Lecture 22-2 Graph-cut Segmentation

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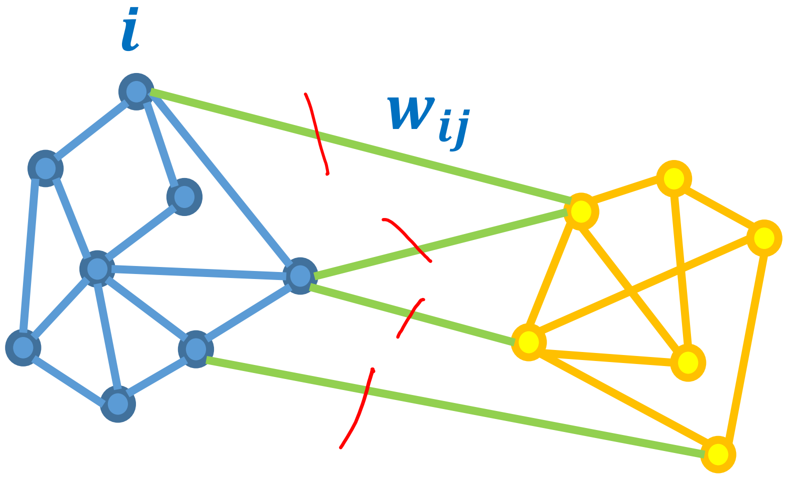
min cut

Graph-cut segmentation



$G = \{V, E\}$

V: Graph nodes ⟷ Image={pixels}

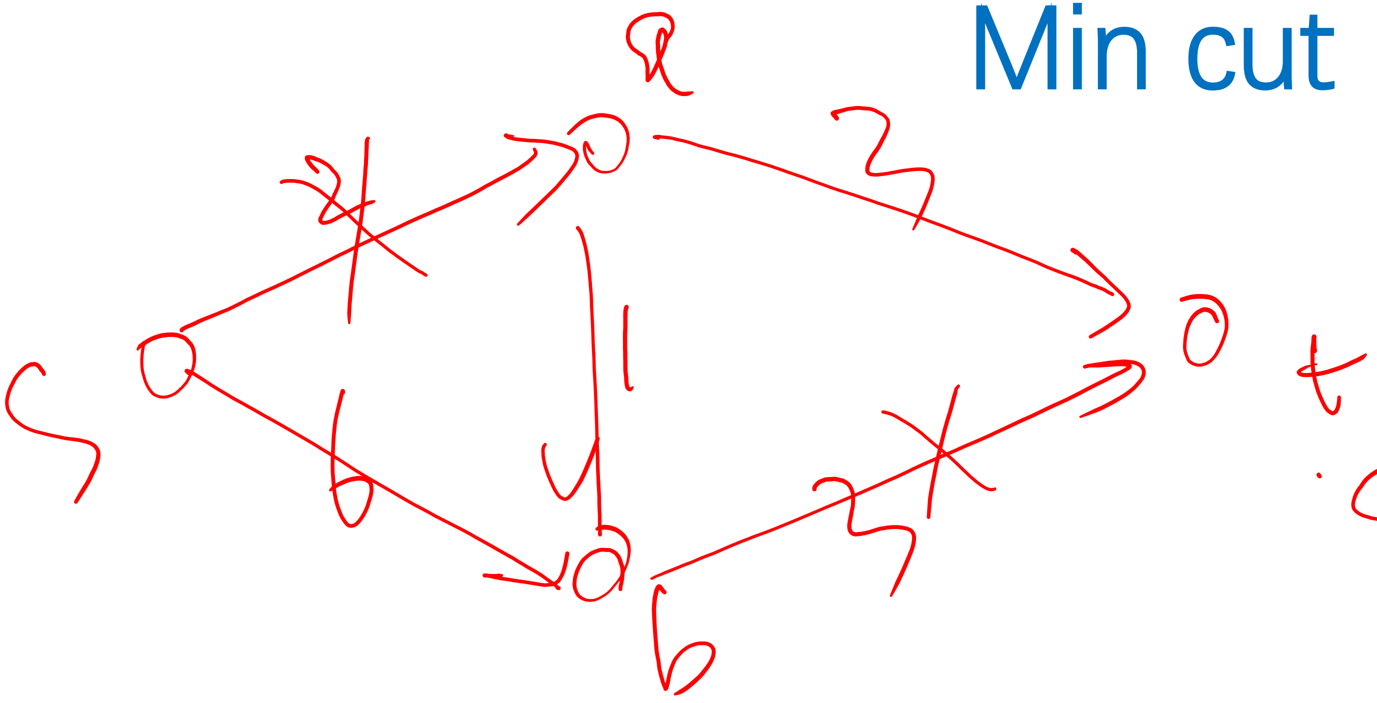
E: edges connection nodes ⟷ Pixel similarity

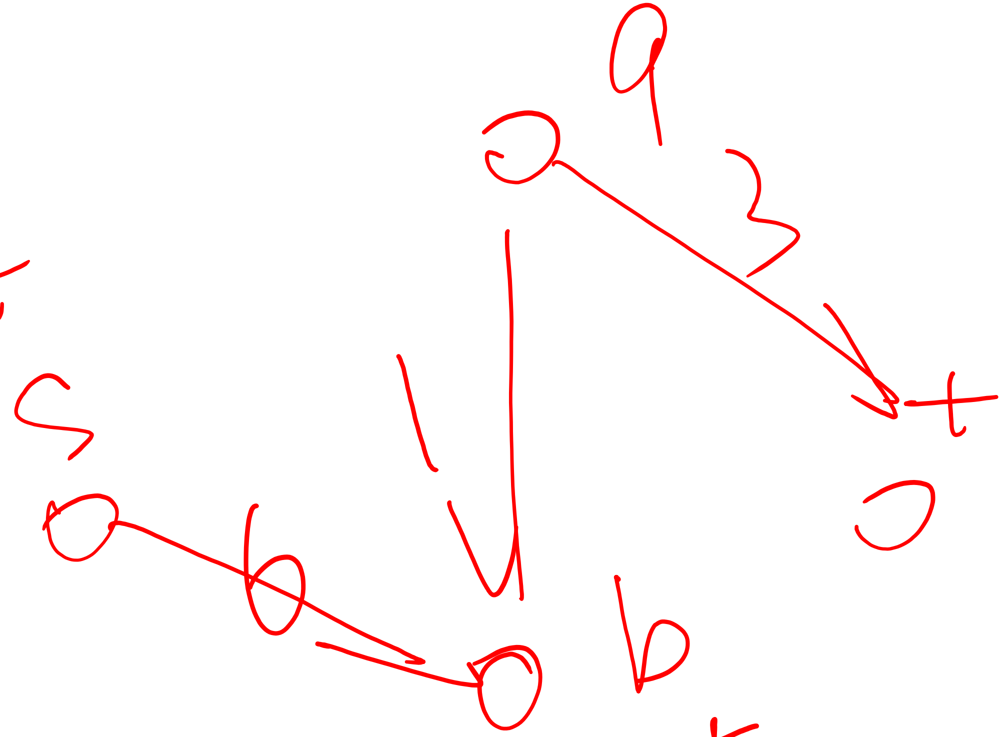
Segmentation = Graph partition

Right partition cost function?

Efficient optimization algorithm?

Min cut

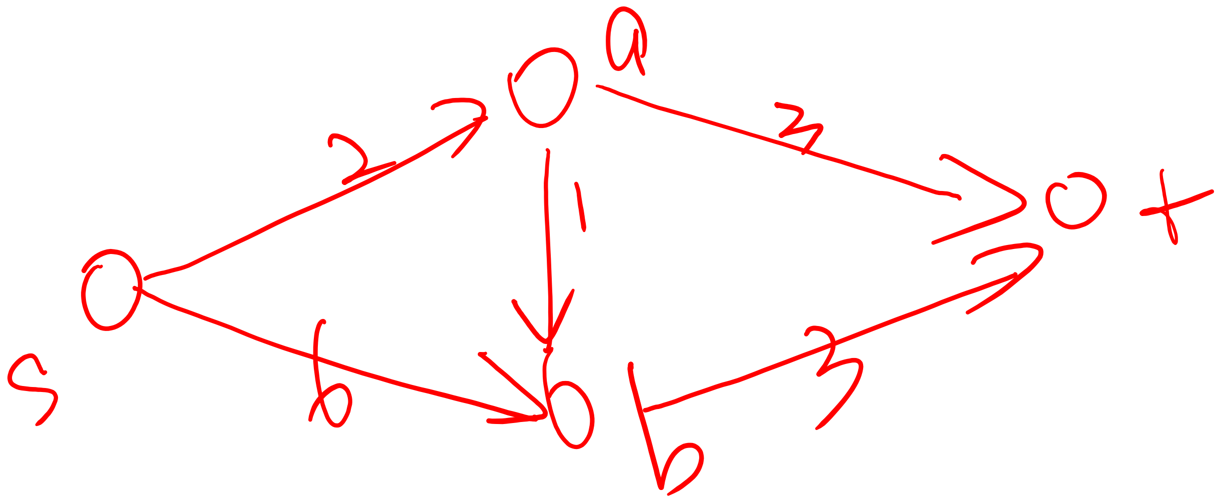




- $s \to a \to t$
- $s \to b \to t$
- $s \to a \to b \to t$

min cut
$2+3=5$

Max flow



① . $s \to a \to t$: 2

② . $s \to b \to t$: 3

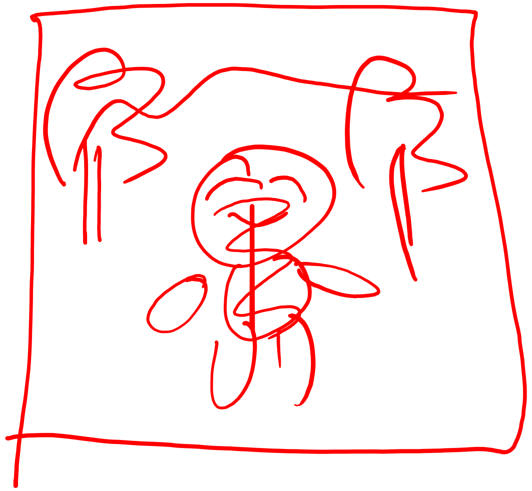
. $s \to a \to b \to t$: 0

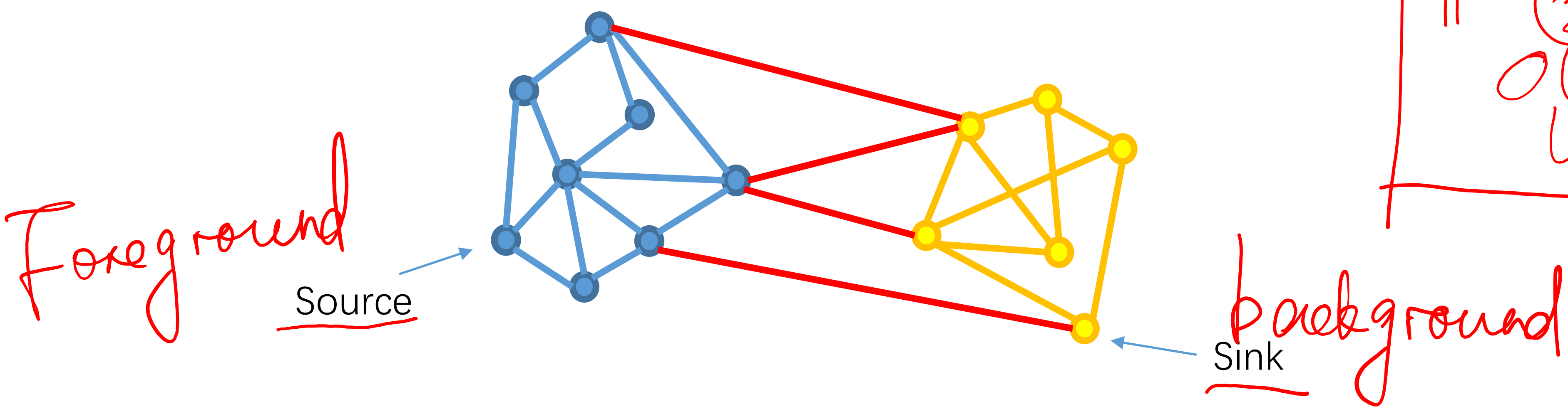
$s \to t$

max flow

① + ② = 5

Graph Cut and Flow

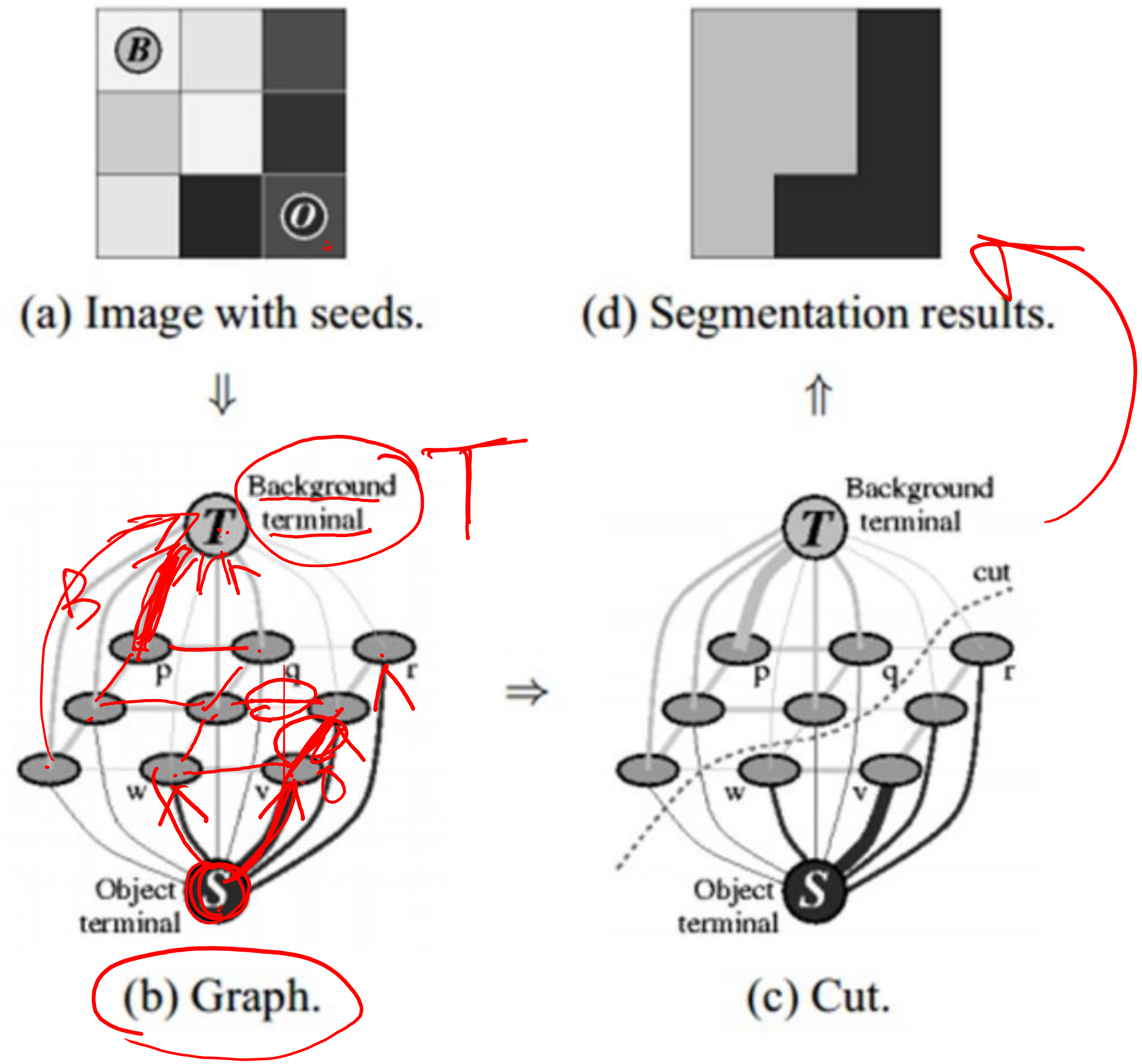




- 1) Given a source (s) and a sink node (t)
- 2) Define Capacity on each edge, $C_{ij} = W_{ij}$
- 3) Find the maximum flow from s→t, satisfying the capacity constraints:

$$\text{Min. Cut} = \text{Max. Flow}$$

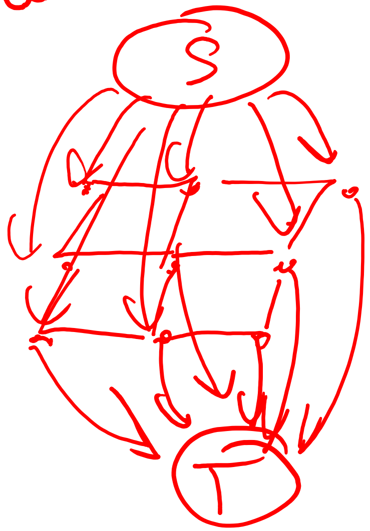
Min Cut



(a) Image with seeds. (d) Segmentation results. (b) Graph. (c) Cut.

Min Cut

min cut → max flow



- The miminum cut: i.e. C that minimizes

$$\text{argmin } C = \sum_{(i,j)\in C} w_{ij}$$

- N-links: between adjacent pixels, we could use

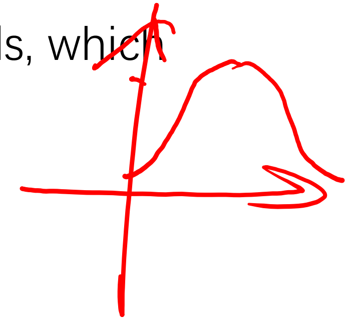
if $I_i \approx I_j \Rightarrow w_{ij} \to 1$

if I_i far from $I_j \Rightarrow w_{ij} \to 0$

$$w_{ij} = e^{-\frac{\|I_i - I_j\|^2}{2\delta^2}}$$

G → G

- T-links: let user "scribble" on image to denote some initial foreground and background pixels, which forms probability distributions F_B, F_F.



$I_i \in$ Foreground $\Rightarrow w_{iF} \to 1$, $w_{iB} \to 0$

$$w_{iF} = F_F(I_i);\ w_{iB} = F_B(I_i)$$

if $I_i \in$ BG: $w_{iF} \to 0$, $w_{iB} \to 1$

$$\text{argmin } aR(L) + E(L)$$

Resource

- https://vision.cs.uwaterloo.ca/code/
- http://www.cs.cornell.edu/~rdz/graphcuts.html
- http://pub.ist.ac.at/~vnk/software.html