**3.7. Distance Measures**

For pixels p, q, and z, with coordinates (x, y), (s, t), and (v, w),respectively, D is a distance function or metric if

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1. The Euclidean distance between p and q is define as

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For this distance measure, the pixels having a distance less than or equal to some value r from (x,y) are the points contained in the disk of radius r centered at (x,y)

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1. The D4 distance (called the city-block distance) between p and q is defined as:



In this case, Pixels having a D4 distance from (x,y) less than or equal to some valuer from a Diamond centered at(x, y),.

**Example**:

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the pixels with D4=1are the 4-nighbors of (x, y).

1. The D8 distance (called the chessboard distance) between p and q is defined

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In this case, the pixels having a D8 distance from (x,y) less than or equal to some value r from a square centered at (x, y).

**Example**:

 

The pixels with D8=1 are the 8-nieghbors of (x,y).

**Note**: that the D4 distance & D8 distance are independent of any paths that might exist between the points because these distances involve only the coordinates of the points.

أن المسافة D4 و المسافة D8 مستقلة عن أي المسارات التي قد توجد بين النقاط لأن هذه المسافات تنطوي فقط إحداثيات نقطة.



**4. Dm – distance** between two points is defined as the shortest m-path between the point.

In this case the distance two pixels will depend on the values of the pixels along the path as well as the values of their neighbors.

**Example :** consider the following arrangement of pixels and assume that p,p2 and p4 have value 1 and that p1 and p3 can have a value of 0 or 1:



Suppose that we consider adjacency of pixels valued 1(i.e. v={1})

1. If p1 and p3 are 0

The m- path (Dm distance between p and p4is **2**



1. If p1 is 1

The Dm distance between p p1 p2 p4 is **3**

 

1. If p3=1 and p1=0

The Dm distance between pp2 p3 p4 is **3**

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

1. If p1 and p3 are 1



The Dm distance between pp1 p2 p3 p4 is **4**





**Homework**: Try the chessboard distance to proof the 8-neighbors