 + (1-T2)/2 = 0.1/2 + 0.1/2 = 0.1
Missclassification error = (E1+E2)/A = (0.1+0.1)/2.1 = =0.095 (9.5%)
(c) se = (T+0.1)/0.5 for T<=0.4
se = 1 for T=>0.4

$$sp = 1 - \frac{0.1/2}{1.6} \qquad 0 \leq T \leq 0.2$$
$$sp = [1.6 - 0.1/2 - (T - 0.2) \cdot 10 \cdot (T - 0.2)/2\,]/1.6 \qquad 0.2 \leq T \leq 0.6$$
$$sp = [(1 - T) * (1 - T) * 10/2 - 0.1/2]/1.6 \qquad 0.6 \leq T \leq 0.9 = T2$$

(d) for $T \geq 0.4$
(e) none