

Homework #5Due 2:20pm, Monday, April 8th, 2024

- Consider a simple 4x16, 8-bit image:
 22 22 21 94 93 94 166 167 166 167 253 254 254 255 253 55
 20 22 21 22 94 95 93 166 167 166 254 253 255 255 254 54
 21 21 20 22 95 95 95 165 166 166 255 254 254 254 253 54
 21 21 22 95 95 94 166 167 165 166 254 255 253 253 255 55
 (a) Compute the entropy of the image. (5 pts)
 (b) Compress the image using Huffman coding and report the compression ratio using Huffman coding. (10pts)
 (c) Use another data compression algorithm shown in the lecture to obtain a higher compression ratio. (10 pts)
- The arithmetic decoding process is the reverse of the encoding procedure. Decode the message 0.222355 given the coding model. Assume that “!” is the symbol indicating the end of message. Show the decoding process. (25 pts)

symbol	probability
A	0.25
B	0.15
C	0.1
D	0.3
E	0.1
!	0.1

- A binary image contains straight lines oriented horizontally, vertically, at 45°, and at -45°. Develop a set of 3x3 masks that can be used to detect 1-pixel breaks in these lines. For example, you may want to detect a pattern like 1 1 1 0 1 1 1 in the vertical direction. Assume that the intensities of the lines and background are represented by 1 and 0, respectively. (25 pts)
- The results obtained by a single pass through an image of some 2D masks can be achieved also by two passes using 1D masks for improving efficiency. Show that the response of Sobel masks $\begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$ and $\begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$ can be implemented similarly by one pass of a vertical differencing mask $\begin{bmatrix} -1 \\ 0 \\ 1 \end{bmatrix}$ followed by a horizontal smoothing mask [1 2 1]. (25 pts)