

Major
EEL715 / MAL715 (Digital Image Processing) IInd Semester 2007-2008

Ques 1. (a) A binary erasure channel is one in which there is finite probability β that a transmitted symbol will not be received. The channel has three possible outputs: a 0, an erasure (no received symbol) and a 1. These three outcomes form the three rows of the binary erasure channel matrix

$$Q = \begin{bmatrix} 1-\beta & 0 \\ \beta & \beta \\ 0 & 1-\beta \end{bmatrix}$$

Obtain the capacity of the channel

(b) Would you prefer a binary symmetric channel with 0.125 probability error an erasure channel with probability of erasure = 0.5? Justify your answer. (5+3)

Ques 2. Consider an 8-pixel gray-scale data, {12, 12, 13, 13, 10, 13, 57, 54}, which is uniformly quantized with 6-bit accuracy.

- (a) Construct its 3-bit IGS code
- (b) Compute the rms error and rms signal-to-noise ratios for the decoded IGS data
- (c) If uniform 3-bit code is used instead of 3-bit IGS, compute the corresponding rms error and rms signal-to-noise ratio (4+2+2)

Ques 3. (a) Use LZW coding algorithm to encode the 7-bit ASCII string "aaaaaaaaa". (ASCII 'a' corresponds to the location 97)

(b) A 64 x 64 pixel binary image has been coded using 1-D WBS with blocks of 4 pixels. The WBS code for one line of the image was 0110010000001000010010000000, where 0 is used to represent black pixel. Decode the line

(c) Create a 1-D iterative WBS procedure that begins by looking for all white lines (a 64-pixel block) and successively halves non white intervals until four block pixels are reached. Use this algorithm to code the previously decoded line. Which of the two encoded sequence has fewer bits? (5+4+4)

Ques 4. Given (refer to Figure P4) the set A (each edge is length L) and four structuring elements B^1 (rectangle of size $L \times L/4$), B^2 (each edge is length $L/4$), B^3 (square with edge $L/2$), B^4 (circle with diameter L), perform the following operations:

- (a) $A \circ B^1$
- (b) $A \cdot B^2$
- (c) Use B^3 as the structuring element to obtain the skeleton of A
- (d) Perform boundary extraction using B^4 (3+3+3+3)

Ques 5. A binary image consists of a black background and a white center rectangle of size $m \times n$ pixels

- (a) Sketch the gradient of the image. Assume that G_x and G_y are obtained using Sobel operators. Show all relevant pixel values in the gradient image.

Max Marks: 60
Duration: 2 hour

- (b) Sketch the histogram of edge directions. Label height of each peak of the histogram
- (c) Sketch the Laplacian of the image. Show all relevant pixel values in the Laplacian image (4+4+3)

Ques 6. (a) Segment the image shown in Figure P6, using split and merge procedure. Let $P(R_i) = \text{TRUE}$ if all pixels in R_i have the same gray level
(b) Show the quadtree corresponding to this segmentation (5+3)

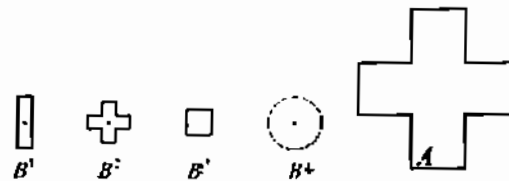


Figure P4: Set A and the 4 structuring elements

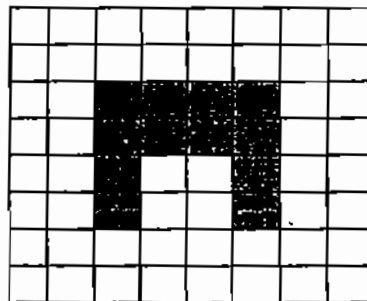


Figure P6: Image to be segmented using split and merge