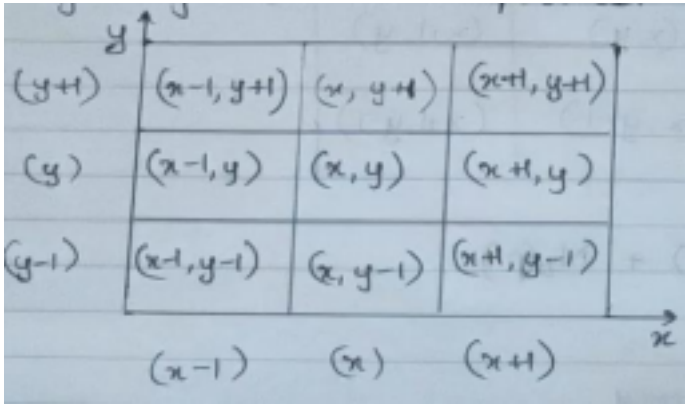
# BASIC RELATIONSHIPS BETWEEN PIXELS

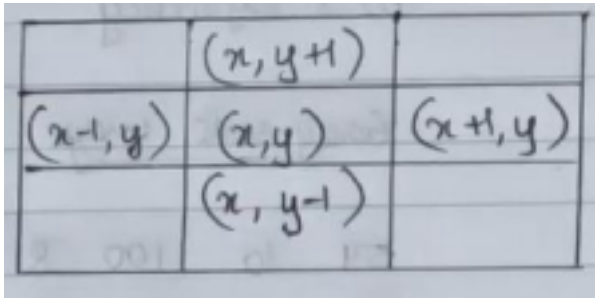


## NEIGHBORS OF A

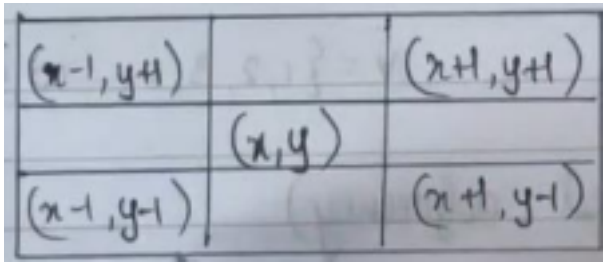
# PIXEL




A pixel p at coordinates (x, y) has **four** horizontal and vertical neighbors whose coordinates are given by




$N_4(p)=(x+1, y), (x-1, y), (x, y+1), (x, y-1)$




$N_D(p)=(x+1, y+1), (x+1, y-1), (x-1, y+1), (x-1, y-1)$

- The points $N_4(p)$and $N_D(p)$ together are called 8-neighbors of p represented as $N_8(p)$.

$$N_8(p)=N_4(p) \cup N_D(p)$$

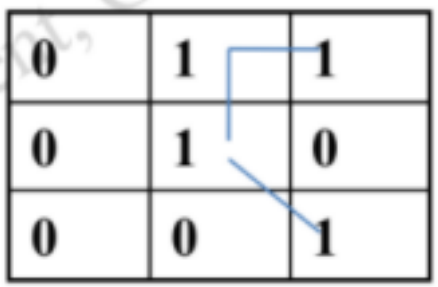
# ADJACENCY

- Let V be the set of intensity values
- **4-adjacency-**Two pixels p and q with values from V are 4-adjacent if q is in the set $N_4(p)$.
- **8-adjacency-** Two pixels p and q with values from V are 8-adjacent if q is in the set $N_8(p)$.
- **m-adjacency (mixed adjacency)-**Two pixels p and q with values from V are m-adjacent if

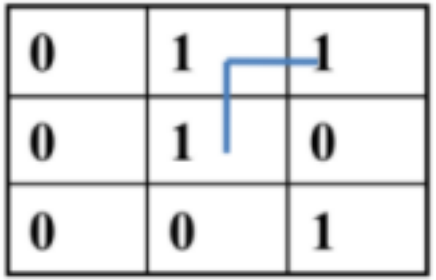
  (i) q is in $N_4(p)$, or

  (ii) q is in is in $N_D(p)$ and the set $N_4(p) \cap N_4(q)$ has no pixels whose values are from V

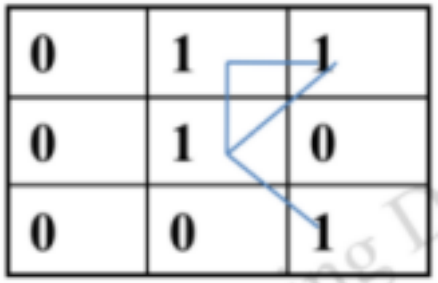
- Consider the following binary image. If V={1}




m-adjacent



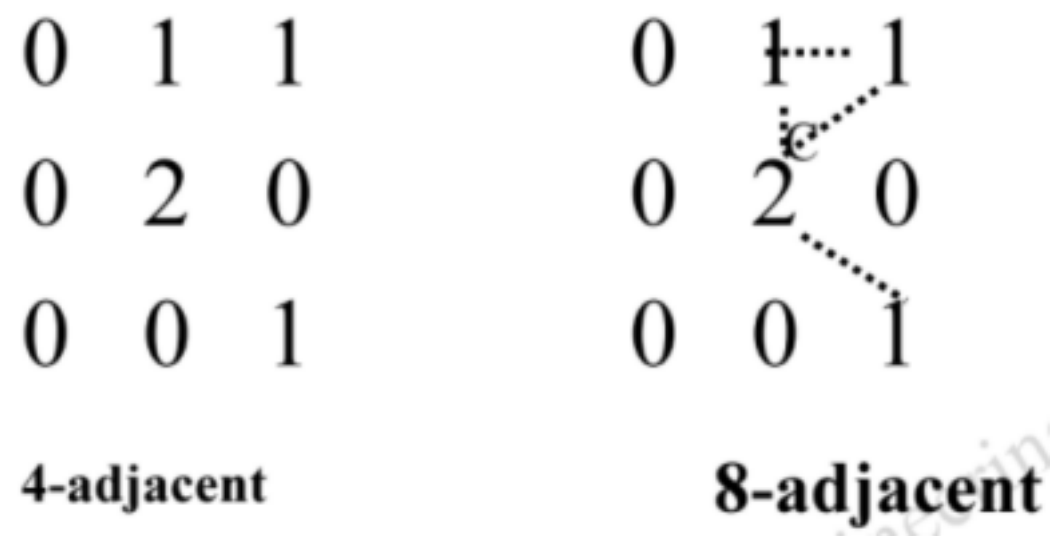

4-adjacent




8-adjacent

**V = {1, 2}**

0 1 1
0 2 0
0 0 1




| | | |
|---|---|---|
| 0 | 1 | 1 |
| 0 | 2 | 0 |
| 0 | 0 | 1 |



- Consider the following image, v={1}, find length of the shortest 4-path, 8-path and m path between p and q.

| | | |
|---|---|---|
| 0 | 1 | 1p |
| 0 | 1 | 0 |
| 0 | 0 | 1q |



- No 4 –path
- 8-path

| | | |
|---|---|---|
| 0 | 1 | 1p |
| 0 | 1 | 0 |
| 0 | 0 | 1q |

M-path

| | | |
|---|---|---|
| 0 | 1 | 1p |
| 0 | 1 | 0 |
| 0 | 0 | 1q |



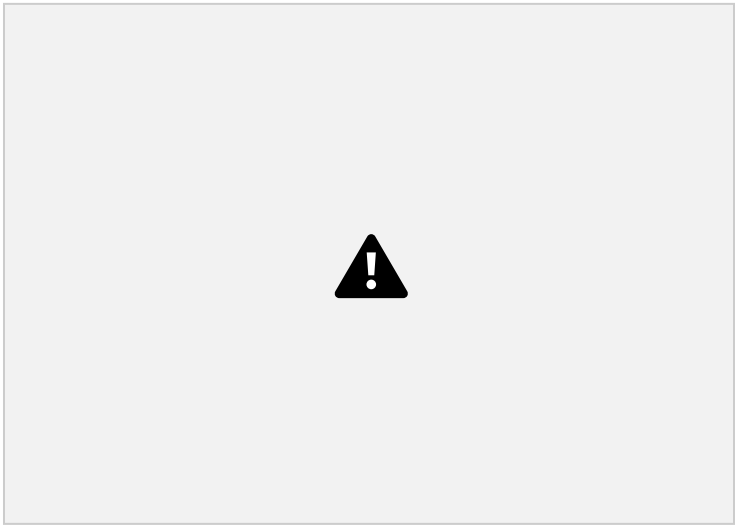
- Consider the following image, v={1,2}, find length of the shortest 4-path, 8-path and m path between p and q.

| | | |
|---|---|---|
| 0 | 1 | 1p |
| 0 | 2 | 0 |
| 0 | 0 | 1q |

- No 4 path
- 8-path

| | | |
|---|---|---|
| $0_{(0,0)}$ | 1 | 1p |
| 0 | 1 | 0 |
| 0 | 0 | 1q |

i)(0,2),(0,1),(1,1),(2,2), length=3
ii)(0,2),(1,1),(2,2), length=2



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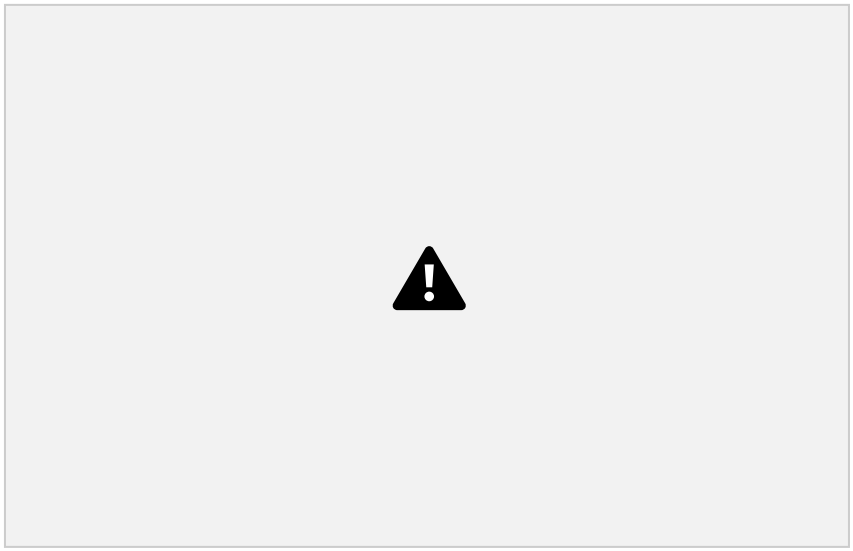
- Let v={3,4,5}. Compute the length of the shortest 4-path, 8 path and m-path between p and q.



4-path (len=6),8-path (len=4) ,m-path(len=5)



# DISTANCE MEASURES

- The Euclidean distance between p and q is defined as

- The $D_4$ distance (also called city-block distance) between p and q is defined as

- The $D_8$(also called chessboard distance) between p and q is defined as

- $D_m$ distance between two points is defined as shortest m path between the points