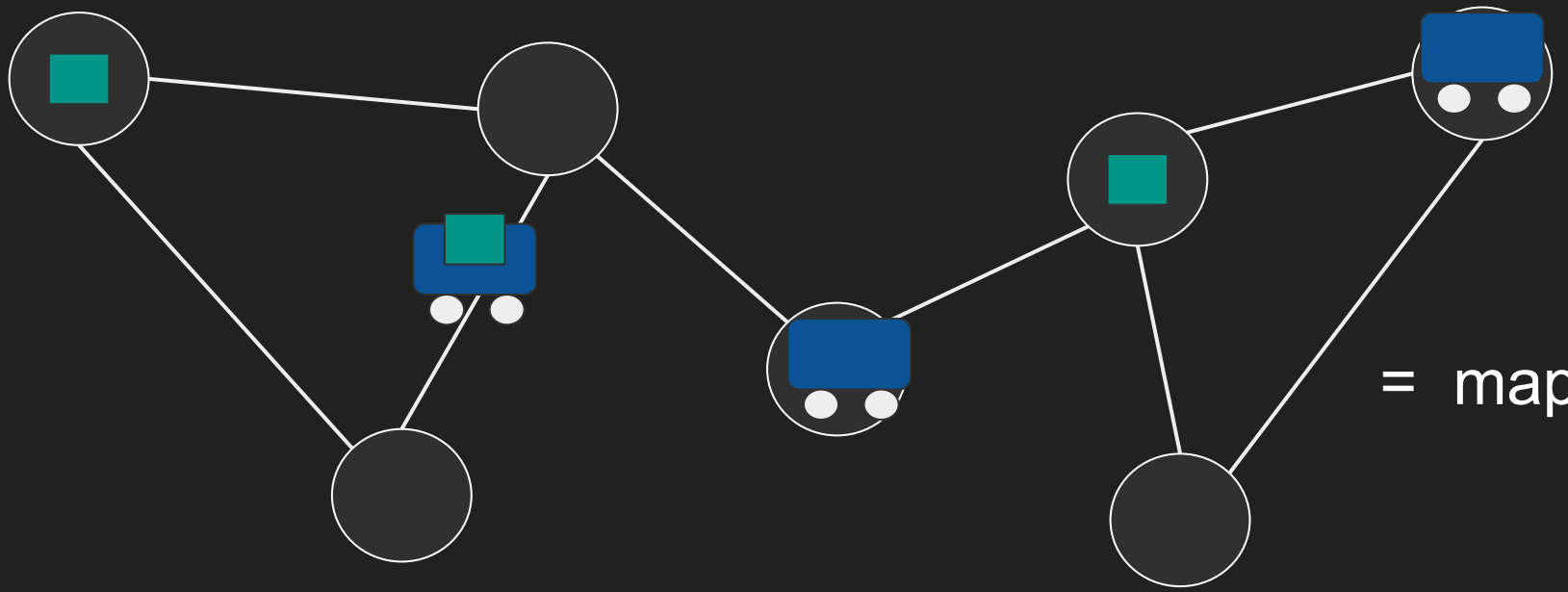
Dispatching of Autonomous Cargo Transport Rovers

August Soderberg

- Problem

= rover

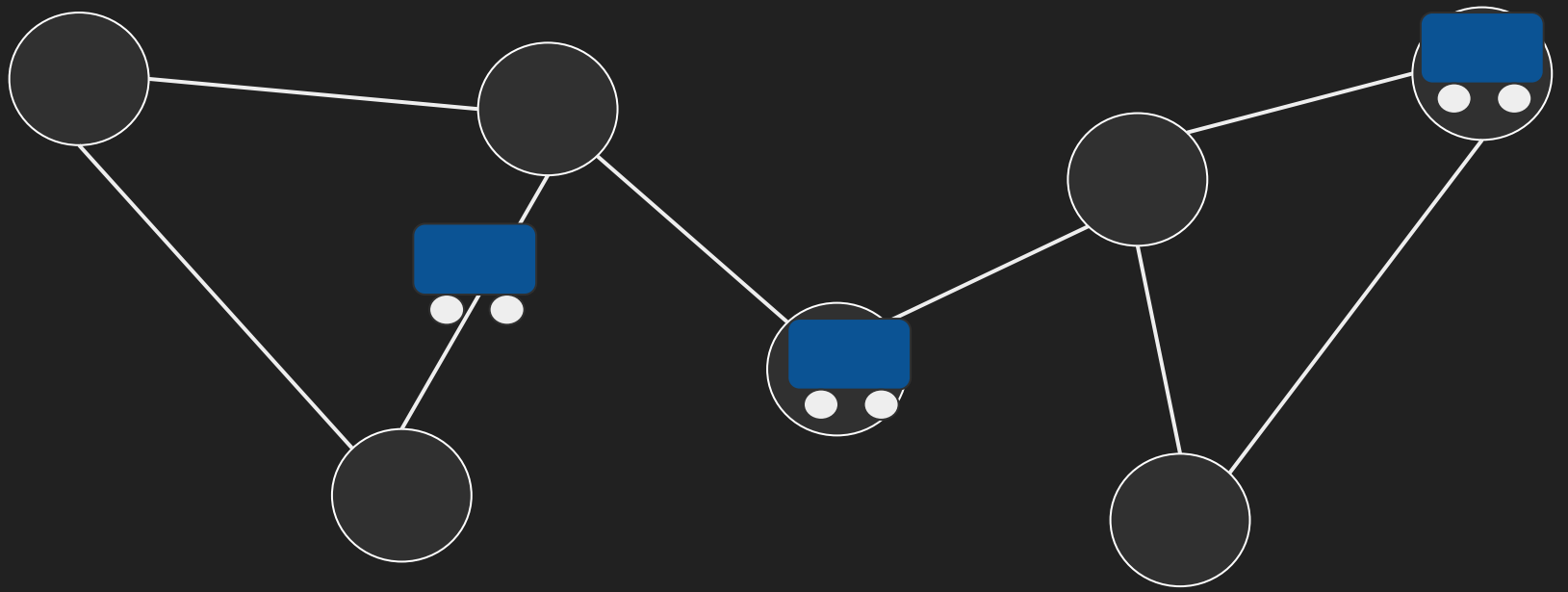
= cargo



= map

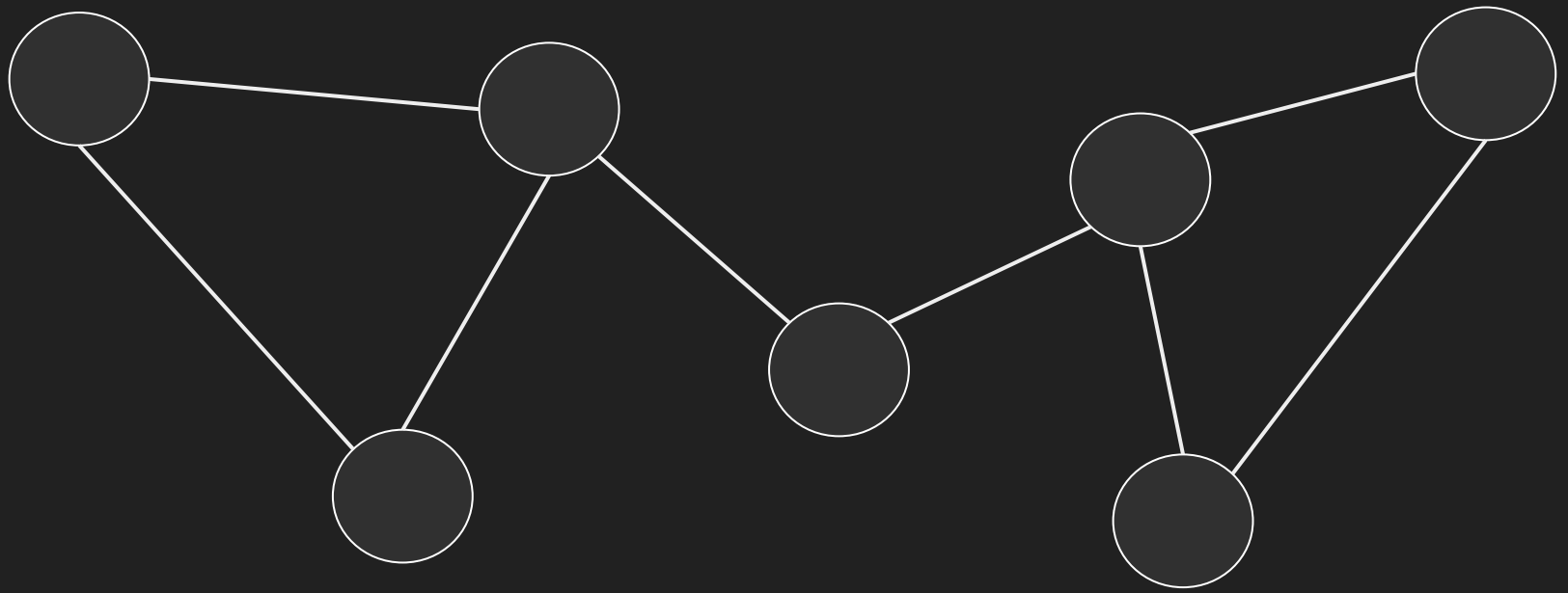
- Problem details

n x



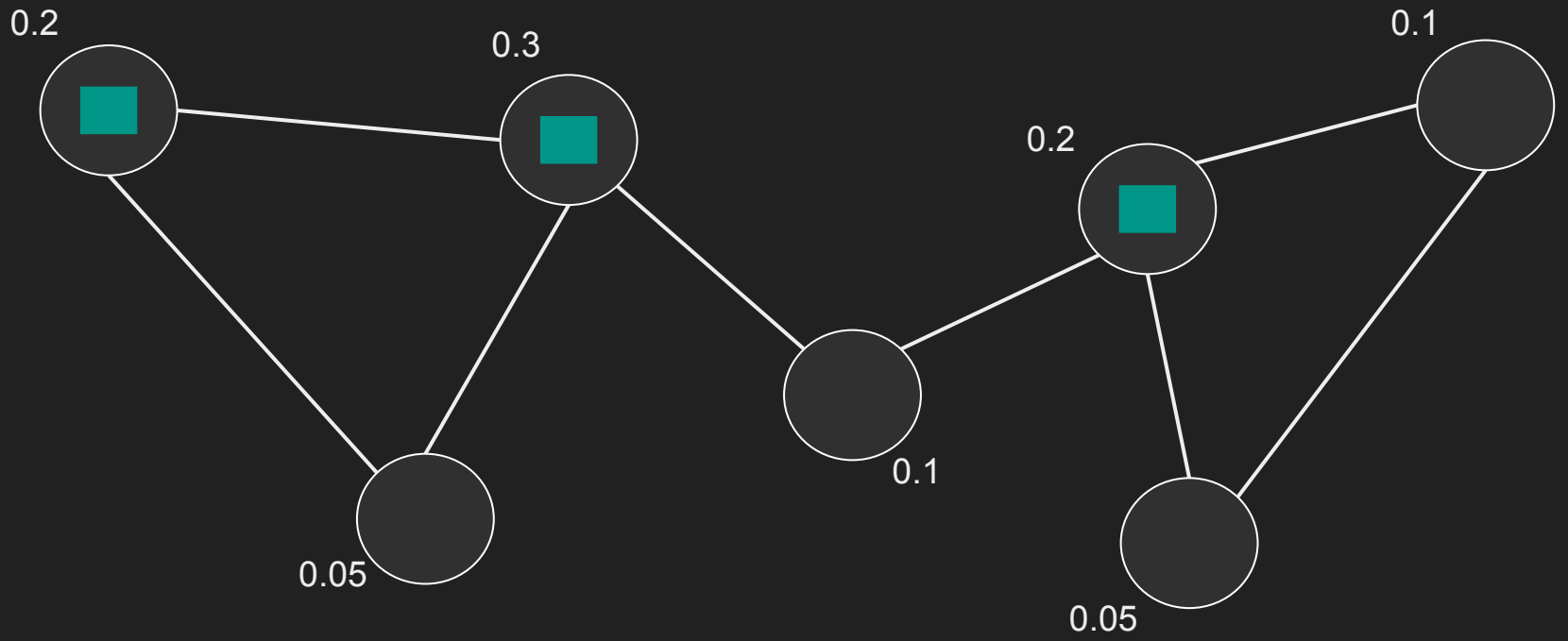
- Problem details

World or map



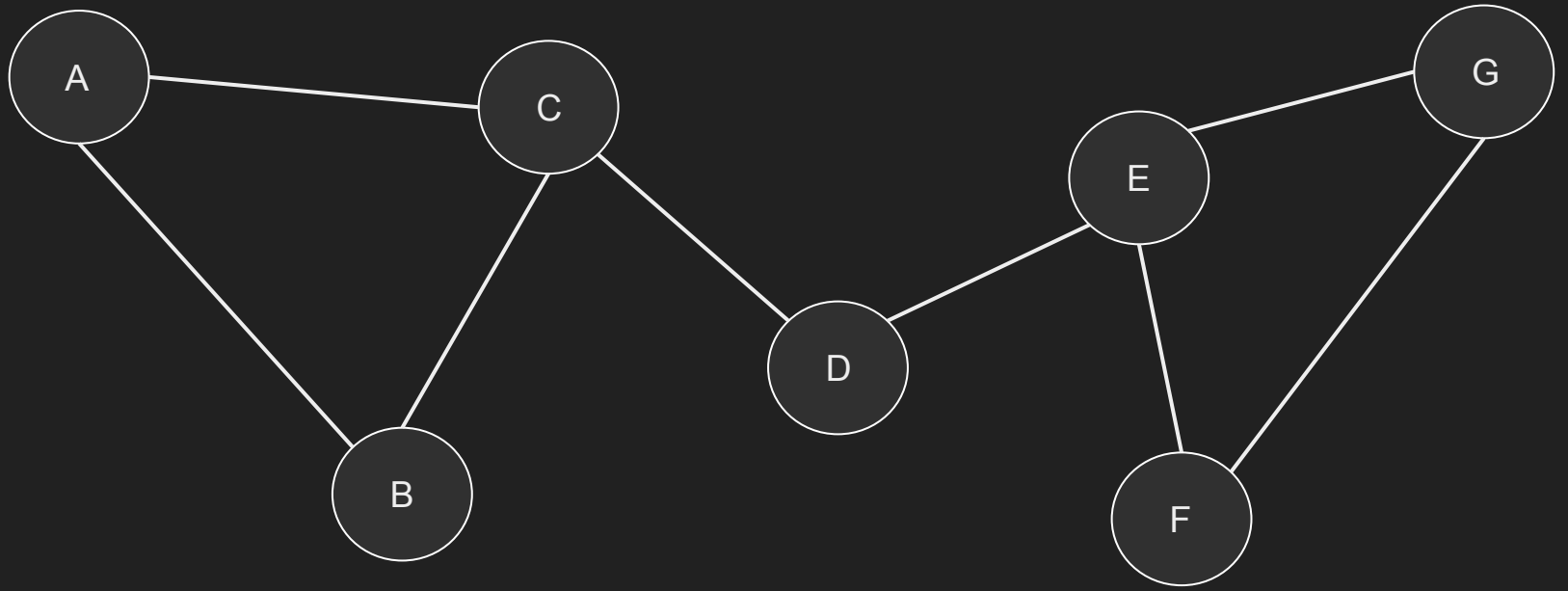
- Problem details

Stochastic → 

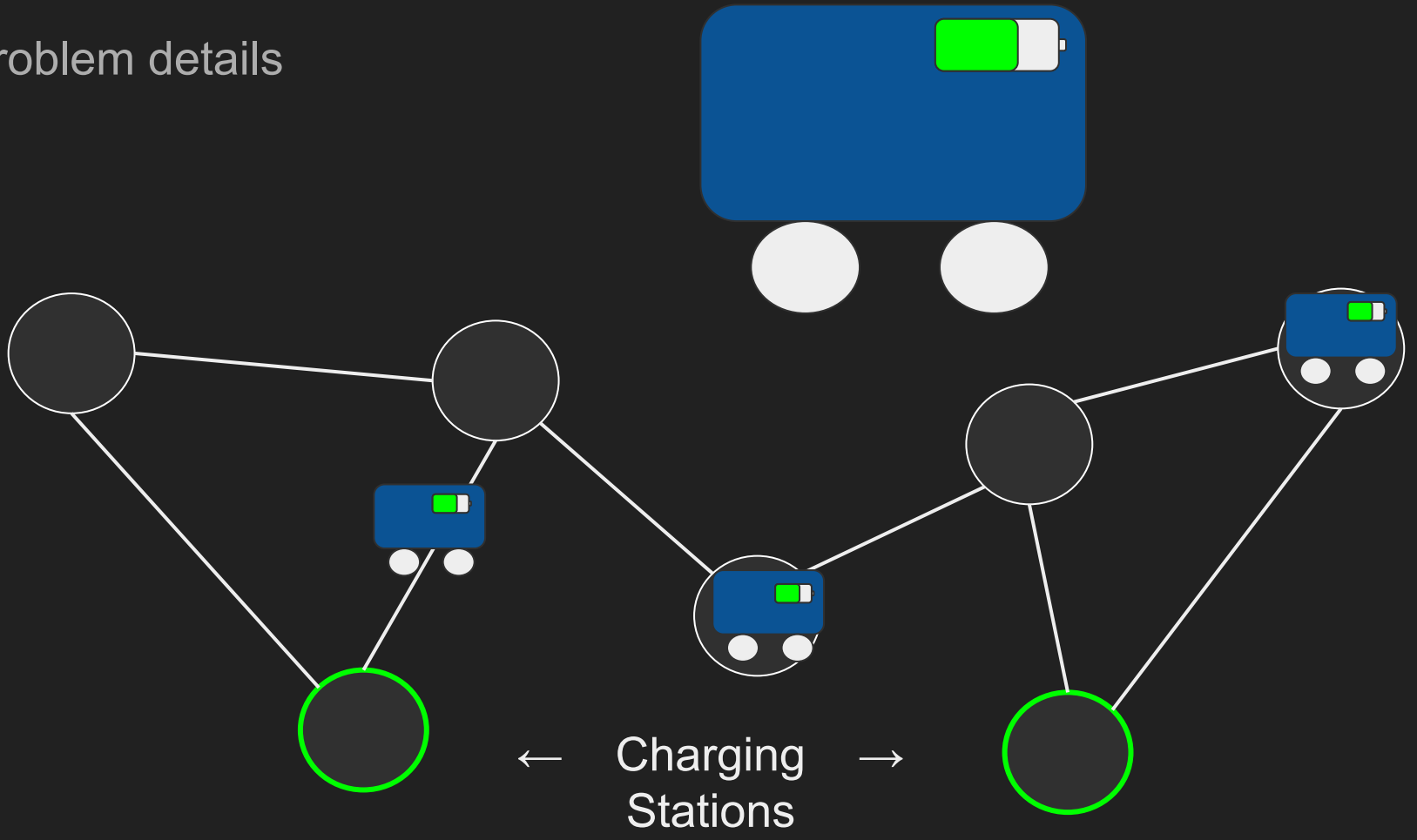


- Problem details

■ : C → E



- Problem details



- Applications

Warehouses

Food Delivery

People Movers

Campus Rovers

- Applications

  Warehouses

  Food Delivery

  People Movers

  Campus Rovers

- Applications

  Warehouses

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- Applications

  Warehouses

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  People Movers

  Campus Rovers

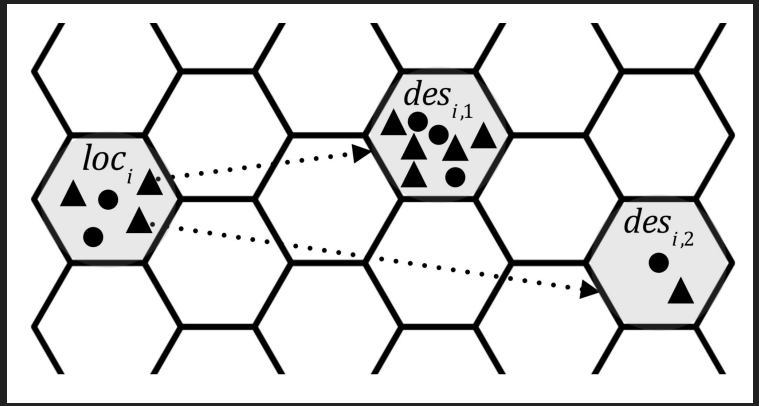
- Prior Work

Efficient Ridesharing Order Dispatching with Mean Field Multi-Agent Reinforcement Learning

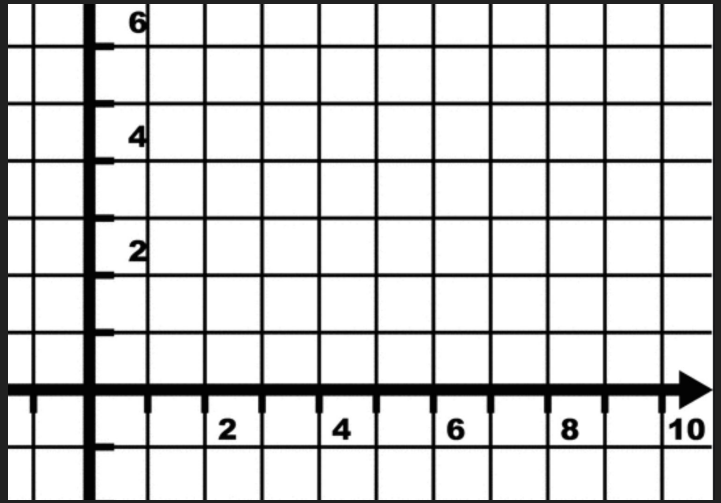
Minne Li, Zhiwei (Tony) Qin, Yan Jiao, Yaodong Yang, Zhichen Gong, Jun Wang, Chenxi Wang, Guobin Wu, Jieping Ye

- Prior Work

Grid Based Simulation



Coordinate Based Simulation



- Prior Work

Markov Game

$\Gamma = \langle S, P, A, R, O, N, \gamma \rangle$

S : sets of states

P : transition probability functions

A : sets of joint actions

R : reward functions

O : sets of private observations

N : number of agents

γ : discount factor

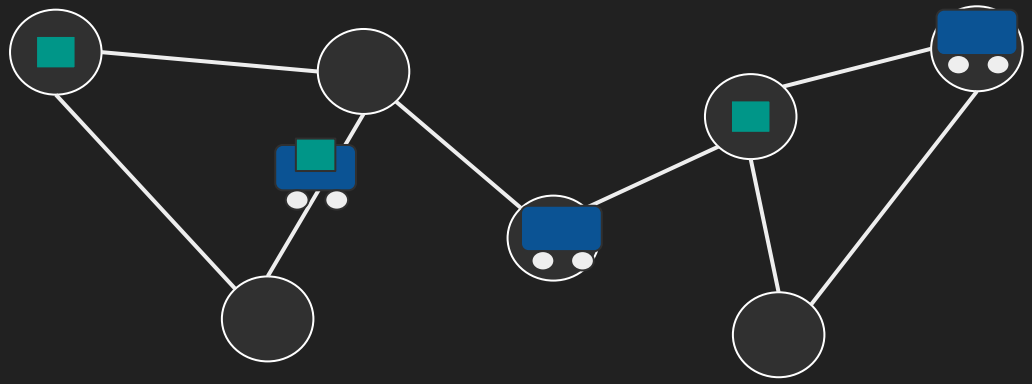
- Simulation details

Configurable Manifest

Graph of Nodes and Edges

Tasks

Decisions



- Simulation details

Configurable Manifest

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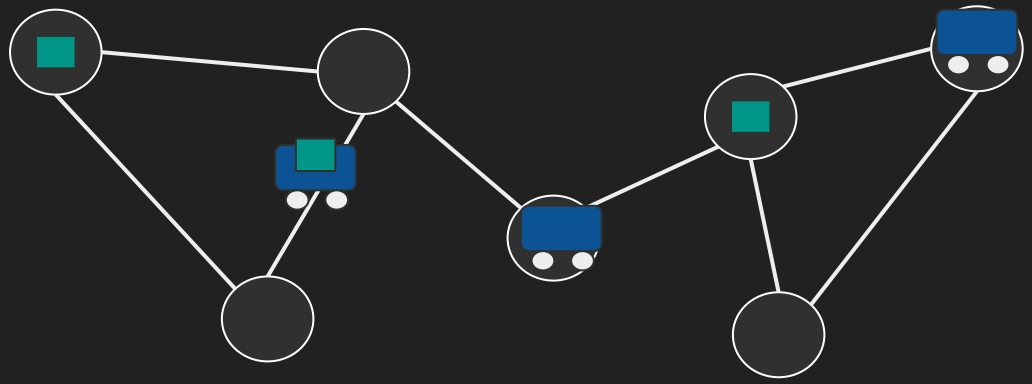
Decisions



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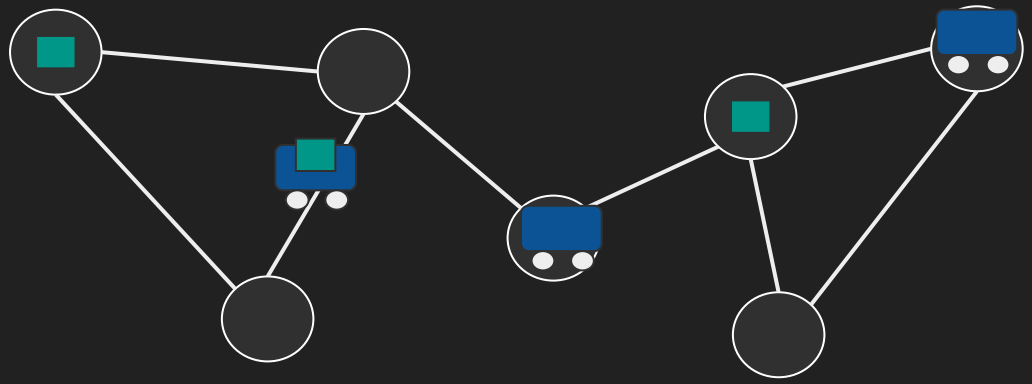

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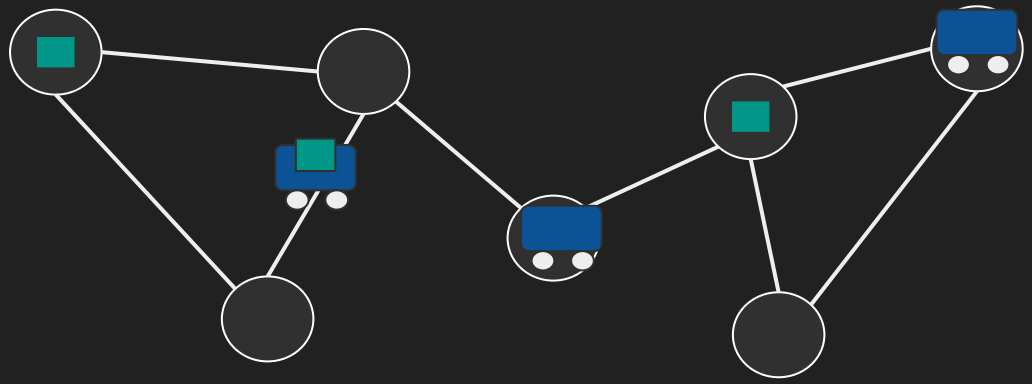
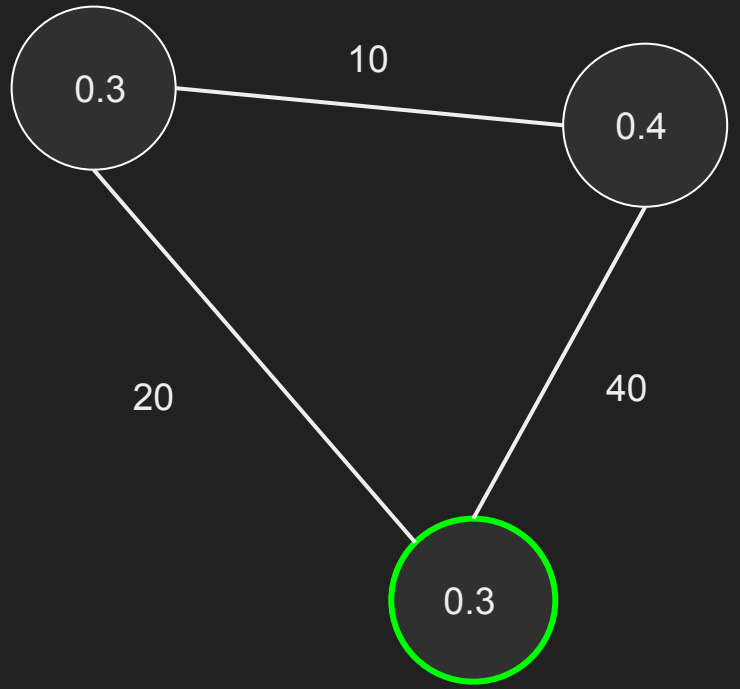


- Simulation details

Nodes -
- Charging and standard
- Task spawning probability
- No capacity

Edges -
- Fixed traversal time
- Black box

Graph of Nodes and Edges



- Simulation details

Tasks

Definition -

Origin and Destination  : $C \rightarrow E$

Behavior -

Agents have 1 task capacity

No choice during task completion

- Simulation details

Choices -

Perform task

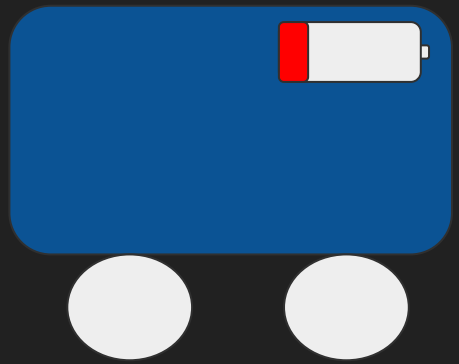
Charge

Visit other nodes?

Safety -

No unsafe decisions allowed

Decisions



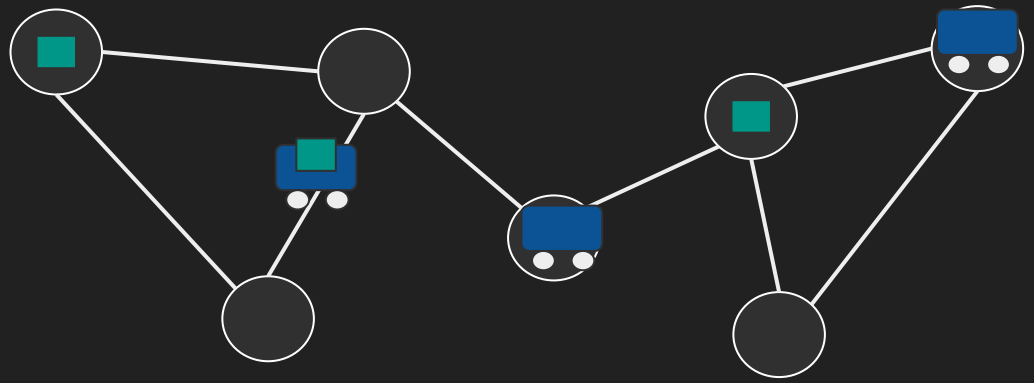
- Solution

Reinforcement learning

Stochastic complex task

Continuation of prior work

Simulatable as a Markov Game



- Solution

Game state knowledge

Agents -

- Available agents
- Charge value
- Distance to nearest charger
- Distance to each available task

- Solution

Game state knowledge

Agents -

- **Available agents**
- Charge value
- Distance to nearest charger
- Distance to each available task

- Solution

Game state knowledge

Agents -

- Available agents
- **Charge value**
- Distance to nearest charger
- Distance to each available task

- Solution

Game state knowledge

Agents -

- Available agents
- Charge value
- **Distance to nearest charger**
- Distance to each available task

- Solution

Game state knowledge

Agents -

- Available agents
- Charge value
- Distance to nearest charger
- **Distance to each available task**

- Solution

Game state knowledge

Tasks -

Age
Charge after completion (always safe)
Distance from destination to charger
Destination task spawning probability

- Solution

Game state knowledge

Tasks -

Age

Charge after completion (always safe)

Distance from destination to charger

Destination task spawning probability

- Solution

Game state knowledge

Tasks -

Age

Charge after completion (always safe)

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- Solution

Game state knowledge

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Destination task spawning probability

- Solution

Game state knowledge

Tasks -

Age

Charge after completion (always safe)

Distance from destination to charger

Destination task spawning probability

- Solution

Rewards

Markov game reward -
- Completing task
- Task spawning adjacency
- Charging station adjacency

Simulation reward -
- Minimizing average task waiting time

- Solution

Rewards

Markov game reward -

- **Completing task**
- Task spawning adjacency
- Charging station adjacency

Simulation reward -

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- Solution

Rewards

Markov game reward -

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Rewards

Markov game reward -
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- Solution

Rewards

Markov game reward -
- Completing task
- Task spawning adjacency
- Charging station adjacency

Simulation reward -
- **Minimizing average task waiting time**

- Conclusion

Questions

Can this be solved by machine learning?

Is reinforcement learning the right choice?

Anything I’m missing?