Computer vision – 2021/2022	Section (3)

Section Content:

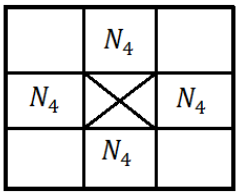
- Neighboring
- Connectivity
- Image path
- Labeling
- Histogram

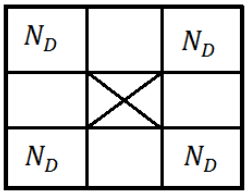
Neighboring

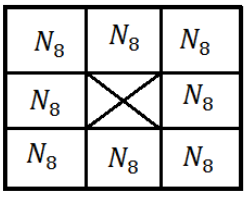
Neighboring:

- To identify **objects** in a digital pattern, we **need to locate groups of black pixels** that are "connected" to each other. In other words, the **objects** in each digital pattern are the **connected components** of that pattern.
- Relation between pixels in some way.
- Generally, objects are group of color/gray connected neighbor pixels

Types of Neighboring:







N_4 four

N_D Diagonal

$N_8 (f(X, Y)) = \{N_D \cup N_4\}$

Connectivity

Connectivity:

- Pixels are considered connected if and only if:

- They're neighbors "according to some neighboring"
- $f(X_1, Y_1), f(X_2, Y_2) \in \xi$ → Where ξ is the gray levels connectivity set {….. , ….. , ….. }.

Example 1: Find the Connectivity

- Giving the connectivity for the pixel f (1,1) giving the connectivity set ξ={ 3,4,5,6,7,8,9,10} for cases N_4, N_D, N_8

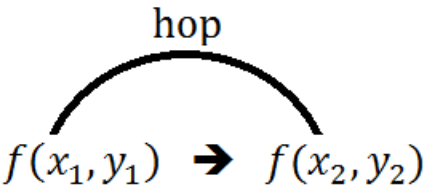
2	4	7
6	5	100
13	120	9

Answer Example 1

- In case of, N_4 "5" is connected with F(1,0) = 4 and F(0,1) = 6.
- In case of, N_D "5" is connected with F(2,0) = 7 and F(2,2) = 9.
- In case of, N_8 "5" is connected to F(1,0), F(0,1) , F(2,0) , F(2,2) ={4,6,7,9 }.

Image Path:

- The Image path is a sequence of connected pixels starts at the first pixel f (x1, y1) and ends at f (xn, yn).
- This Path sometimes doesn't exist as there might be a disconnection in the Gray scale with respect to the connectivity set, could be unique, and could be multiple paths
- Image Path Length: The number of hops



Example 2 Find the Image Path Between f (1,1) and f (3,5)

- Giving the connectivity set ξ= {3,4,5,6,7,8,9,10} and neighbor N_4

6	**3**	**8**	**7**	**5**	**4**	**2**
2	2	5	6	9	8	7
4	5	2	3	0	1	2
3	2	1	3	1	2	1
1	1	1	8	0	5	5

8	8	8	6	7	9	8
7	7	7	8	6	7	5

Answer Example 2

Image path = {f(1,1), f(2,1), f(3,1), f(3,2), f(3,3), f(3,4), f(3,5)}

Image path length =n-1 = 7-1=6

6	3	1	7	5	4	2
2	2	5	6	9	8	7
4	5	2	3	0	1	2
3	2	1	7	1	2	1
1	1	1	8	0	5	5
8	8	8	6	7	9	8
7	7	7	8	6	7	5

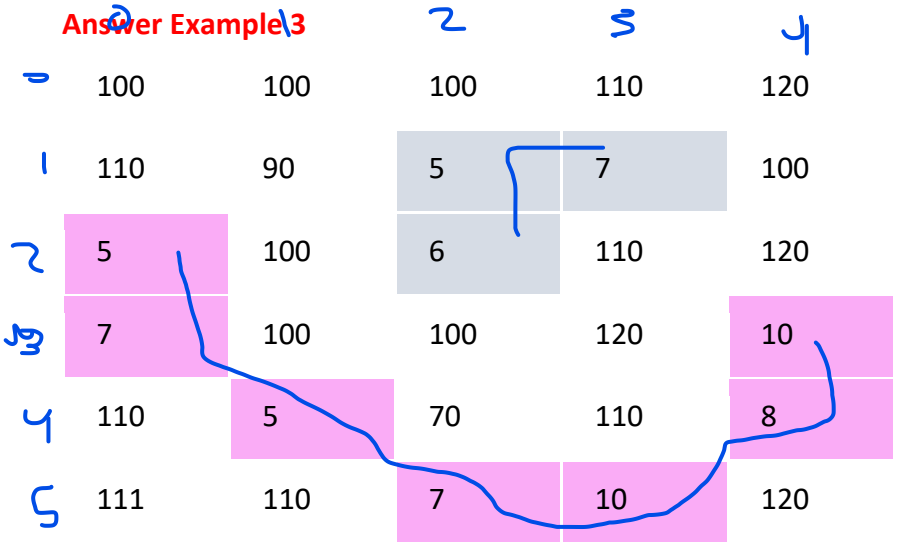
Labeling of Connected Regions

- Region: is the group of connected pixels.
- Labeling is a mean to find out the regions that exists within an image matrix

Example 3: get the labels for the pixels satisfying the rule of ξ={ 0-->20} and neighbor N 8

100	**100**	**100**	**110**	**120**
110	90	5	7	100
5	100	6	110	120
7	100	100	120	10
110	5	70	110	8
111	110	7	10	120

Answer Example 3



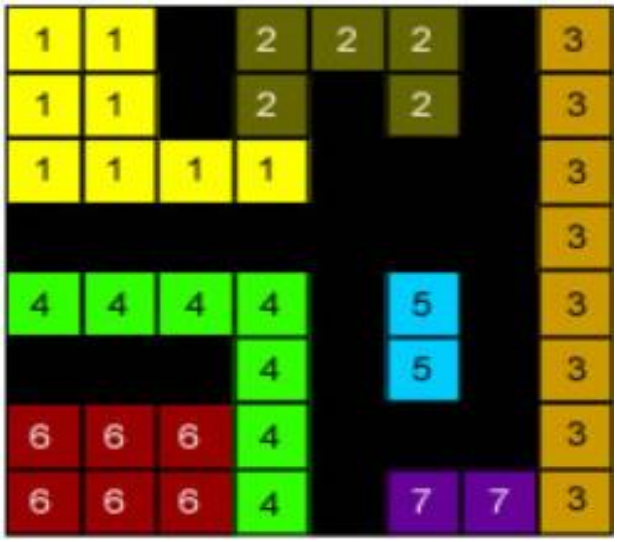
Finally, the found labels are L1 and L2

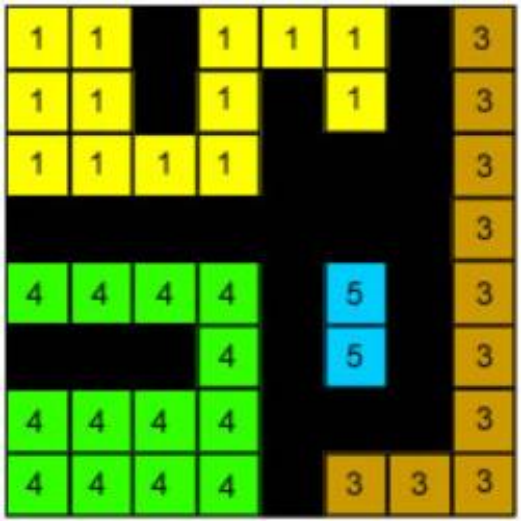
Label 1 = {f (2,1), f (3,1), f (2,2)}

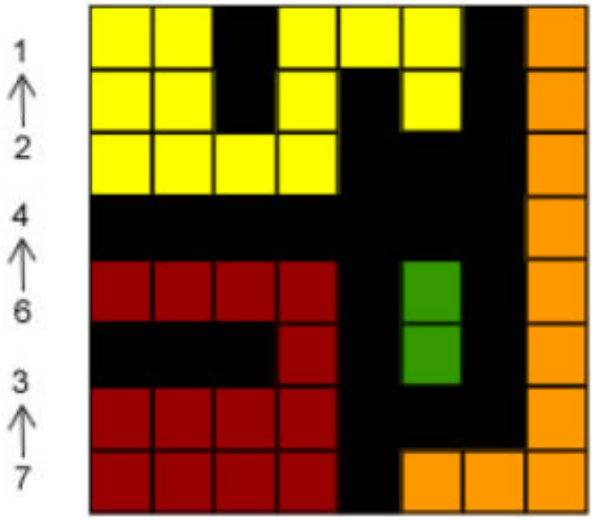
Label 2 = {f (0,2), f (0,3), f (1,4), f (2,5), f (3,5), f (4,3),f(4,4)}

Example 3 perform labeling of connected regions using N_8, $\xi = \{1\}$

1	1	0	1	1	1	0	1
1	1	0	1	0	1	0	1
1	1	1	1	0	0	0	1
0	0	0	0	0	0	0	1
1	1	1	1	0	1	0	1
0	0	0	1	0	1	0	1
1	1	1	1	0	0	0	1
1	1	1	1	0	1	1	1







Histogram

Histogram:

- Histogram: count the number of occurrences per gray/color component value within the image matrix/matrices.
- So, histogram is a table of two columns: gray/color, counts.
- The total number of counts should be equal to M*N pixel counts

Example 1:

Calculate the Following for the following Matrix: Find histogram

$$\begin{pmatrix} 5 & 5 & 4 & 5 \\ 10 & 20 & 5 & 4 \\ 10 & 20 & 5 & 10 \\ 20 & 4 & 5 & 100 \end{pmatrix}$$

Answer:

Gray Value	Count
4	3
5	6
10	3
20	3
100	1
Total count	16

Example 2:

Calculate the Following for the following Matrix: Find histogram

1	**2**	**7**	**5**	**6**
7	2	3	4	5
0	1	5	7	3
1	2	5	7	3
6	1	0	3	4

Answer:

Gray	Count
0	2
1	4
2	3
3	3
4	2
5	4
6	3
7	4
Total →	25