COLLEGE OF ENGINEERING & TECHNOLOGY

Department : Artificial Intelligence (Alamein Branch)

Lecturer : Dr. Mohamed Waleed Fakhr

Course Name : Digital Image Processing & Pattern Recognition

Course Code : IN 322 **Total Marks: 20**

Date 18-5-2023 **Time allowed: 80min**

Question 1:

(a) An Image Run-length-coding step produced the following 5 symbols shown in the table below with their number of occurrences in the image:

Symbol	Number of occurrences
S1: (0,0)	160
S2: (0,1)	20
S3: (1,1)	10
S4: (2,1)	5
S5: (3,1)	5

(i) Explain the meaning of the RLC representations (0,1), (3,1) and (0,0). **(1)**

(ii) Design a **Huffman** code using the given data showing the binary codes for all the 5 possible symbol values. **(2)**

(iii) Find the total number of bits required to store this image using the designed Huffman encoder and the total number of bits required if we are using a fixed-length encoder. **(1)**

(b) (i) for the 8-by-8 image below, After doing proper normalization, apply the given filter on pixel **f(4,4)=200** and find the pixel's new value

(ii) Is this a smoothing filter or a sharpening filter? Explain your answer

70	70	100	70	87	87	150	187
85	100	96	79	87	154	87	113
100	85	116	79	70	87	86	196
136	69	87	200	79	71	117	96
161	70	87	200	103	71	96	113
161	123	147	133	113	113	85	161
146	147	175	100	103	103	163	187
156	146	189	70	113	161	163	197

f(i, j)

-0.5* | 1 | 1 | 1 |
|---|---|---|
| 1 | -12 | 1 |
| 1 | 1 | 1 |

(c) A digital image has 128 rows and 128 columns, calculate its size in **Bits** for the following cases:

(i) The image *Y* is standard true color **(1)**

(ii) If the image *Y* is converted to 256-colors indexed image (include the LUT size**)** **(1.5)**

(iii) If the 4:2:0 Chroma sub-sampling is used. **(1)**

(d) Explain how the K-means clustering is used to convert a 128-by-128 true color image to a 256-indexed-color image, showing the K-means algorithm internal steps; how you make sure K-means found a good solution? **(2)**

Question 2

(a) point to the wrong statements in the following, and explain why the statement is wrong:

i. When DCT2 is applied to a spatial block of size 8-by-8 the resulting is another 8-by-8 block with positive and negative numbers.

ii. When DCT2 is applied to a spatial block of size 8-by-8, each pixel in the resulting block is the frequency of the corresponding pixel in the spatial domain

iii. If the "Round" operation is removed, the JPEG will be lossless compression

iv. A Huffman table is designed for Image-A will always compress the size of another image-B even if it has different characteristics.

v. Chroma sub-sampling is used because Y-I-Q allows us to have less resolution to color planes

vi. JPEG relies on the fact that most images contain more low frquency than high frequency components

vii. A spatial block with many edges would benefit more from JPEG compression than a block with less edges

viii. JPEG will not be able to do any compression without the quantization and rounding processes

(b) An image is quantized so that each pixel takes value between (0-3). The table below shows the number of occurrences of the pixels:

Pixel value	Number of occurrences
0	25
1	25
2	150
3	150
4	25
5	25

(i) Compare between histogram equalization and contrast stretching in image enhancement **(1)**

(ii) Plot the **Normalized Histogram** as well as the **cumulative distribution** of the image in the above table **(1)**

(iii) Apply the **histogram equalization algorithm** on this image and find the new pixel values **(2)**

(iv) Plot the histogram for the histogram-equalized image **(1)**