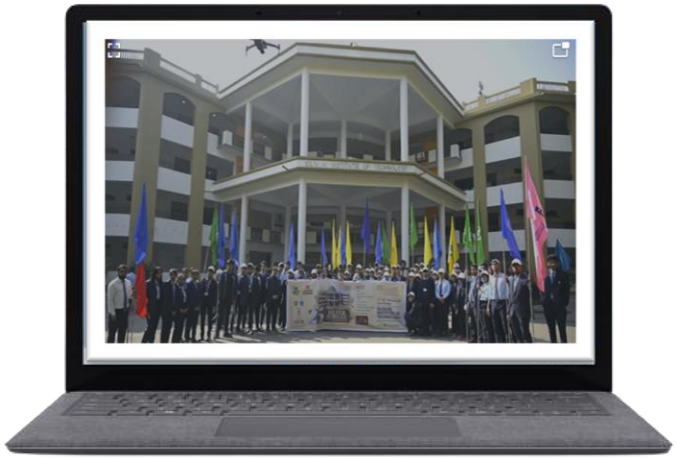


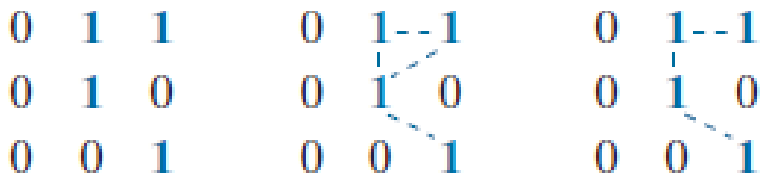
# Some basic relationships between pixels

# Neighbors of a pixel

- A pixel p at co-ordinates (x,y) has two horizontal and two vertical neighbors with coordinates
- $(x + 1, y), (x - 1, y), (x, y + 1), (x, y - 1)$
- This set of pixels, called the 4-neighbors of p, is denoted $N_4(p)$.
- The four diagonal neighbors of p have coordinates
- $(x + 1, y + 1), (x + 1, y - 1), (x - 1, y + 1), (x - 1, y - 1)$
- and are denoted $N_D(p)$. These neighbors, together with the 4-neighbors, are called the 8-neighbors of p, denoted by $N_8(p)$).
- The neighborhood is said to be closed if it contains p. Otherwise, the neighborhood is said to be open.

# Adjacency

- Let V be the set of intensity values used to define adjacency.
- 4-adjacency. Two pixels p and q with values from V are 4-adjacent if q is in the set $N_4(p)$.
- 8-adjacency. Two pixels p and q with values from V are 8-adjacent if q is in the set N$N_8(p)$.
- m-adjacency (also called mixed adjacency). Two pixels p and q with values from V are m-adjacent if
  - a) q is in $N_4(p)$, or
  - b) q is in $N_D(p)$ and the set $N_4(p) \Omega \mathrm{N}_4(\mathrm{q})$ has no pixels whose values are from V.



# Connectivity, Regions, And Boundaries

- A digital path (or curve) from pixel $p$ with coordinates $(x_0, y_0)$ to pixel $q$ with coordinates $(x_n, y_n)$ is a sequence of distinct pixels with coordinates
- $(x_0, y_0), (x_1, y_1), \ldots (x_n, y_n)$
- where points $(x_i, y_i)$ and $\left(x_{\{i-1\}}, y_{\{i-1\}}\right)$, are adjacent for $1 \leq i \leq n$ . In this case, $n$ is the length of the path.

# Connectivity, Regions, And Boundaries

- Let S represent a subset of pixels in an image. Two pixels p and q are said to be connected in S if there exists a path between them consisting entirely of pixels in S.
- For any pixel p in S, the set of pixels that are connected to it in S is called a connected
- component of S. If it only has one component, and that component is connected, then S is called a connected set.

# Distance Measures

- For pixels $p, q\ and\ s$, with coordinates $(x, y), (u, v)$ and $(w, z)$ respectively, $D$ is a distance function or metric if
- $D(p, q) \geq 0\ (D(p, q) = 0\ iff\ p = q)$
- $D(p, q) = D(q, p)$, and
- $D(p, s) \leq D(p, q) + D(q, s)$.

# Distance Measures

- The Euclidean distance between p and q is defined as

$$D_e(p,q) = [(x-u)^2 + (y-v)^2]^{\{\frac{1}{2}\}}$$

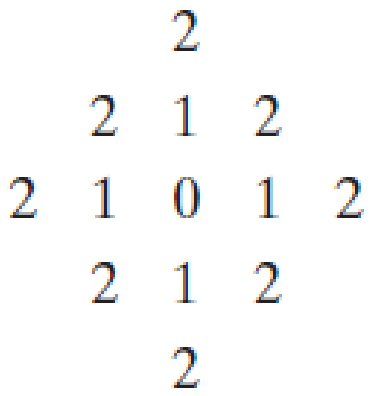
- The D4 distance, (called the city-block distance) between p and q is defined as

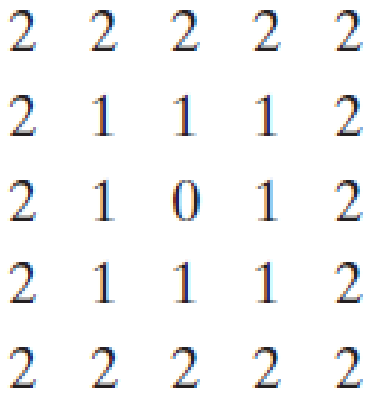
$$D_4(p,q) = |x-u| + |y-v|$$

- The D8 distance (called the chessboard distance) between p and q is defined as

$$D_8(p,q) = \max\{|x-u|, |y-v|\}$$

# Distance Measures





# Reference


- E Woods, Richard, and Rafael C Gonzalez. "Digital image processing." (2008).