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1. Construct the Huffman code of the source whose symbol probabilities are defined below.

r	p(r)
0	0.11
1/7	0.01
2/7	0.09
3/7	0.17
4/7	0.23
5/7	0.07
6/7	0.17
1	0.15

Construct Huffman code and assign values to binary bits:

0.23	0.23	0.23	0.26	0.34	0.4	0.6
0.17	0.17	0.17	0.23	0.26	0.34	0.4
0.17	0.17	0.17	0.17	0.23	0.26	
0.15	0.15	0.17	0.17	0.17		
0.11	0.11	0.15	0.17			
0.09	0.09	0.11				
0.07	0.08					
0.01						

10	10	10	00	01	1	0
000	000	11	10	00	01	1
001	001	000	11	10	00	
010	010	001	000	11		
011	011	010	001			
100	100	011				
110	101					
111						

$$L_{avg} = 0.23(2) + 0.17(3) + 0.17(3) + 0.15(3) + 0.11(3) + 0.09(3) + 0.07(3) + 0.01(3)$$
$$L_{avg} = 2.77$$
$$C_r = \frac{8}{2.77} \qquad C_r = 2.888 \qquad R_D = 1 - \frac{1}{2.888} \qquad R_D = 65\%$$

2. Consider the bit-map below:

0	3	49	111	111	111	200
0	3	77	111	111	111	255
0	3	77	111	111	122	255
0	3	77	111	111	122	255

0	49	77	111	111	122	255
0	49	77	111	111	122	255
0	49	111	111	111	122	255

a) Compress image using Huffman coding:

r	f	p
0	7	0.14
1	4.00	0.08163265
2	4.00	0.08163265
3	5.00	0.10204082
4	17.00	0.34693878
5	5.00	0.10204082
6	1.00	0.02040816
7	6.00	0.12244898

0.3469387	0.3469387	0.3469387	0.3469387	0.3469387	0.3877551	0.61
0.14	0.14	0.1836734	0.2040816	0.27	0.3469387	0.3877551
0.1224489	0.1224489	0.14	0.1836734	0.2040816	0.27	
0.1020408	0.1020408	0.1224489	0.14	0.1836734		
0.1020408	0.1020408	0.1020408	0.1224489			
0.0816326	0.1020408	0.1020408				
0.0816326	0.0816326					
0.0204081						

00	00	00	00	00	1	0
000	000	11	10	01	00	1
001	001	000	11	10	01	
011	010	001	000	11		
100	011	010	001			
101	100	011				
110	101					
111						

b) Compute the compression achieved and the effectiveness of Huffman coding

$L_{avg} = 0.347(2) + 0.14(3) + 0.122(3) + 0.102(3) + 0.102(3) + 0.082(3) + 0.082(3) + 0.02(3)$

$$L_{avg} = 2.653$$

$$C_r = \frac{8}{2.653} \qquad C_r = 3.015 \qquad R_D = 1 - \frac{1}{2.888} \qquad R_D = 67\%$$

3. Outputs displays each figure includes the original image as Right :
Original grayscale image (gamma = 1) (Right)

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Fig 1.1 Binary Transformation , where t1 = 70 (Middle)
Fig 1.1 Binary Transformation , where t2 = 170 (Left)
Fig 1.2 Interval Reservation, where t1 = 70 and t2 = 70 (Left)
Fig 1.2 Log Base 10 Transformation (Middle)
Fig 1.3 Gamma Correction , where gamma1 = 0.57 (Left)
Fig 1.3 Gamma Correction , where gamma2 = 1.57 (Middle)

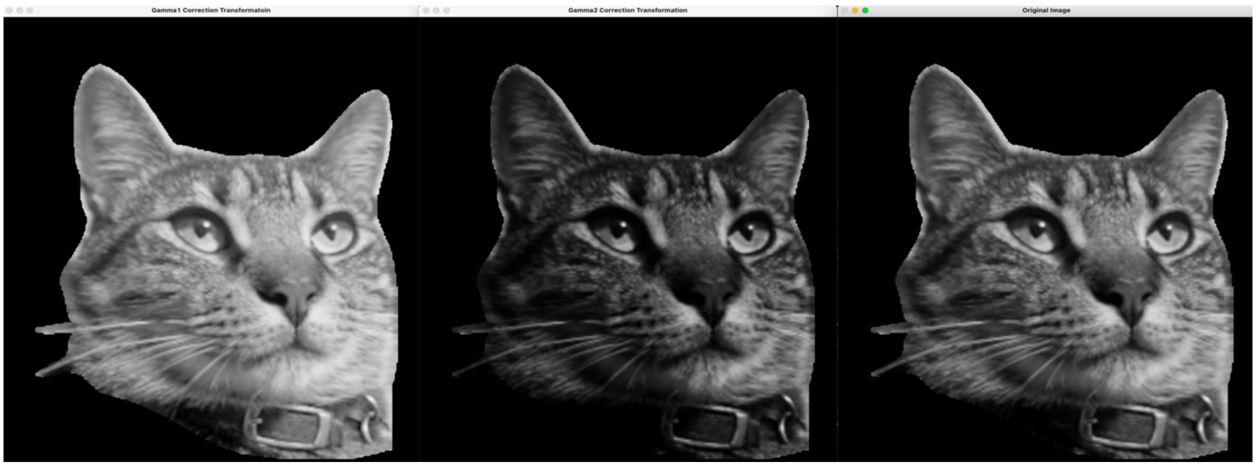

Fig 1.3

Fig 1.2

Fig 1.1