TD: Image enhancement

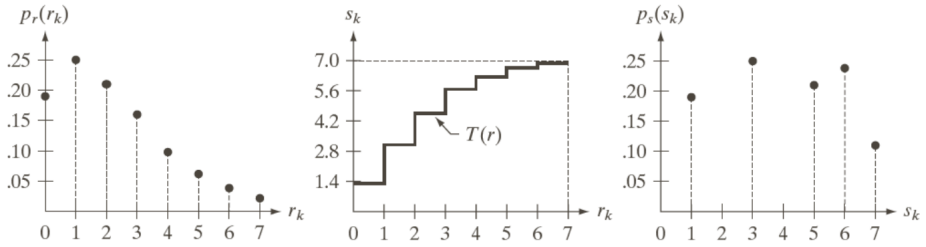
M1 E3A international track, Evry

UE "Image and signal processing", Upsay / UEVE

Answer of exercise 1

Soit : $M \times N = 4096$, image sizee : 64×64, coded using 3-bits ($L = 8$)

r_k	n_k	$p_r(r_k) = \frac{n_k}{MN}$	cumulative value		s_k	n'_k	$p_s(s_k)$
0	790	0.19	0.19	1/7	1/7	790	0.19
1/7	1023	0.25	0.44	3/7	3/7	1023	0.25
2/7	850	0.21	0.65	5/7	5/7	850	0.21
3/7	656	0.16	0.81	6/7	6/7	985	0.24
4/7	329	0.08	0.89	6/7			
5/7	245	0.06	0.95	1	1	448	0.11
6/7	122	0.03	0.98	1			
1	81	0.02	1				



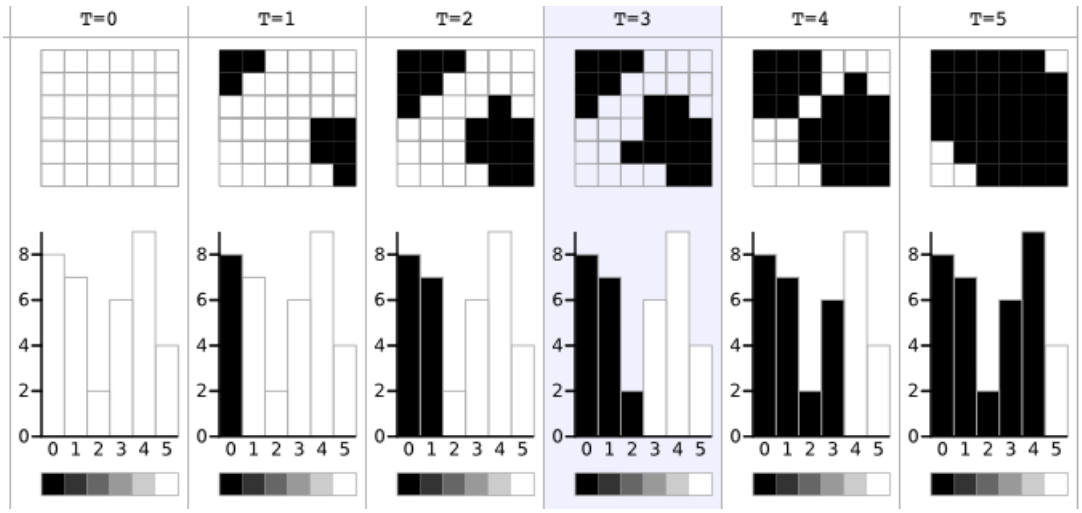
a b c

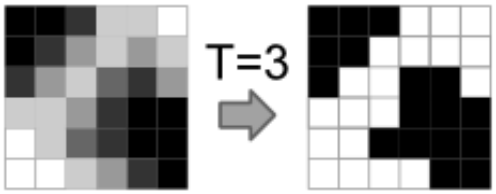
FIGURE 3.19 Illustration of histogram equalization of a 3-bit (8 intensity levels) image. (a) Original histogram. (b) Transformation function. (c) Equalized histogram.

Answer of exercise 2

1. 3 bits are sufficient. The dynamic range is $[0, 5]$. Mean: $m_G = \frac{1}{MN} \sum_0^5 ip_i$ where p_i is the ieme value of the histogram and $MN = 36$. Here, m_G equal $2, 36$.
2. See:

k	0	1	2	3	4	5
P1(k)	0	0,22222222	0,41666667	0,47222222	0,63888889	0,88888889
P2(k)	1	0,77777778	0,58333333	0,52777778	0,36111111	0,11111111
m1	0	0	0,46666667	0,64705882	1,26086957	2,03125
m2	2,36111111	3,03571429	3,71428571	3,89473684	4,30769231	5
sigmaB^2	0	7,16765873	8,13835979	8,20356037	7,71655518	6,4453125





Answer of exercise 3

1.

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

2. With a threshold = 2 :

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

Answer of exercise 4

Pass 1 :

1	1	1	0	2	2	0	3
1	1	0	4	2	0	5	3
1	0	6	2	0	7	3	3
1	1	1	0	8	3	3	3
0	0	0	9	3	3	3	3
10	10	10	3	3	3	3	3
10	10	10	3	3	3	3	3
10	10	3	3	3	3	3	3

Equivalence table:

1	2	3	4	5	6	7	8	9	10
			2	3	2	3	3	3	3
	1		1		1				

Pass 2 :

1	1	1	0	1	1	0	3
1	1	0	1	1	0	3	3
1	0	1	1	0	3	3	3
1	1	1	0	3	3	3	3
0	0	0	3	3	3	3	3
3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3