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 5/4-2023　　　　　**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).

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

(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.

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

(ii) Is this a proper Gaussian filter?　(iii) What would be the exact filter weight values if it were a Box filter?

```
 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)
```

0.04	0.065	0.04
0.065	0.1	0.065
0.04	0.065	0.04

(c) A digital image has 300 rows and 300 columns, calculate its size in **Bits** for the following cases:

　(i)　　The image Y is standard true color

　(ii)　　If the image Y is converted to 128-colors indexed image (include the LUT size)

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

(d) Explain how the K-means clustering is used to convert a 300-by-200 true color image to a 128-indexed-color image, showing the K-means algorithm internal steps; how you make sure K-means found a good solution?

Question 2

(a) For the figures shown below explain:

(i)　　What is the domain of each figure shown below and how do we convert from one to another?

(ii)　　What the x-axis and y-axis represent in each of them?

(iii)　　Why are the bright values in the upper left corner only in the right-hand figure?
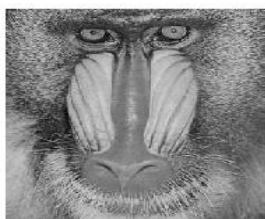
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(b) For the JPEG image compression system shown below**,** *explain briefly using equations when needed;*

(i)   Explain why the JPEG system works on the YIQ image instead of the RGB

(ii)   Explain why the image is divided into 8-by-8 blocks?

(iii)   Explain **why and how** the DCT block is used?

(iv)   Explain the quantization and rounding process and why it is the reason JPEG is lossy?

(v)   Explain why do we use Entropy coding in the JPEG system?
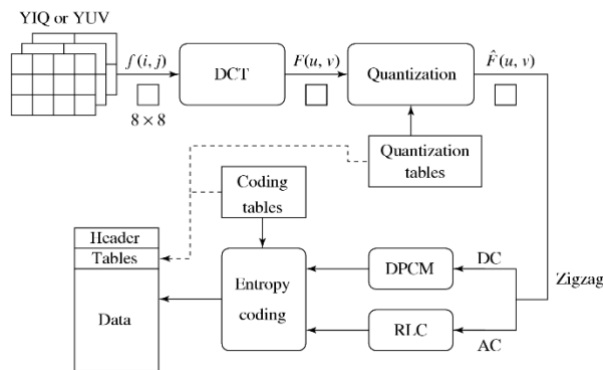
(b) An image is quantized so that each pixel takes value between (0-3). The table below shows the number of occurrences of the pixels:

Pixel value	Number of occurrences
0	150
1	40
2	10
3	0

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

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

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

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