LAB-03: Connected Component Analysis

Objective:

The objective of this lab to perform connected component labelling in images and to get an understanding of distance maps and intensity level resolution.

Theory:

Connected Component Analysis or Labelling enables us to detect different objects from a binary image. Once different objects have been detected, we can perform a number of operations on them: from counting the number of total objects to counting the number of objects that are similar, from finding out the biggest object of the bunch to finding out the smallest and from finding out the closest pair of objects to finding out the farthest etc.
Connected Component labelling procedure is as follows:

- Process the image from left to right, top to bottom:

If the next pixel to process is 1

i.) If only one of its neighbors (top or left) is 1, copy its label.

ii.) If both are 1 and have the same label, copy it.

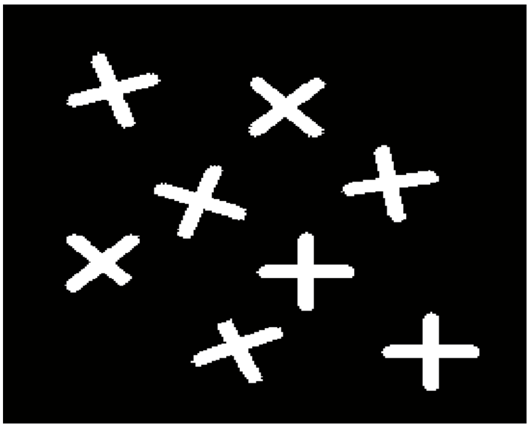
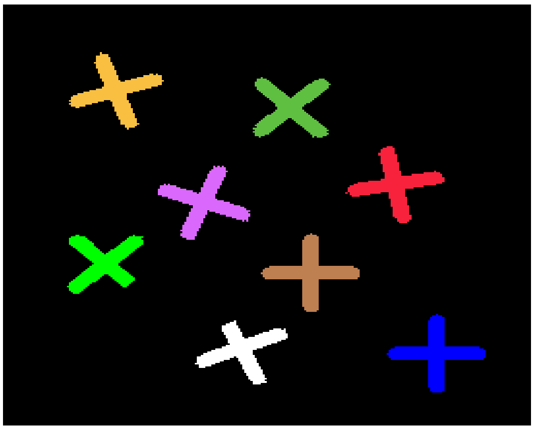
iii.) If they have different labels

– Copy the label from the left.

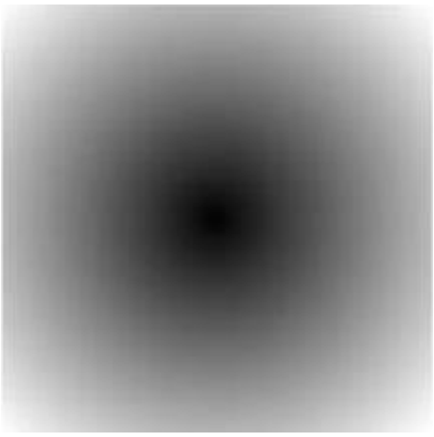
– Update the equivalence table.

iv.) Otherwise, assign a new label.

- Re-label with the smallest of equivalent labels

A **Distance map** can be created by measuring the Euclidian distance of every pixel (position in x and y) from the center and then assigning that value to the pixel for which the Euclidian distance has been calculated. A distance map is shown below:



Intensity level resolution defines the resolution at bit level i.e. how many bits are used to represent a pixel value. The more bits we have per pixel, the more levels there are. For example, a grayscale image has 256 different levels because for each pixel value we use 8 bits to store the value. If the bits per pixel are decreased to 4, then the maximum levels that we can have is 16. Similarly, if only 1 bit is used for it then we can have only two levels (or a binary image). To change the bit level resolution, different levels (or intensities) can be grouped together to form new levels. For example, for a 3 bits/pixel image:

0	1	2	3	4	5	6	7

0	1	2	3

0	1

Some Useful Commands:

No new commands needed for this lab.

Lab Tasks:

Lab Task 1:

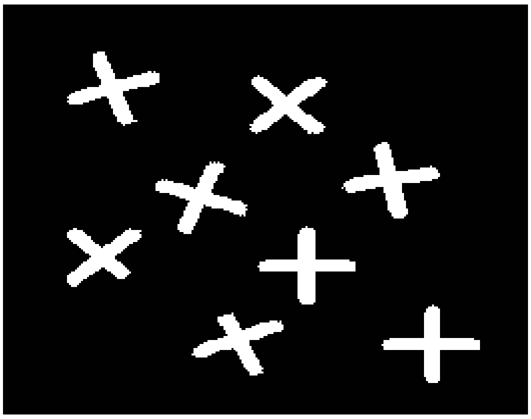
Read a grayscale image (given below) and convert the image to 16 levels, then to 4 levels and finally to 1. Display all four images.

Lab Task 2:

Create an empty image of zeros of size 501x501 and then create a distance map by calculating the Euclidian Distance of every pixel from the center. Display the distance map. (Don't forget to declare the data type of the array of zeros as **uint8**).

Lab Task 3:

For the image given above (also available with the lab handout), apply the connectected component labelling using **4 connectivity** and count the total number of objects in the lsit. (**HINT:** In the image given here, the background (black portion) has a numeric value of 1 while the white objects have a numeric value of 255.)



Conclusion:

This focus of this lab is on connected component labelling, generating a distance map using Euclidian distance and understanding the effects of changing the number of bits per pixel.