

BG3104 Biomedical Imaging

Tutorial 1

1) A common measure of transmission for digital data is the baud rate, defined as the number of bits transmitted per second. Generally, transmission is accomplished in packets consisting of a start bit, a byte (8 bits) of information, and a stop bit. Using these facts, answer the following:

(a) How many minutes would it take to transmit a 1024 x 1024 image with 256 gray levels using a 56K baud modem? Assuming one baud is equal to one bit per second (bps).

(b) What would the time be at 750K baud, a representative speed of a phone DSL (digital subscriber line) connection?

2) The pixel value of the following 5 x 5 image are represented by 8-bit integers:

$$f = \begin{bmatrix} 123 & 162 & 200 & 147 & 93 \\ 137 & 157 & 165 & 232 & 189 \\ 151 & 155 & 152 & 141 & 130 \\ 205 & 101 & 100 & 193 & 115 \\ 250 & 50 & 75 & 88 & 100 \end{bmatrix}$$

Determine f with a gray-level resolution of 2^k for (i) $k = 5$ and (ii) $k = 3$

3) Determine **true** or **false** for the following arrangement of pixels.

$$\begin{array}{ccccc} 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & \textcircled{1} & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{array}$$

- a) The circled point is part of the boundary of the 1-valued pixels if 8-adjacency is used.
- b) The circled point is part of the boundary of the 1-valued pixels if 4-adjacency is used.

4) Consider the two 4×4 image subsets, S_1 (top) and S_2 (bottom), shown in the following figure. For $V = \{1, 2\}$, determine whether these two subsets are (a) 4-adjacent (b) 8-adjacent or (c) m-adjacent.

S_1					
0	0	0	1	0	0
1	0	0	1	1	1
0	0	0	2	2	2
0	0	2	0	0	2
1	0	0	1	2	2
2	1	1	1	1	1
1	2	2	2	1	0
3	0	0	0	0	1
S_2					

Figure 1. Two image subset

5) Consider the image segment shown in Figure 2.

a). Let $V = \{1, 2\}$ and compute the lengths of the shortest 4-, 8-, and m-path between p and q . If a particular path does not exist between these two points, explain why.

b). Determine the Euclidean, D_4 , and D_8 distance between p and q .

3	1	2	1 (q)
2	2	0	2
1	2	1	1
(p) 1	0	1	2

Figure 2.

Answers

1. (a) 187.25 sec or 3.1 min

(b) 14 sec

2. (i)

$$f = \begin{bmatrix} 15 & 20 & 25 & 18 & 11 \\ 17 & 19 & 20 & 29 & 23 \\ 18 & 19 & 19 & 17 & 16 \\ 25 & 12 & 12 & 24 & 14 \\ 31 & 6 & 9 & 10 & 12 \end{bmatrix}$$

(ii)

$$f = \begin{bmatrix} 3 & 5 & 6 & 4 & 2 \\ 4 & 4 & 5 & 7 & 5 \\ 4 & 4 & 4 & 4 & 4 \\ 6 & 3 & 3 & 6 & 3 \\ 7 & 1 & 2 & 2 & 3 \end{bmatrix}$$

3 (a) True. (b) True

4 (a) No (b) Yes (c) Yes

5 (a) Shortest 4 path is 6.

Shortest 8 path is 4.

Shortest m-path is 6.

(b) Euclidean distance is 4

D₄ distance is 6

D₈ distance is 3