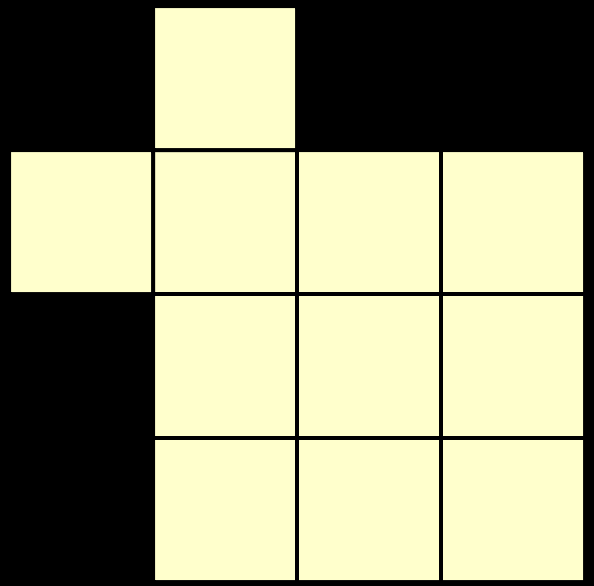
CSSE463: Image Recognition Day 9

- Lab 3 due Weds, 11:59pm
- Take home quiz will be assigned tomorrow and due Friday, 4:00 pm.
  - Mostly written problems too long for in-class quizzes
- Today: region properties
- Questions?

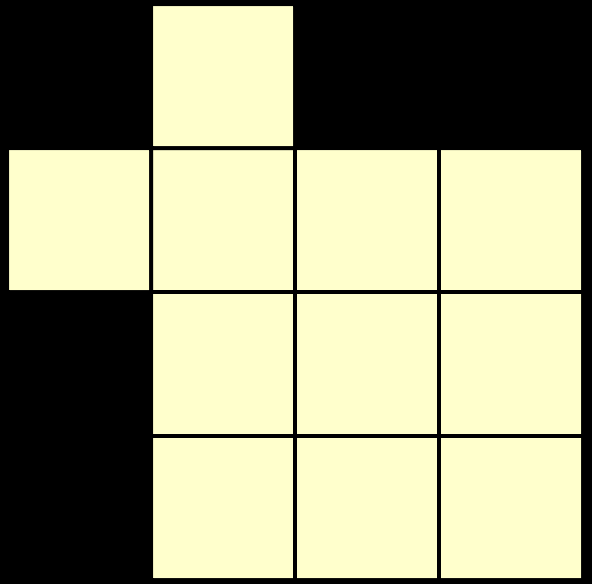
Representing a Region

- Review: Connected components labels groups of connected pixels.
  - 4-connectivity vs. 8-connectivity matters
  - Could you write a recursive algorithm for connected components?



Region properties

- Includes location, size, shape, and orientation
- Focus on binary images



Region Properties
Area and Centroid

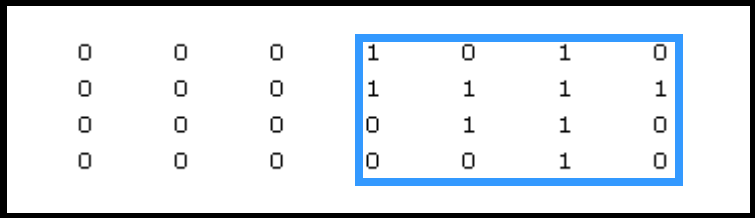
- Area: sum of pixels in region $A = \sum_{(r,c)\in R} 1$
- Centroid: (avg row, avg column) = $(\bar{r}, \bar{c})$

$$\bar{r} = \frac{1}{A} \sum_{(r,c)\in R} r \qquad \bar{c} = \frac{1}{A} \sum_{(r,c)\in R} c$$

- Recall that *find* returns row and column coordinates if you ask it to do so:
  - [r,c] = find(mask == 1)

Bounding box

- Can be used to describe a region's location
- For region to right, $(r_{min}, r_{max}, c_{min}, c_{max})$ = (1,4,4,7)
- Matlab returns $(x_{min}, y_{min}$, width, height)



Extent = (area of region)/ (area of bounding box)

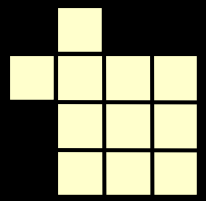
What types of shapes have maximal/minimal extent?

Perimeter

- Perimeter (assume no holes)
  - The set of interior border pixels

$$P_8(R) = \{(r,c) \in R \mid N_4(r,c) - R \neq \phi\}$$

  - Interpretation, please?
  - In Matlab P_8(region) is called **bwperim(region, 4)** because the border pixels are connected with the background using a 4-neighborhood.
    - The output is a mask
  - The definition for P_4 is dual to P_8 .



Perimeter length

- Assume we have an algorithm to list the perimeter pixels in a chain of neighboring pixels…
  1. Matlab's bwtraceboundary

  1. On an upcoming written assignment, you'll study the "Inner boundary tracing" algorithm (from text)
     1. Extremely efficient representation for large regions

- …to find perimeter length, denoted PL or |P|:
  - Each pair of horizontal/vert. neighbors contributes 1
  - Each pair of diagonal neighbors contributes sqrt(2)
  - Which is typically shorter, $|P_8|$ or $|P_4|$?

Q2,3

Circularity measures

$$C_1 = \frac{|P|^2}{A}$$

$$C_2 = \frac{\mu_R}{\sigma_R}, \text{ where}$$

$$\mu_R = \frac{1}{N}\sum_{i=1}^{N}\left\|(r_i, c_i) - (\bar{r}, \bar{c})\right\|$$

$$\sigma_R = \left(\frac{1}{N}\sum_{i=1}^{N}\left[\left\|(r_i, c_i) - (\bar{r}, \bar{c})\right\| - \mu_R\right]^2\right)^{\frac{1}{2}}$$

$N = \#$ of pixels on perimeter

$\|\cdot\|$ = Euclidean length of vector

μ_R = mean distance of boundary pixel from center

μ_R = standard deviation of distances from center

- Circles (theoretically) have minimum ratio, C_1
  - Why?
- Having a small standard deviation gives a larger circularity.
  - Sample *radial representations* of images
  - What's a circle's C_2?

Q2,4