Decentralized Strategies for the assignment problem

Hariharan Lakshmanan

Dynamic networks

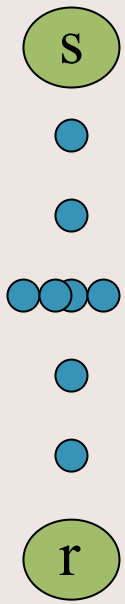
- Changing network topology – example wireless sensor networks.
- Change is usually undirected
- Sometimes changes need to be directed – example Mobile robots for search and rescue operations

Related work

- Chang *et.al*. applied a reinforcement learning approach to learn node movement policy to optimize long-term system routing performance
- Goldenberg *et.al* proposed a network mobility control model for improving system communication performance

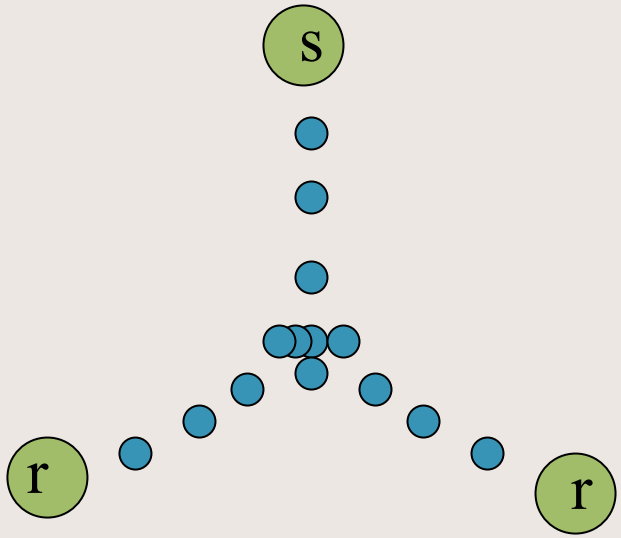
Choosing the objective function

- Learn network mobility to maximize network connectivity?
- Example



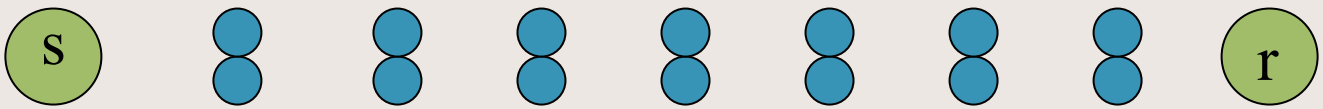
Example continued

- One source and two receivers



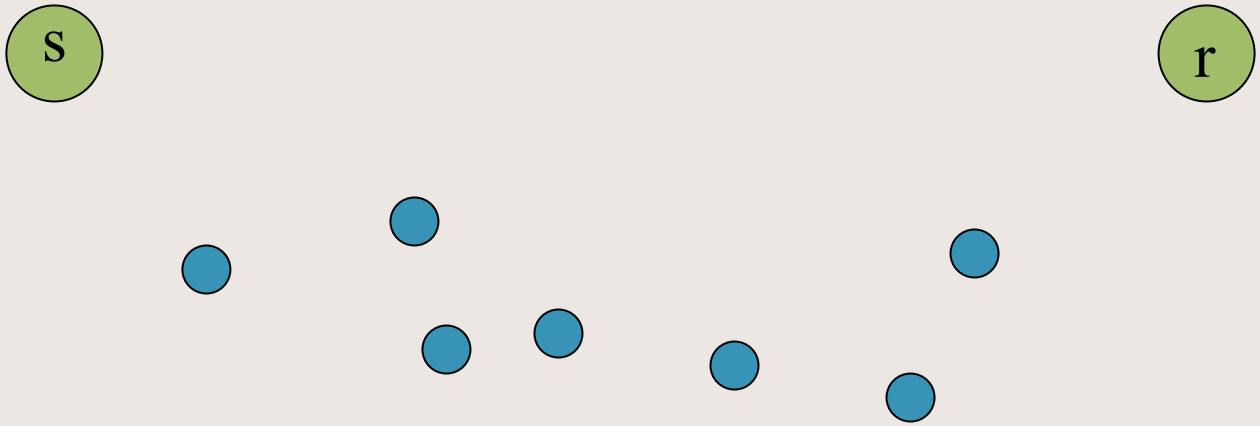
Maximize network flow

- Configuration that maximizes network flow for the case of one source and one receiver



Decentralized assignment problem

- Initial configuration



- Each node chooses a destination between the source and the receiver to minimize the maximum distance that some node has to cover while maximizing the network flow.

Problem formulation

$$\min \max \sum_j x_{ij} d_{ij} \forall i$$

$$\min \quad y$$

$$y \geq \sum_j x_{ij} d_{ij} \forall i$$

$$\sum_j x_{ij} = 1 \forall i$$

$$\sum_j x_{ji} = n \forall j$$

General strategy for decentralized assignment

- Solve local assignment problem
- Exchange assignments with neighbors
- Modify destination if necessary
- Move towards destination for a certain time
- Perform above steps till convergence

Methodology

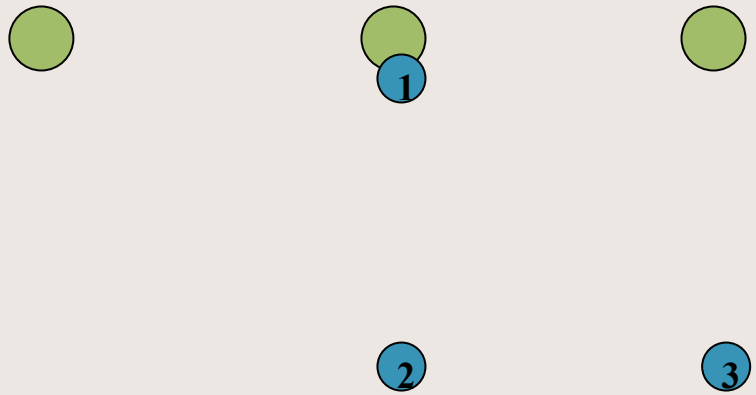
- Simulator written – Currently does not communicate with neighbors
- Uses Dynamic programming to solve local assignment problems

Results

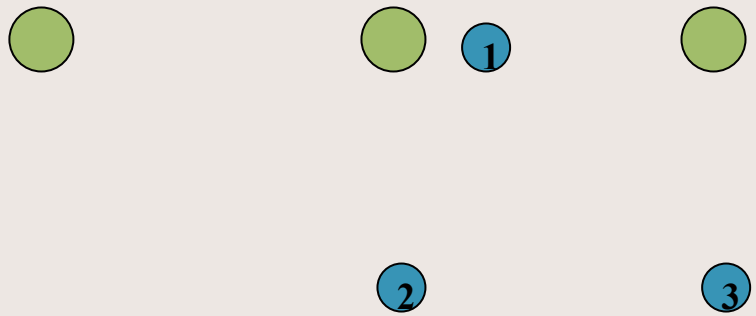
- Converges to a feasible solution for the limited problems tested so far.
- Performance depends on the initial configuration

Example

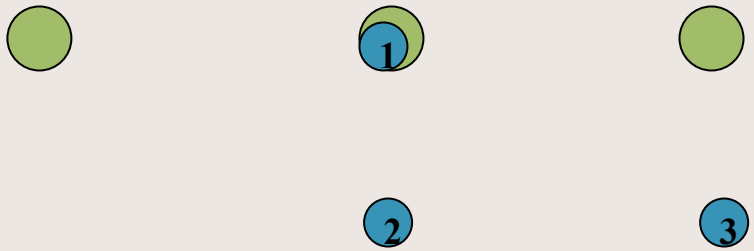
- The green circles indicate destination points and the blue circles represent nodes



Example continued

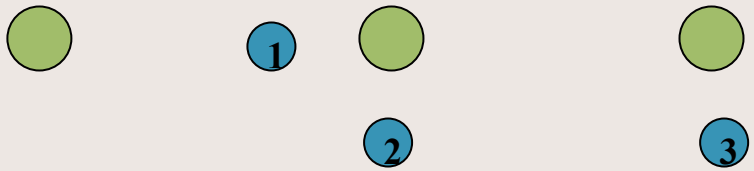


Example continued



Example continued…

- Re-Solving the assignment problem periodically led to convergence



References

- Y. Chang, T. H., L. P. Kaelbling (2003). Mobilized ad-hoc networks: A reinforcement learning approach, MIT AI Laboratory

- D. Goldberg, J. L., A.S. Morse, B.E.Rosen, Y.R. Yang (December, 2003). Towards mobility as a network control primitive, Yale University