Random Walks for Segmentation

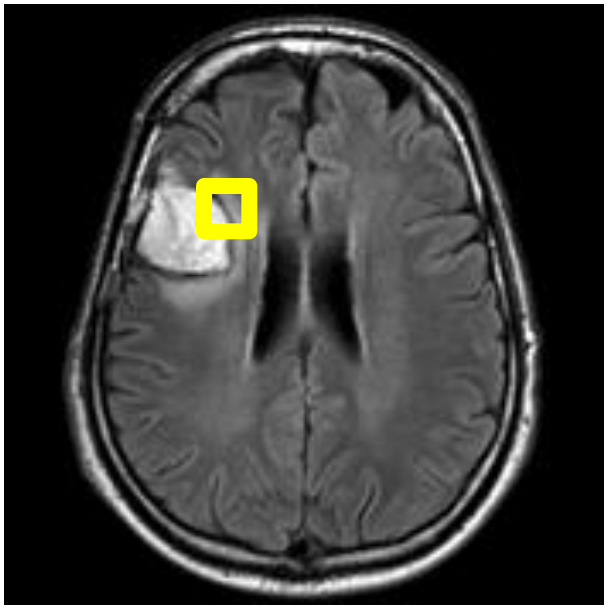
Dr. Debdoot Sheet
Assistant Professor
Department of Electrical Engineering
Indian Institute of Technology Kharagpur

www.facweb.iitkgp.ernet.in/~debdoot/

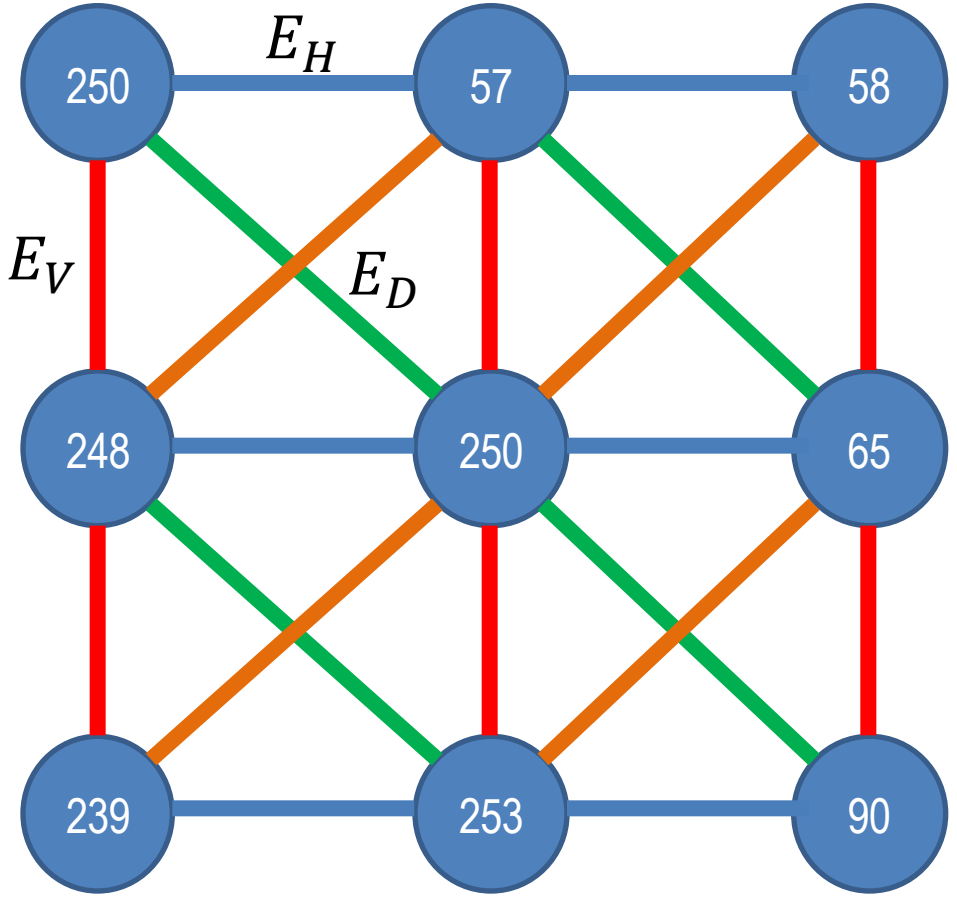
Contents

- Graph equivalent of an image
- Random walks as a statistical phenomenon
- Electrical circuit equivalent of image
- Random walks via electrical network
- Random walks solver
- Example segmentation

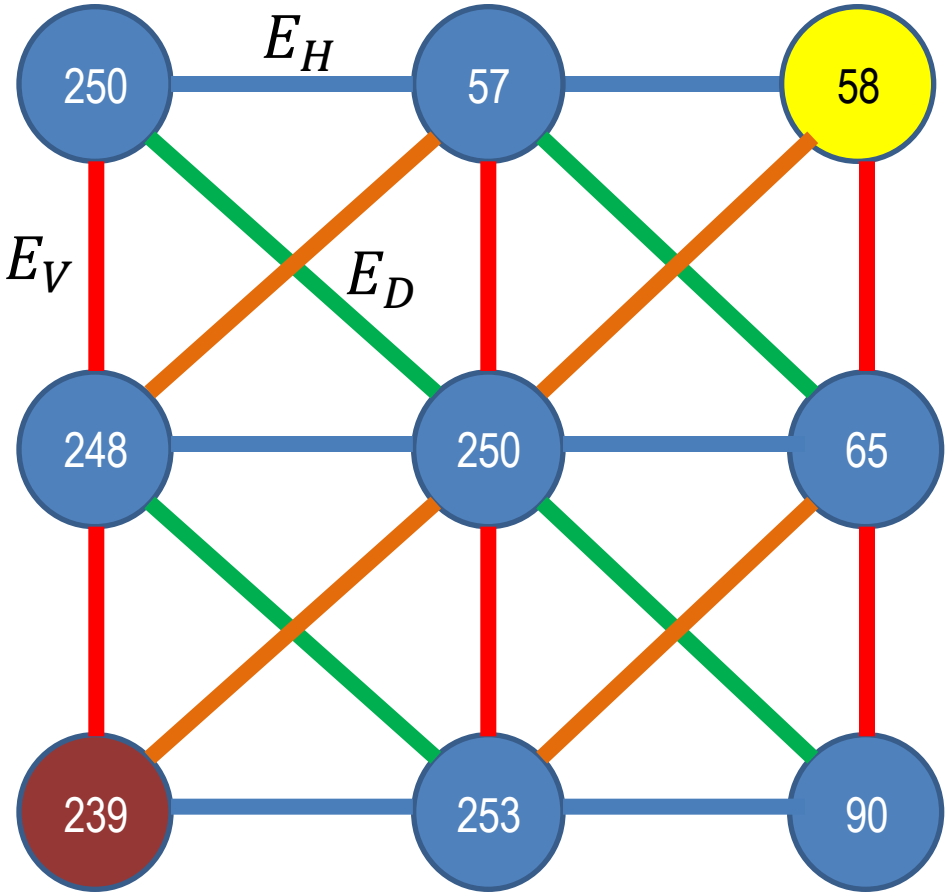
Graph Equivalent of Image



250	57	58
248	250	65
239	253	90



Random Walk (Drunkard's walk)



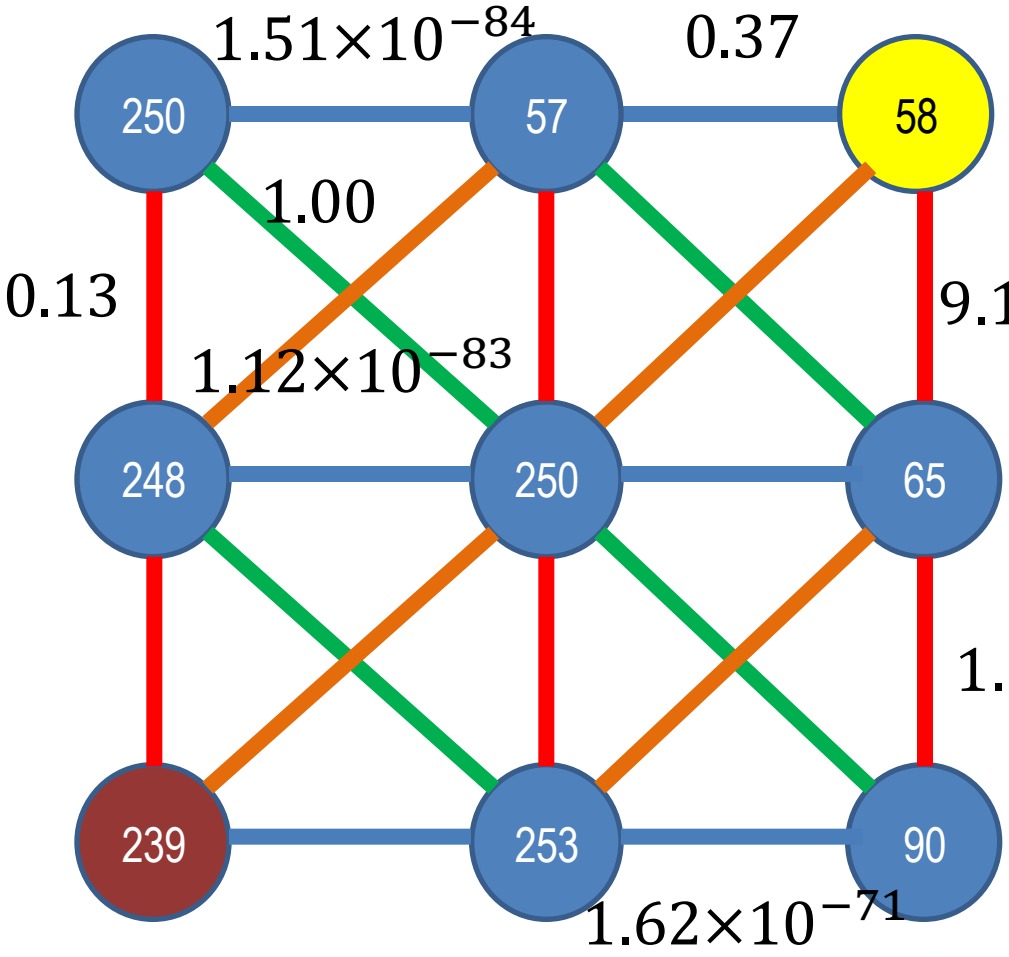
$$G = (V, E) \quad E = V \times V$$

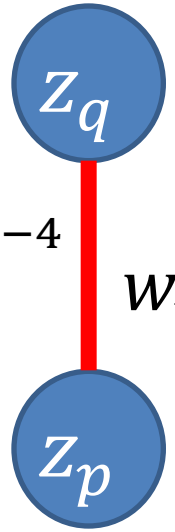
$$p(\omega_1 | \text{  })$$

$$p(\omega_2 | \text{  })$$

$$y_n = \text{argmax}\left(p_n(\omega_k | \mathbf{x})\right)$$

Equivalent Electrical Circuit

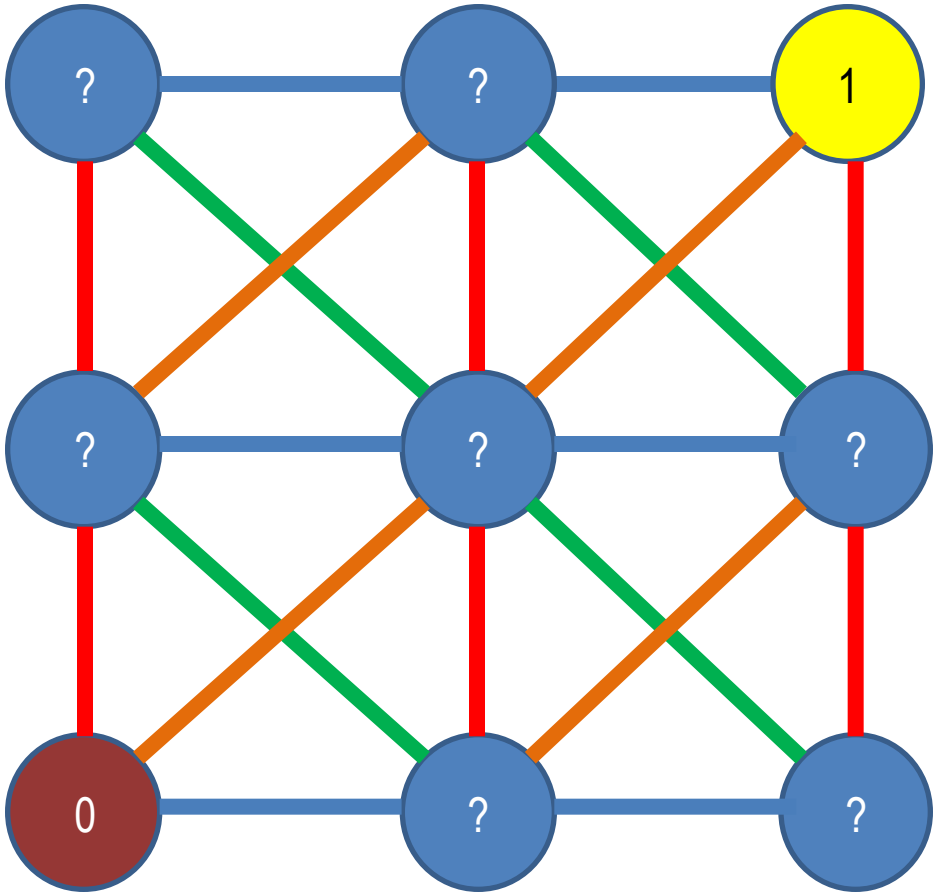




$$w_{pq} = e^{-\beta|z_p - z_q|}$$

$$\beta = 1$$

Random Walks via Electrical Circuit



$$d_p = \sum_q w_{pq}$$

$$L_{pq} = \begin{cases} d_p, \text{if } p = q \\ -w_{pq}, \text{if } v_p, v_q \text{ adjacent} \\ 0, \text{otherwise} \end{cases}$$

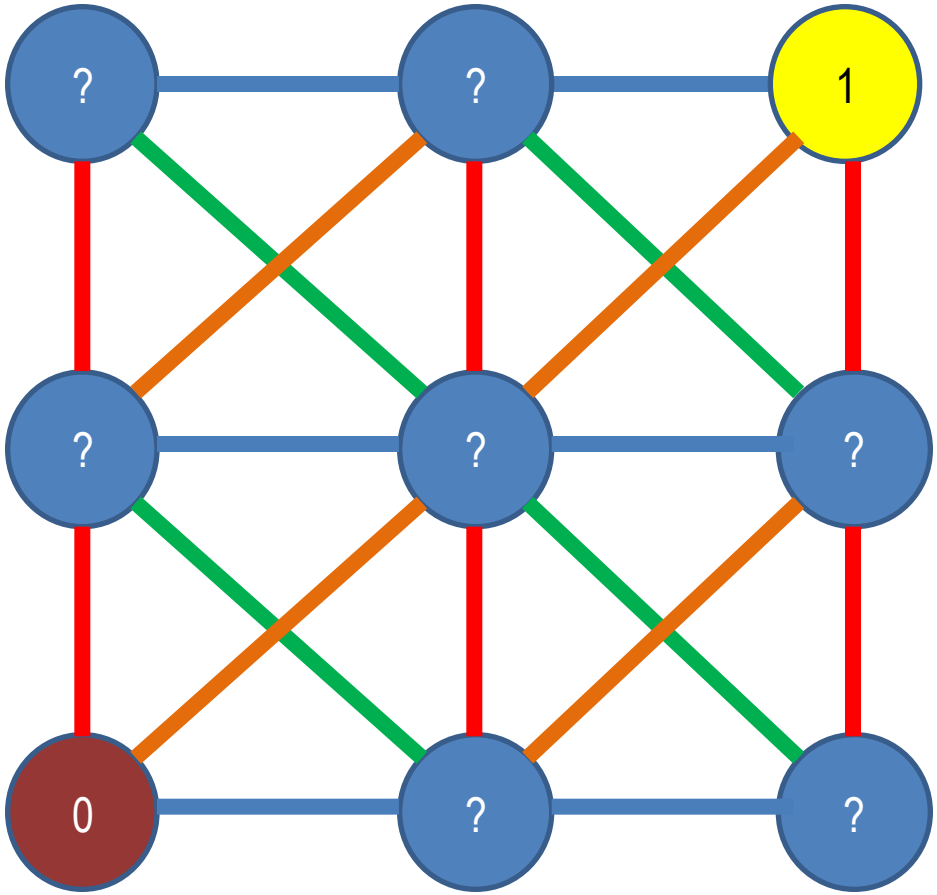
$$L = \begin{bmatrix} L_M & B \\ B^T & L_U \end{bmatrix}$$

Random Walks Solver

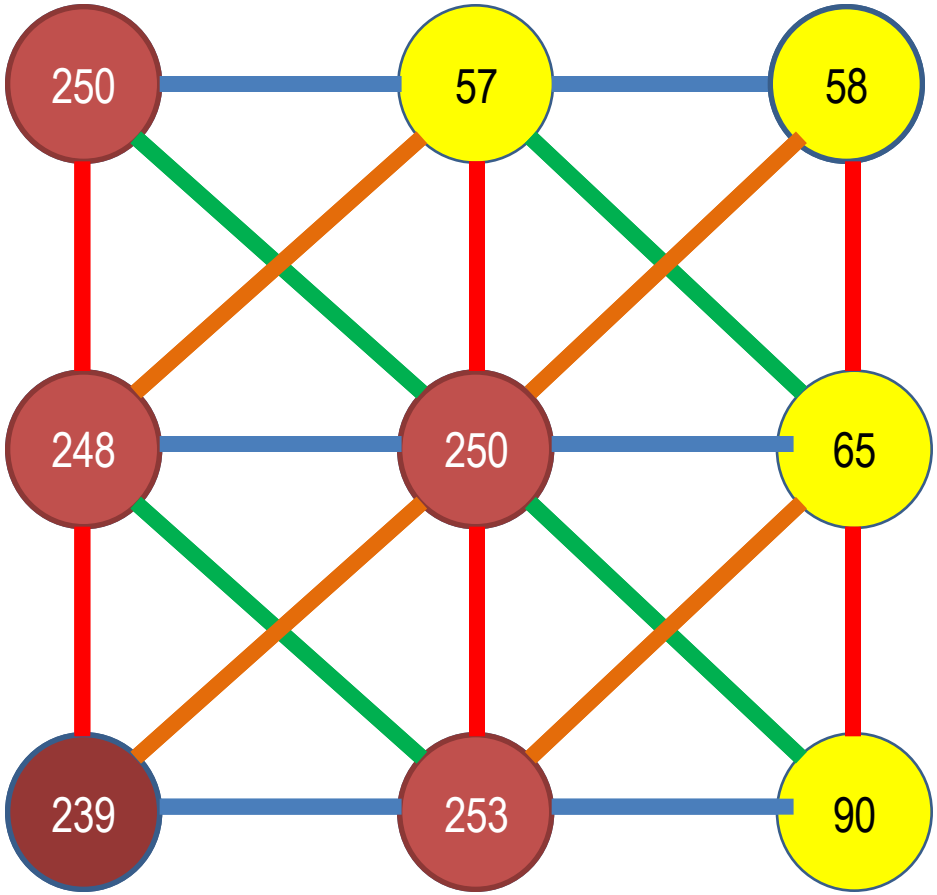
$$m_q^{\omega} = \begin{cases} 1, \text{if } Q(v_q) = \omega \\ 0, \text{if } Q(v_q) \neq \omega \end{cases}$$

$$L_U X = -B^T M$$

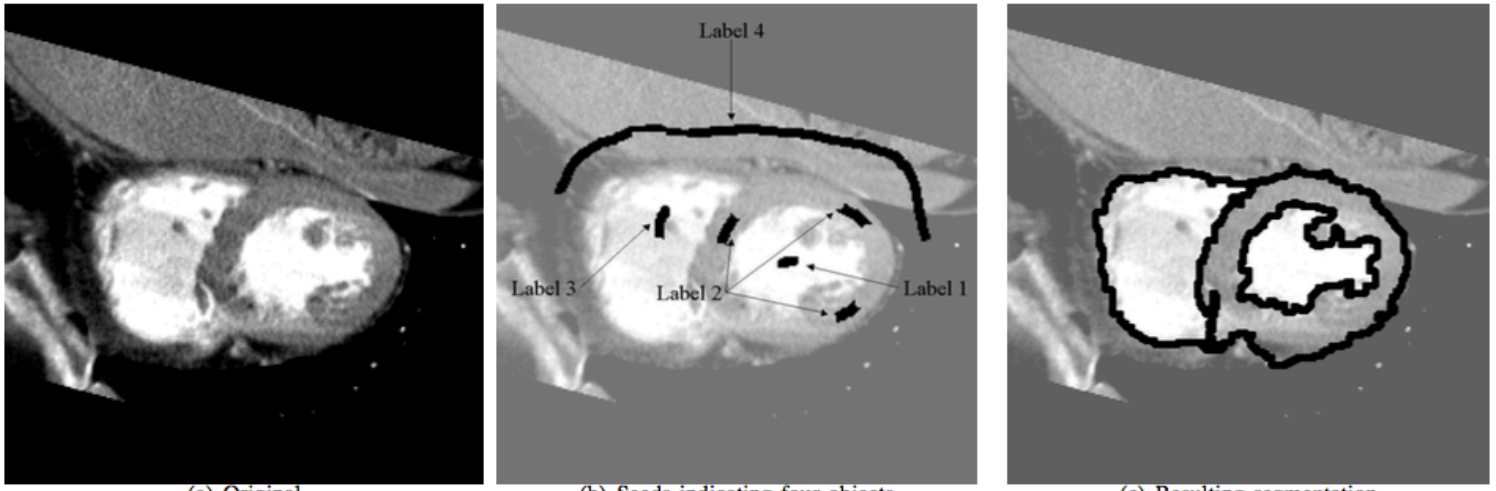
$$p(\omega|\mathbf{x}) = x_q^{\omega}$$



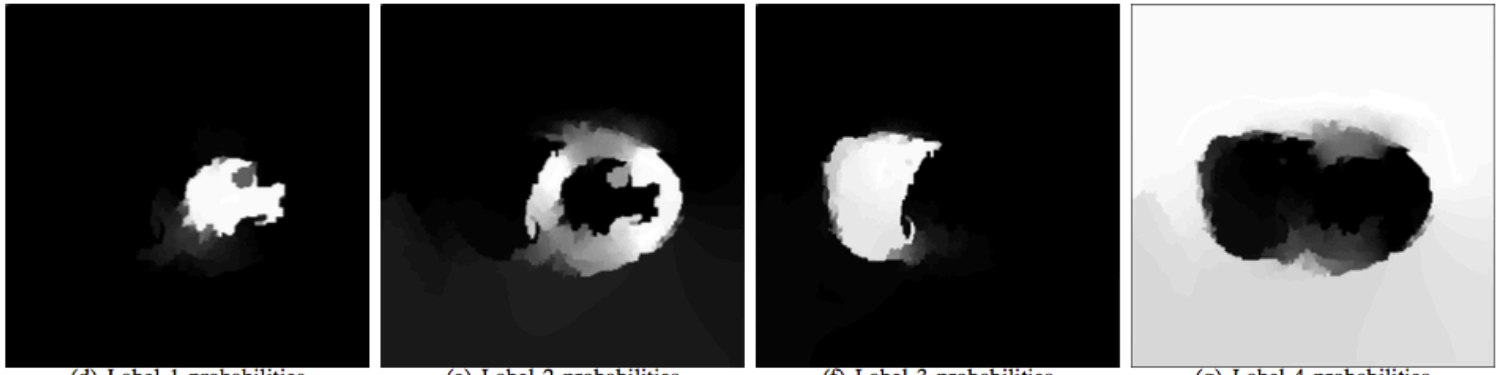
Random Walks Solver



Some Examples



(a) Original (b) Seeds indicating four objects (c) Resulting segmentation



(d) Label 1 probabilities (e) Label 2 probabilities (f) Label 3 probabilities (g) Label 4 probabilities

Take home message

- L. Grady, "Random Walks for Image Segmentation", *IEEE Trans. Pattern Analysis and Machine Intelligence*, vol. 28, no. 11, pp. 1768-1783, 2006.
- Toolboxes
  - Matlab: http://cns.bu.edu/~lgrady/software.html
  - Python: skimage.segmentation.random_walker