

## Image Processing

### DIGITAL ASSIGNMENT-1

Dhrur Garg  
16BCE1190

- Q1 Consider the two image subsets  $S_1$  and  $S_2$ , shown in the figure, for  $V = \{1\}$ , determine whether the two subsets are (a) 4-adjacent, (b) 8-adjacent, or (c) m-adjacent.

	$S_1$					$S_2$				
0	0	0	0	0		0	0	1	1	0
1	0	0	1	0		0	1	0	0	1
1	0	0	1	0		1	1	0	0	0
0	0	1	1	1		0	0	0	0	0
0	0	1	1	1		0	0	1	1	1

Ans: THEORY:

"V" is the set of gray levels used to define connectivity for two points  $p, q \in V$ .

3 types of connectivity are defined as follows:

(A) 4-connectivity  $\Rightarrow p, q \in V$  and  $p \in N_4(q)$

(B) 8-connectivity  $\Rightarrow p, q \in V$  and  $p \in N_8(q)$

(C) M-connectivity (mixed connectivity)  $\Rightarrow$

(i)  $q \in N_4(p)$  or

(ii)  $q \in N_D(p)$  and  $N_4(p) \cap N_4(q) = \emptyset$

Two pixels:  $p$  &  $q$  are adjacent if they are connected by 4/8/m-adjacency.

$\therefore$  Two image subsets  $S_i$  and  $S_j$  are adjacent if  $\exists p \in S_i$  and  $\exists q \in S_j$  such that  $p$  and  $q$  are adjacent.

### SOLUTION :

Let "p" and "q" be two pixels from the subsets  $S_1$  and  $S_2$ .

	$S_1$					$S_2$				
0	0	0	0	0	0	0	0	1	1	0
1	0	0	1	0	0	0	1	0	0	1
1	0	0	1	0	0	1 <sup>q</sup>	1	0	0	0
0	0	1	1	1 <sup>p</sup>	1	0	0	0	0	0
0	0	1	1	1	1	0	0	1	1	1

- (a)  $S_1$  and  $S_2$  are not 4-connected because "q" is not in the set  $N_4(p)$ .
- (b)  $S_1$  and  $S_2$  are 8-connected because "q" is present in the set  $N_8(p)$ .
- (c)  $S_1$  and  $S_2$  are m-connected because (i) q is in  $N_D(p)$  and (ii) the set  $N_4(p)$  and its intersection with  $N_4(q)$  is empty .ie.  $N_4(p) \cap N_4(q) = \emptyset$

Q<sub>2</sub>

Consider the image segment as shown:

- (a) Let  $V = \{0, 1\}$  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) Repeat for  $V = \{1, 2\}$

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



Ans:

THEORY:

A path from  $p(x, y)$  to  $q(s, t)$  is a sequence of distinct pixels.

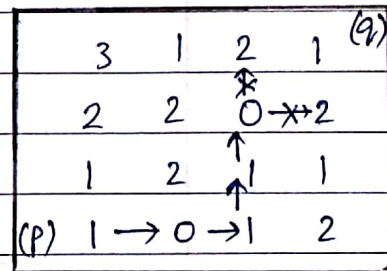
$$(x_0, y_0), (x_1, y_1), \dots, (x_n, y_n)$$

where  $(x_0, y_0) = \underbrace{(x, y)}_p, (x_n, y_n) = \underbrace{(s, t)}_q$

such that  $(x_i, y_i)$  is adjacent to  $(x_{i-1}, y_{i-1})$  for  $1 \leq i \leq n$  where "n" is the length of the path.

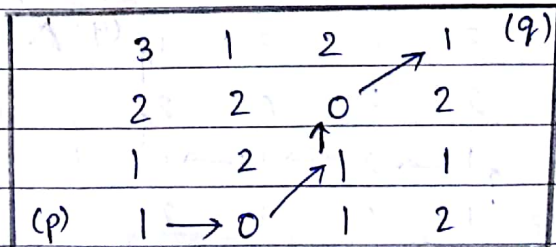
Part (a): when  $v = \{0, 1\}$

4-path A 4-path does not exist between "p" and "q" by traveling along the points that are both 4-adjacent and also have values from  $v$ .

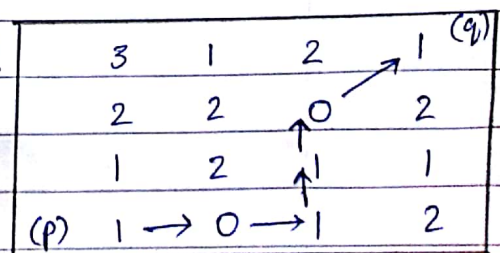
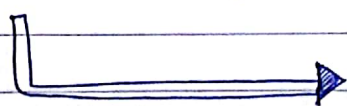


The figure shows that it is not possible to get to q.

8-path The shortest 8-path is of length 4.



m-path The shortest m-path length is 5.



Part (b) : when  $V = \{1, 2\}$

4-path

There are multiple 4-paths available. The shortest is of length 6. For length 6 as well there are multiple paths. One of them is shown.

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

8-path

For shortest 8-path, its length is 4. However it is not unique i.e. there are multiple 8-paths with length 4.

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

m-path

The shortest m-path is of length 6. There are multiple m-paths with length 6. One of them is shown below.

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