Distance Measures:

The distance between two pixels in a given image can be given by three different types of measures and they are-

1. Euclidean distance
2. D_4 distance
3. D_8 distance

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

$$\begin{aligned}&\textbf{(a)}\ D(p,q) \geq 0 \quad (D(p,q) = 0 \quad \text{iff} \quad p = q),\\ &\textbf{(b)}\ D(p,q) = D(q,p), \text{and}\\ &\textbf{(c)}\ D(p,z) \leq D(p,q) + D(q,z).\end{aligned}$$

The **Euclidean distance** between p and q is defined as

$$D_e(p,q) = \left[(x-s)^2 + (y-t)^2\right]^{\frac{1}{2}}.$$

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 a disk of radius r cantered at (x, y).

The **D4 distance (also called city-block distance)** between p and q is defined as

$$D_4(p,q) = |x-s| + |y-t|.$$

In this case, the pixels having a D_4 distance from (x, y) less than or equal to some value r form a diamond centered at (x, y). For example, the pixels with D4 distance . 2 from (x, y) (the center point) form the following contours of constant distance:

4		2		4
	2	1	2	
2	1	0	1	2
	2	1	2	
4		2		4

The pixels with D_4 =1 are the 4-neighbors of (x, y).

The **D8 distance (also called chessboard distance)** between p and q is defined as

$$D_8(p,q) = \max(|x-s|, |y-t|).$$

In this case, the pixels with D8 distance from(x, y) less than or equal to some value r form a square centered at (x, y). For example, the pixels with D8 distance ≤ 2 from(x, y) (the center point) form the following contours of constant distance:

2	2	2	2	2
2	1	1	1	2
2	1	0	1	2
2	1	1	1	2
2	2	2	2	2

The pixels with D_8=1 are the 8-neighbors of (x, y).

Question: Let V = {0,1}, compute D_4, D_8 distances between p and q