Basic Relationship between Pixels

Connectivity & Adjacency

Connectivity

- Two pixels are connected if they are in the same class (i.e. the same color or the same range of intensity) and they are neighbors of one another.
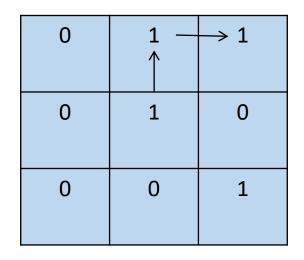
  For p and q from the same class

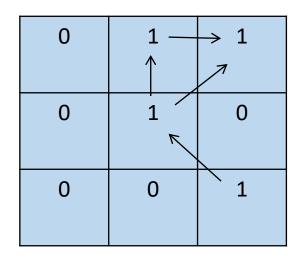4-connectivity: p and q are 4-connected if $I(p,q) \in v$ & $q \in N_4(p)$

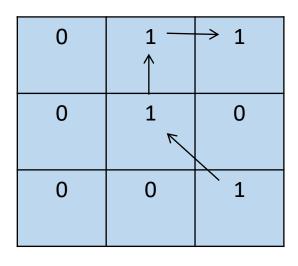8-connectivity: p and q are 8-connected if $I(p,q) \in v$ & $q \in N_8(p)$

mixed-connectivity (m-connectivity):

$\qquad$ p and q are m-connected if $I(p,q) \in v$ & $q \in N_4(p)$ or

$\qquad$ $q \in N_D(p)$ and $N_4(p) \cap N_4(q) = \varnothing$

Connectivity

4-connectivity   8-connectivity   m-connectivity

Connectivity

- Establishing Object boundary
- Defining Object component/region

If f(x,y) > Th
$\Rightarrow$(x,y) is an element of
foreground else
background

Adjacency

- A pixel p is adjacent to pixel q if they are connected to each other. Two image subsets S_1 and S_2 are adjacent if some pixel in S_1 is adjacent to some pixel in S_2
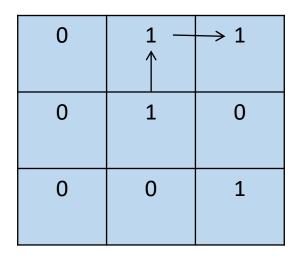
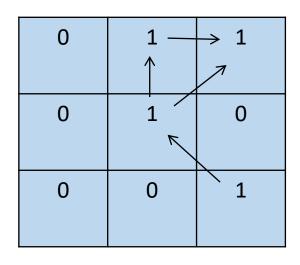4-adjacency: p and q are 4-adjacent if $q \in N_4(p)$

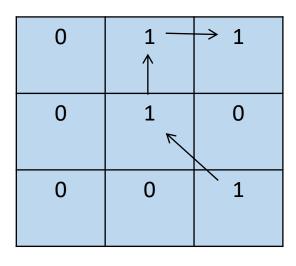8-adjacency: p and q are 8-adjacent if $q \in N_8(p)$

mixed-adjacency (m-adjacency):

p and q are m-adjacent if $q \in N_4(p)$ or

$q \in N_D(p)$ and $N_4(p) \cap N_4(q) = \varnothing$

Adjacency

4-adjacency

8-adjacency

m-adjacency

Path

- A path from pixel p at (x,y) to pixel q at (s,t) is a sequence of distinct pixels:

$$(x_0,y_0), (x_1,y_1), (x_2,y_2),..., (x_n,y_n)$$

such that

$$(x_0,y_0) = (x,y) \text{ and } (x_n,y_n) = (s,t)$$

and

$$(x_i,y_i) \text{ is adjacent to } (x_{i-1},y_{i-1}), \qquad i = 1,...,n$$

If $(x_0,y_0) = (x_n,y_n)$, the path is closed

Connected Component

S is subset of image I and p,q $\in$ S

p is connected to q if path exist

All pixels in S connected to p forms a connected component

- Region
  - R is a region of the image if R is a connected set

- Boundary
  - The boundary of a region R is the set of pixels in the region that have one or more neighbors that are not in R

- Edge
  - Pixels with derivative values that exceed a preset threshold