Optimal Algorithms for the Implementation of Group Strategies

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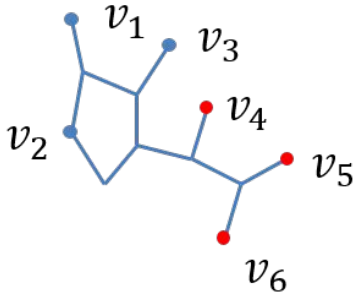
General Idea

Agents move from initial positions to some target formation on a connected graph

- Optimize total distance travelled
- Avoid collision

Problem is made simpler when agents are indistinguishable

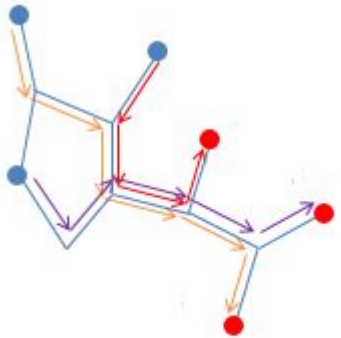


Determining Distance-Optimal Paths

- Construct a matrix representing distance (shortest path) from initial and final positions

	v_4	v_5	v_6
v_1	5	6	6
v_2	4	5	5
v_3	4	5	5

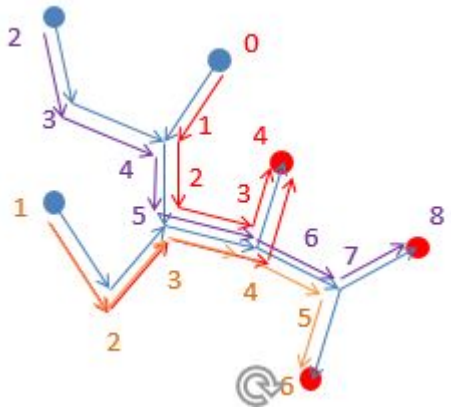
- Use the Hungarian algorithm to determine best assignment



Path Scheduling: Avoiding Collision

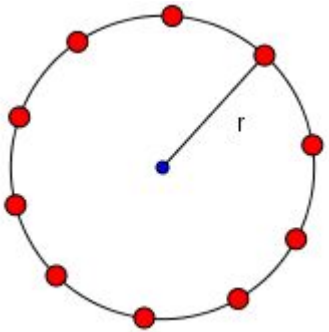
Assign different start times:

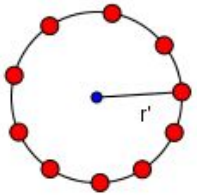
- Agents are scheduled to begin moving along the graph according to their path lengths and whether or not their assigned goal is a standalone vertex
- Maximum amount of time for all agents to reach goal is n + l -1, where
  - n is number of agents
  - l is longest distance between all initial and respective final positions



Implementing Specific Group Strategies

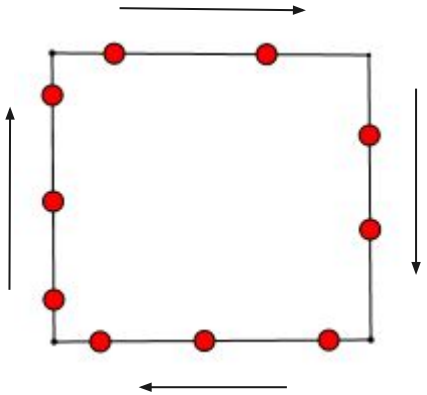
- Surrounding a target
  - Keeping some desired distance
  - Closing in for capture





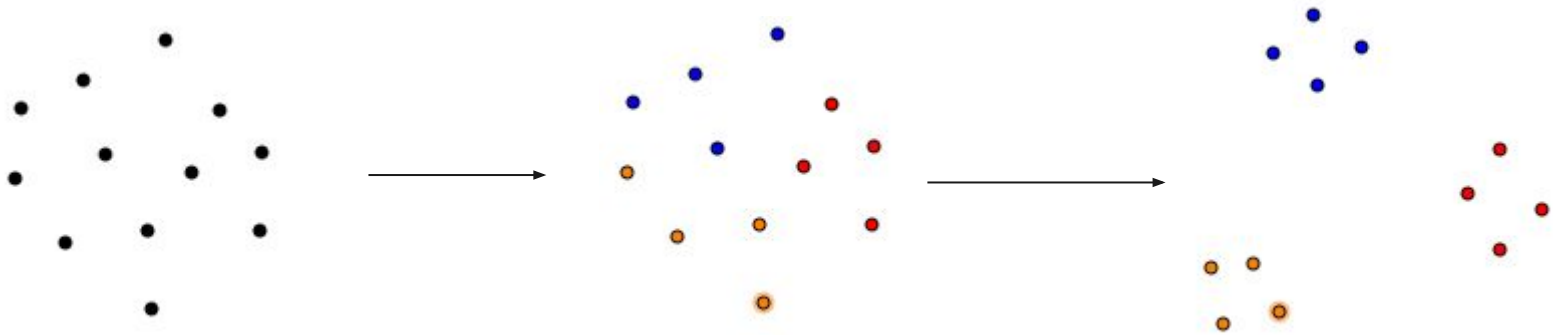
Implementing Specific Group Strategies

- Patrolling a perimeter
  - Applicable to above
  - Possible extension to patrolling an area



Implementing Specific Group Strategies

- Dispersion and grouping
  - Transition from some group task to another
  - Agents may be assigned to “teams” with different tasks
  - Add constraints such as a maximum distance between agents



Motivation: System of Autonomous Agents

Use data generated from many specific tasks to train a model with elements of artificial intelligence

References & Acknowledgements

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Reference:

Yu, J., & LaValle, S.M. (2012). Distance Optimal Formation Control on Graphs with a Tight Convergence Time Guarantee, presented at 51st IEEE Conference on Decision and Control, Maui, HA, December 10-13.