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 |  |  |  |  |  |  |

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

3. Outputs displays each figure includes the original image as Right :

Original grayscale image (gamma = 1) (Right)

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)

A group of cats

Description automatically generated with low confidence

Fig 1.3

A collage of a cat

Description automatically generated with medium confidence

Fig 1.2

A picture containing text, cat, mammal, domestic cat

Description automatically generated

Fig 1.1