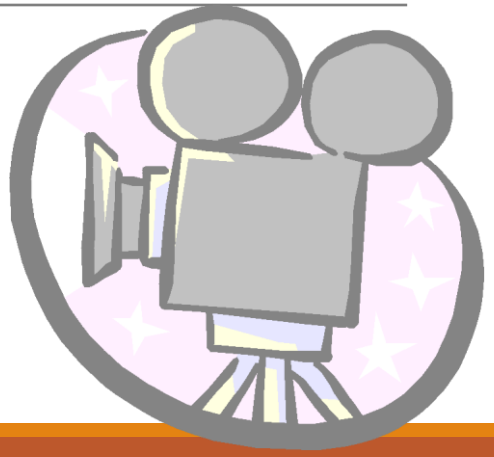
Image Processing

CS-317/CS-341



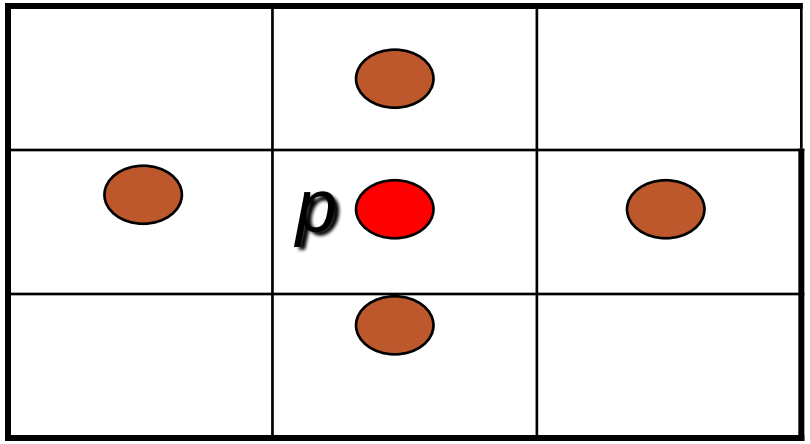
Outline

- Relationship between pixels
- Connectivity
- Distance measure

Relationship between pixels

Neighbours of a Pixel:

A pixel ***p*** at coordinates ***(x,y)*** has ***four(4) horizontal and vertical*** neighbours.



The coordinates of these neighbours are given by

(x+1,y), (x-1,y), (x,y+1) and (x,y-1)

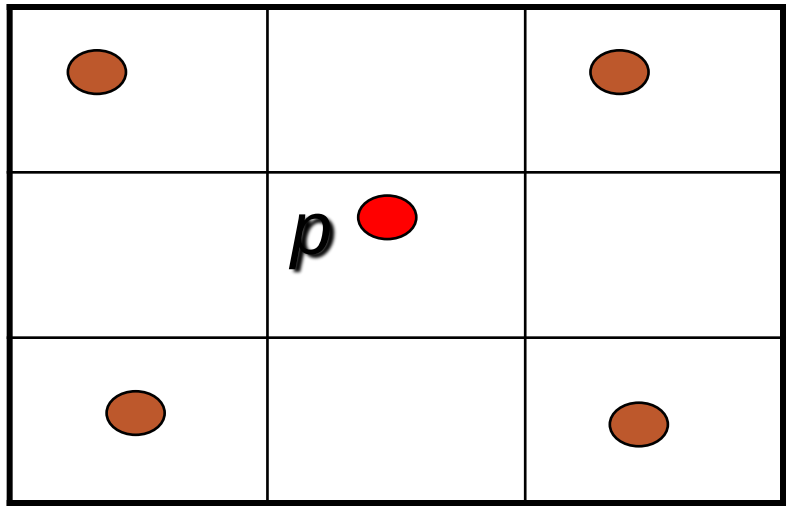
The above set of pixels is called the ***4-neighbours of p – $N_4(p)$***

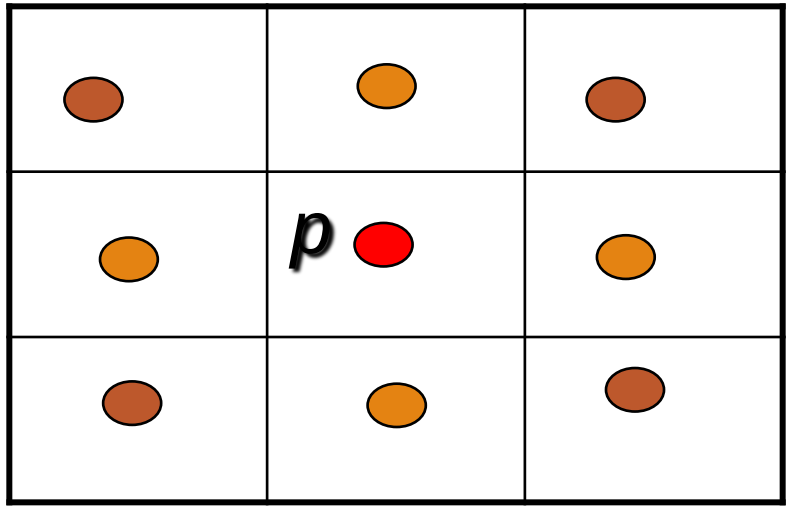
Each pixel is a unit distance from ***(x,y)***

Neighbors of a Pixel

The ***four (4) diagonal neighbors*** of ***p*** have coordinates

(x+1,y+1),(x+1,y-1),(x-1,y+1) and (x-1,y-1)





$N_8(p)$

The above set of pixels is denoted by – $N_D(p)$.

These pixels, together with 4-neighbours are called ***8-neighbours of p*** and is denoted by $N_8(p)$.

$N_8(p) = N_4(p) \cup N_D(p)$.

Connectivity

Connectivity forms the basis for establishing the ***boundaries of an objects*** and also components of regions in an image.

To establish whether two pixels are connected:

1. Whether the ***pixels are adjacent*** (e.g. are they 4-neighbours)
2. Whether their gray levels satisfy ***a specified criterion of similarity*** (e.g. equal or belongs to a set – falls within a given range of gray level)

Connectivity (Cont..)

- ***4-connectivity*** **–** Two pixels p and q with values from V are 4-adjacent if q is in the set $N_4(p)$. V is the set of gray level.
- ***8 connectivity*** – Two pixels p and q with values from V are 8-adjacent if q is in the set $N_8(p)$
- ***m-connectivity*** **-** Two pixels p and q with values from V are m-adjacent if:
  1. q is in $N_4(p)$ or
  2. q is in $N_D(p)$ ***and*** the intersection of ($N_4(p)$ and $N_4(q)$) is empty

Distance Measures

• For pixels p,q, and z with coordinates (x,y),(s,t) and (v,w), respectively, D is a distance functions if:

$$\text{(a) } D(p,q) \geq 0 \quad (D(p,q) = 0 \text{ iff } p = q)$$

$$\text{(b) } D(p,q) = D(q,p), \text{ and}$$

$$\text{(c) } D(p,z) \leq D(p,q) + D(q,z)$$

Euclidean Distance between p and q is defined as :

$$D_e(p,q) = [x-s]^2 + (y-t)^2]^{1/2}$$

City-Block Distance (D_4) between p and q is defined as

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

Distance Measures …

Chess Board Distance (D_8) between p and q is defined as

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

D_e – 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 centered at ***(x,y).***

D_4 – Pixels having a ***D_4*** distance from ***(x,y)*** less than or equal to some value ***r*** form a diamond centered at ***(x,y).***

D_8 – Pixels having a ***D_8*** distance from ***(x,y)*** less than or equal to some value ***r*** form a square centered at ***(x,y).***

Suggested Readings

- **Digital Image Processing by Rafel Gonzalez, Richard Woods, Pearson Education India, 2017.**

- **Fundamental of Digital image processing by A. K Jain, Pearson Education India, 2015.**

Thank you