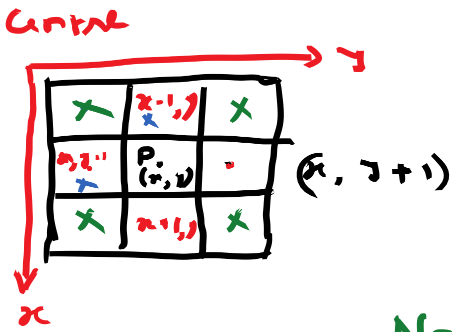
Lecture-4



4-neighbors of p

→ $N_4(p)$

→ $N_D(p)$

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

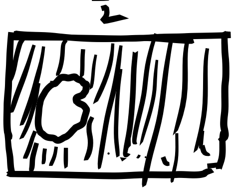
- Each of the neighbors is at a unit distance from p
- If p is a boundary pixel then it will have less no. of neighbours.

- $N_4(P)$
- $N_D(P)$
- $N_8(P)$

* **Connectivity:-**
- Establishing object boundaries
- Defining image component/regions.

0 , 1

$\frac{1}{2}$

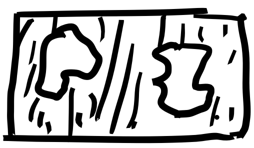


if $f(x,y) > Th$ $\frac{1}{2}$, 128

→ $(x,y) \in$ Object

else

$(x,y) \in$ background.



* Two pixels are connected if they are adjacent in some sense:

p, q ① They are neighbors (N_4, N_8, N_D) and

$q \in N_4(p)$ ② $I(p) = I(q)$

* Let V be the set of gray levels used to define connectivity for 2 points $I(p), I(q)$

$$I(p) \in V \; ; \; I(q) \in V. \qquad \overset{8\text{ bit}}{[0-255]}$$

3-types of connectivity :-

(i) 4-connectivity $\rightarrow I(p), I(q) \in V$ & $p \in N_4(q)$

(ii) 8 " $\rightarrow I(p), I(q) \in V$ & $p \in N_8(q)$

(iii) m " (mixed connectivity)

(a) $I(p), I(q) \in V$

e

(b) $q \in N_4(p)$

or

(b') $q \in N_D(p)$ and $N_4(p) \cap N_4(q) = \phi$

Example :- $V = \{1\}$

$N_4(p) \cap N_4(q) \neq \phi$

0	1	1
0	1	0
0	0	1

4-Connectivity

0	1	1
0	1	0
0	0	1

8-Connectivity

0	1	q 1
0	p 1	0
0	0	1

m-Connectivity

Adjacency :- p, q

- 4 adjacency
- 8 adjacency
- m "

Path:- 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 $(x_0, y_0) = (x, y)$, $(x_n, y_n) = (s, t)$

(x_i, y_i) is adjacent to (x_{i-1}, y_{i-1})

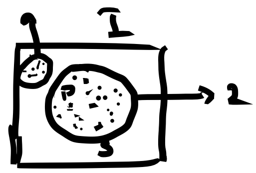
length of the path $= n$ $[1 \leq i \leq n]$

Connected Component:-

Let $S \subseteq I$ and $p, q \in S$

p is connected to q in S if there is a path from p to q consisting entirely of pixels in S.

For any $p \in S$, the set of pixels in S that are connected to p is called connected component of S.



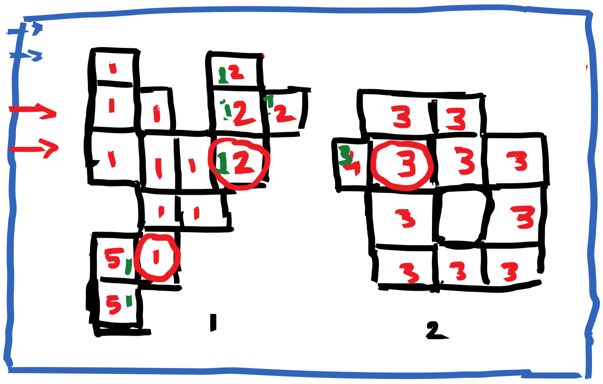
Connected Component Labelling:-

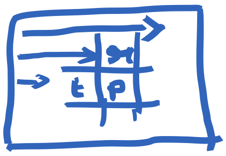
- Shape
- Area
- Boundary

Algorithm:-

-

- $(1,2) \Rightarrow 1$
- $(4,3) \Rightarrow 3$
- $(5,1) \Rightarrow 1$





- Scan an image from left to right and top to bottom.
- Assume 4-connectivity.
- p be the target pixel at any step in the scanning process.
- $I(p)$: pixel value at position p.
  $L(p)$: label assigned to pixel location p.

Steps:-

(i) If $I(p) == 0$, move to next position.

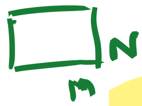
(ii) If $I(p) == 1$, $I(r) == 0$
$I(t) == 0$
Then assign a new label to p.

→ (iii) If $I(p) == 1$, $I(r) == 1$ | $I(r) == 0$
$I(t) == 0$ | $I(t) == 1$
Top/left neighbour
Assign the label of r to p
t to p

(iv) If $I(p) == 1$, $I(r) == 1$
$I(t) == 1$

If $L(r) == L(t)$ then $L(p) = L(r)$
→ else assign $L(p) = L(r)$ with a note.

- At the end all the pixels with value 1 are labeled.
- Some labels are equivalent
- IInd pass - equivalent pairs will be formed equivalent class
- Assign a different label to each class.



$$\mu_x = \frac{1}{MN}\sum_{i=1}^{MN} f(i)$$

$$\sigma^2 = \frac{1}{MN}\sum_{i=1}^{MN}\left(f(i)-\mu_x\right)^2$$

$(MN-1)$