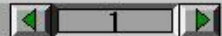


7.10 Image Segmentation

7.10 Image Segmentation



<http://people.cs.uchicago.edu/~pff/segment/>



Draw Mode <input checked="" type="radio"/> Regions <input type="checkbox"/> Edges	Extender <input type="checkbox"/> Visuals Do It	Spatial Filter <input checked="" type="radio"/> Salt Pepper Do It	Propagation <input type="checkbox"/> Visuals Do It	Space Track <input type="checkbox"/> Visuals Do It	Time Track <input type="checkbox"/> Visuals Do It	Trace Structure <input checked="" type="radio"/> None Do It	Extract Edges <input checked="" type="radio"/> None Do It
Auto Process	Clear Frame	Reload	Save Overlay	Save Structure	Exit	System Ready!	

Image Segmentation

Image segmentation.

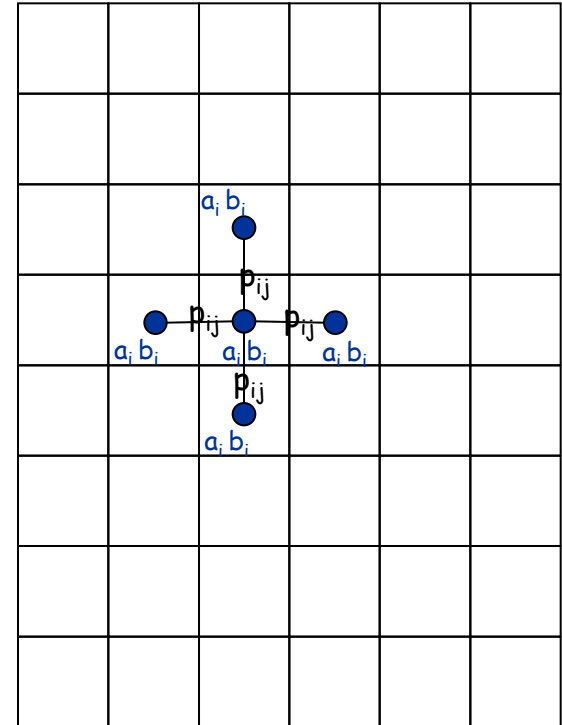
- Divide image into coherent regions.
- Central problem in image processing.

Ex: Three people standing in front of complex background scene. Identify each person as a coherent object.

Image Segmentation

Foreground / background segmentation.

- Label each pixel in picture as belonging to foreground or background.
- V = set of pixels, E = pairs of neighboring pixels.
- $a_i \geq 0$ is likelihood pixel i in foreground.
- $b_i \geq 0$ is likelihood pixel i in background.
- $p_{ij} \geq 0$ is separation penalty for labeling one of i and j as foreground, and the other as background.



Goals.

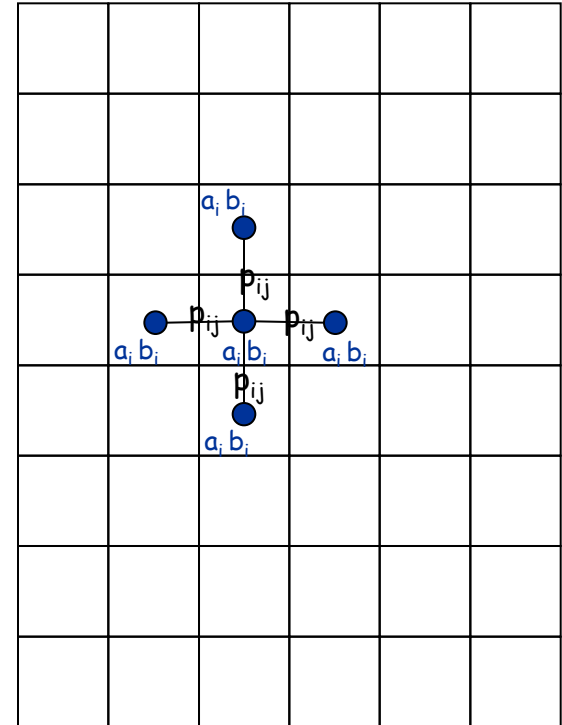
- **Accuracy**: if $a_i > b_i$ in isolation, prefer to label i in foreground.
- **Smoothness**: if many neighbors of i are labeled foreground, we should be inclined to label i as foreground.

Q. What function would we like to optimize (in terms of a_i , b_i and p_{ij})?

Image Segmentation

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Goals.

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Q. What function would we like to optimize (in terms of a_i , b_i and p_{ij})?

A. Find partition (A, B) that maximizes:

$$\sum_{i \in A} a_i + \sum_{j \in B} b_j - \sum_{(i,j) \in E: |A \cap \{i,j\}| = 1} p_{ij}$$

↗ foreground ↖ background

Image Segmentation

Q. How to formulate this as a max-flow or min-cut problem? (1 min)

Image Segmentation

Formulate as min cut problem.

Turn into minimization problem.

- Maximizing
$$\sum_{i \in A} a_i + \sum_{j \in B} b_j - \sum_{(i,j) \in E : |A \setminus \{i,j\}| = 1} p_{ij}$$

is equivalent to minimizing
$$\sum_{j \in B} a_j + \sum_{i \in A} b_i + \sum_{(i,j) \in E : |A \setminus \{i,j\}| = 1} p_{ij}$$

Image Segmentation

Formulate as min cut problem.

- $G' = (V', E')$.
- Add source to correspond to foreground;
add sink to correspond to background
- Use two anti-parallel edges instead of
undirected edge.

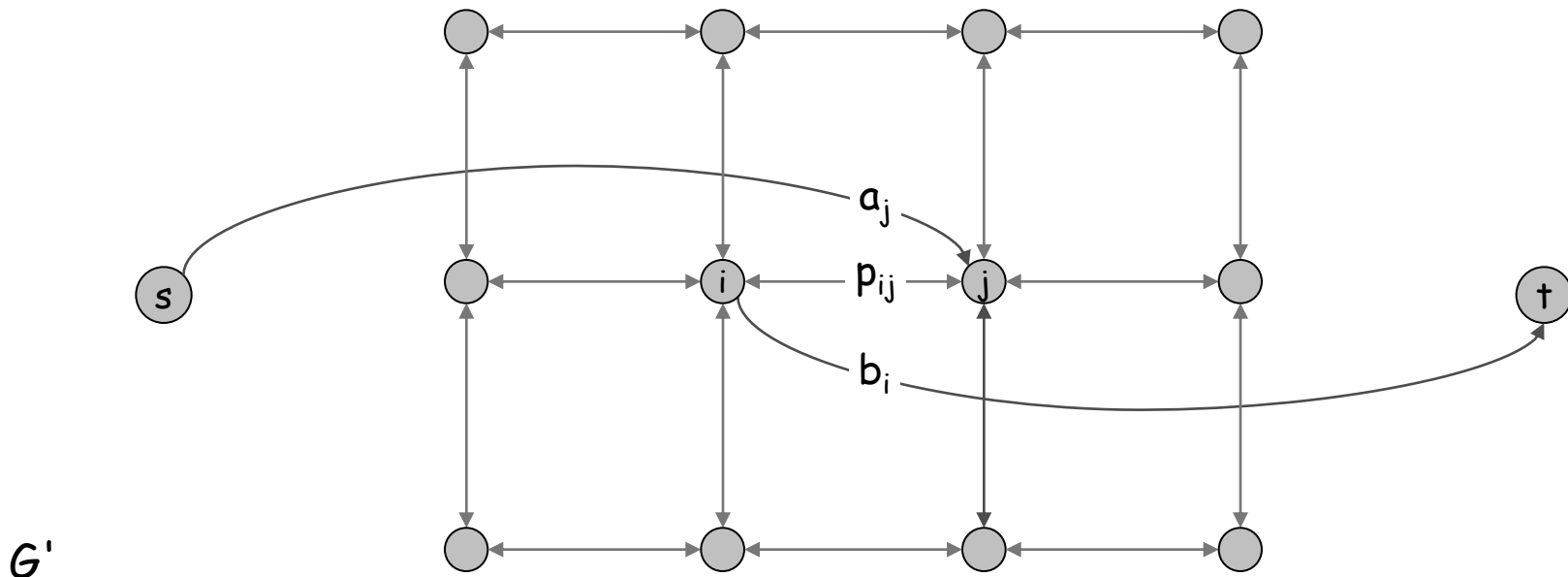
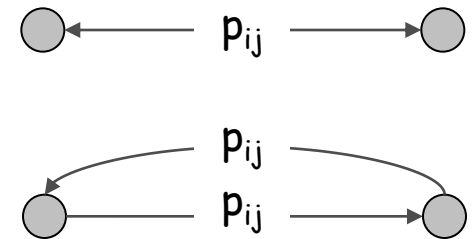


Image Segmentation

Consider min cut (A, B) in G' .

- A = foreground.

$$cap(A, B) = \sum_{j \in B} a_j + \sum_{i \in A} b_i + \sum_{\substack{(i,j) \in E : \\ i \in A, j \in B}} p_{ij}$$

if i and j on different sides,
 p_{ij} counted exactly once

- Precisely the quantity we want to minimize.

