Efficient Dispatching of Autonomous Cargo Vehicles

August Soderberg

Advisor: Pito Salas

Why do we care?

- Warehouses
- Campuses + Urban areas
- Trucking + Rail

Why do we care?
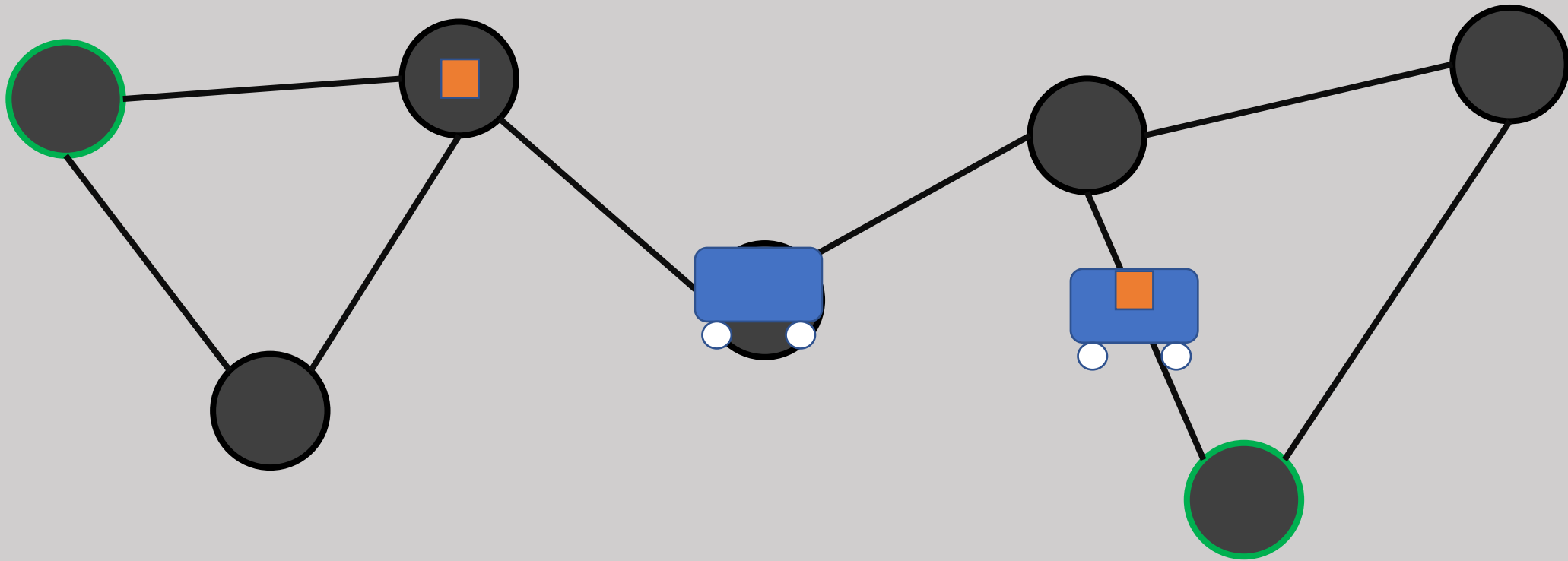
- Users
- Companies
- Planet

How can we solve this problem?

Features:

- Vehicles
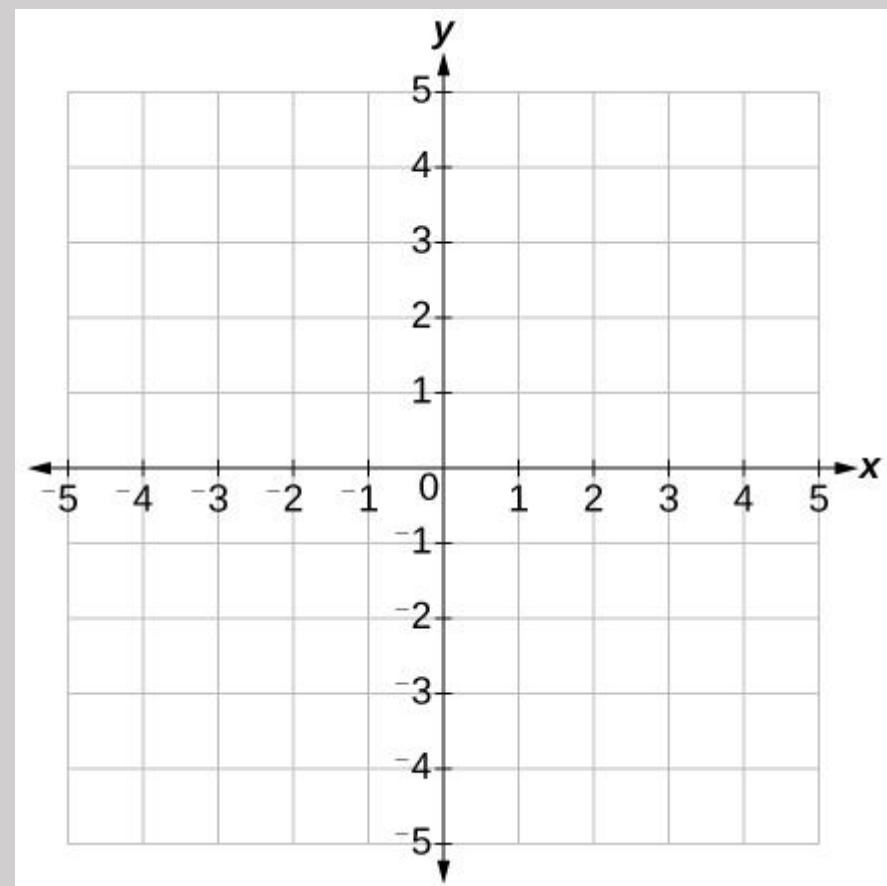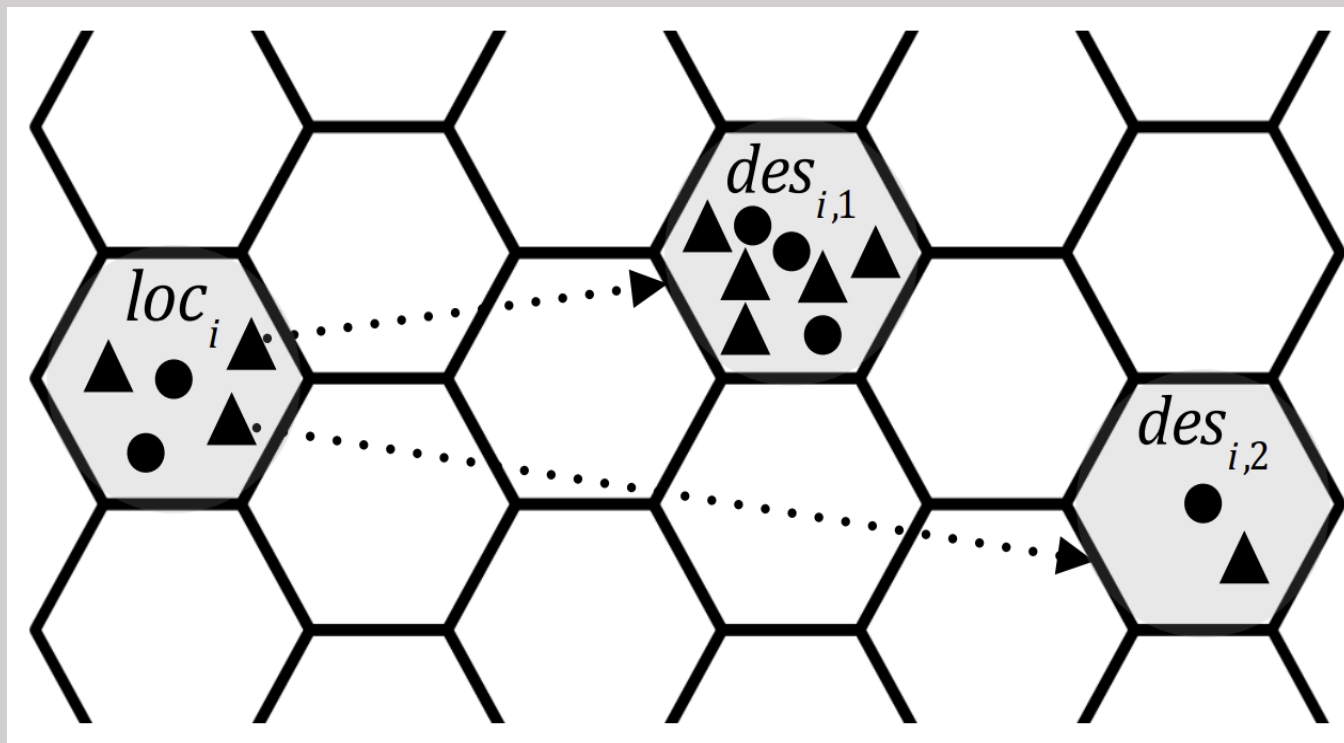- Tasks
- Map
- Charging

How can we solve this problem?

Related Work

What have other people done?

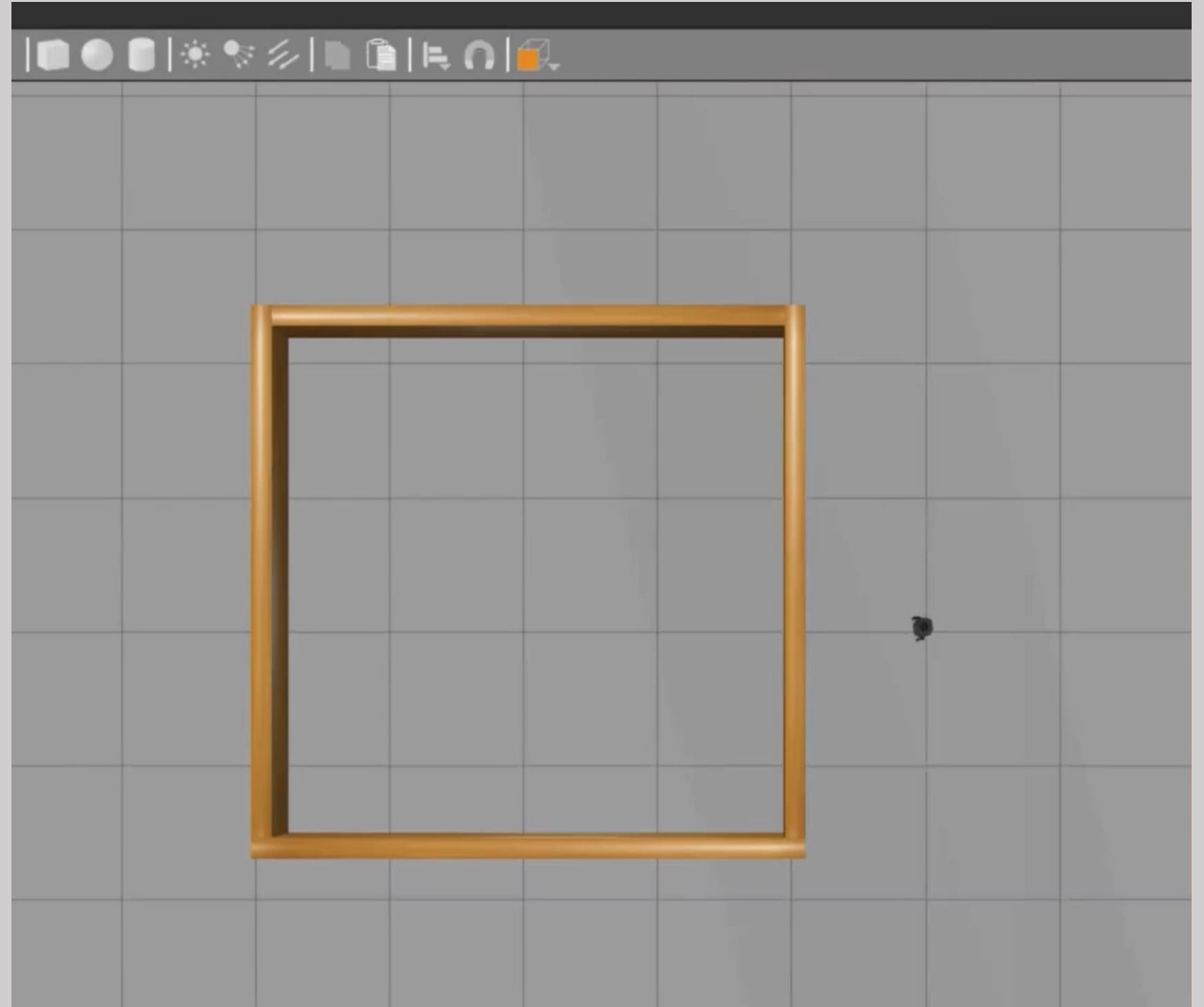- Ridesharing

- Mean Field Multi-Agent Reinforcement Learning
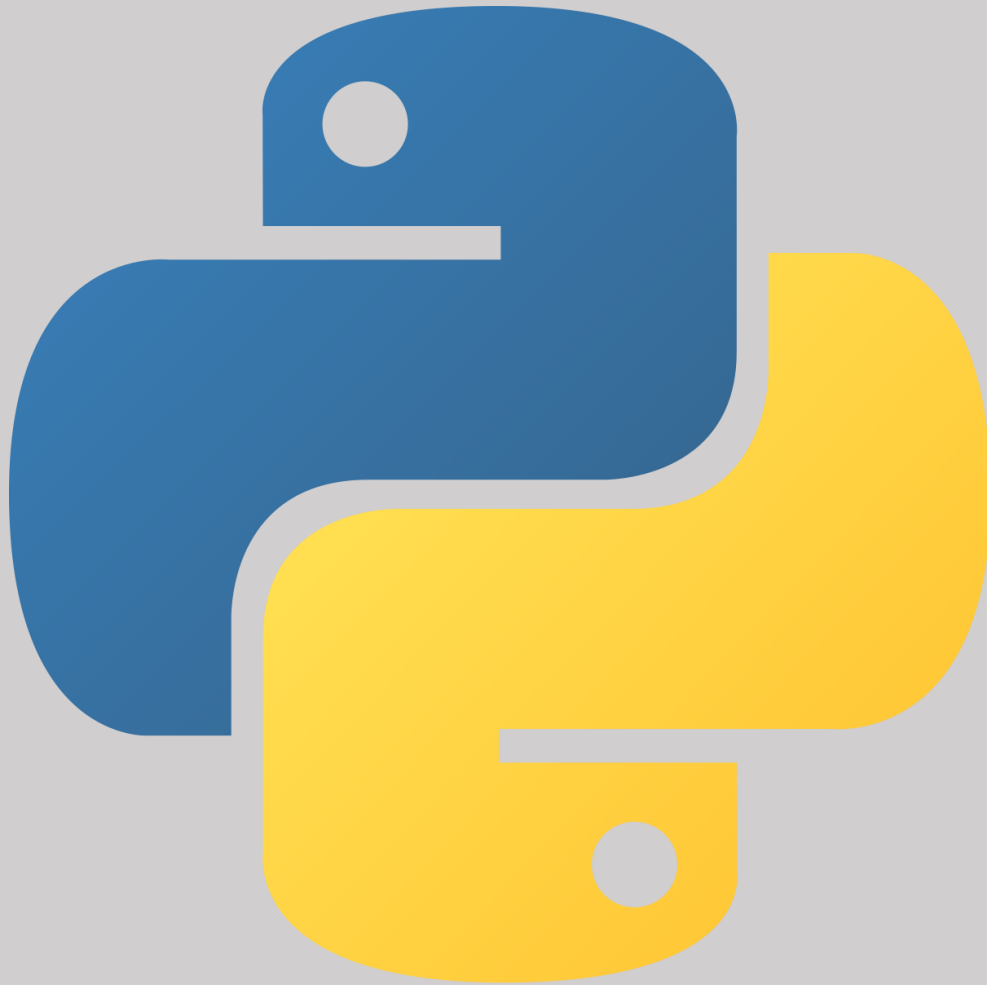
Related Work

- Autonomous Mobile Robots

- Twin Delayed Deep Deterministic (TD3) policy gradient algorithm

Related Work

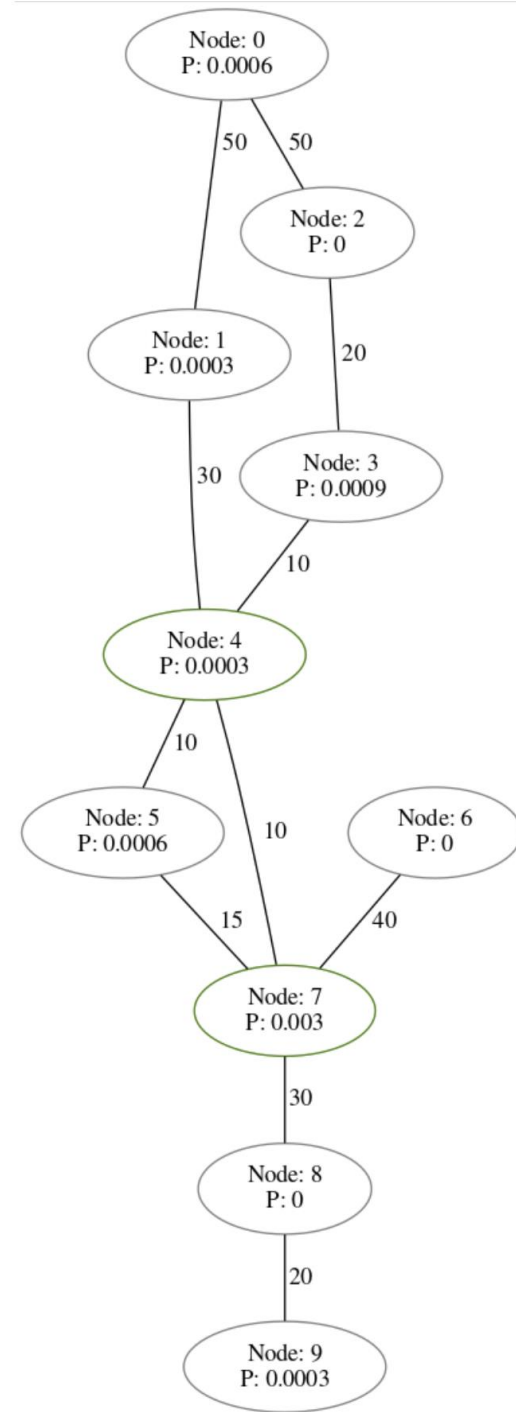# Requirements:

- Capture applications

- Doesn't overfit

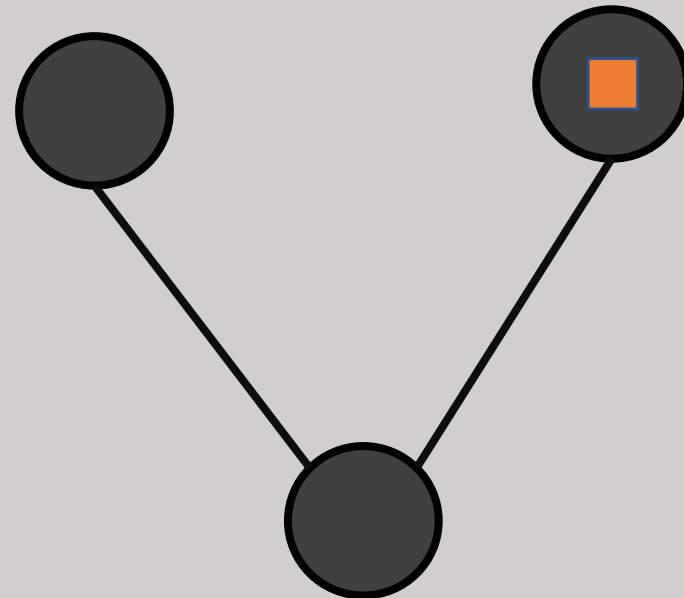# Proposed Simulation
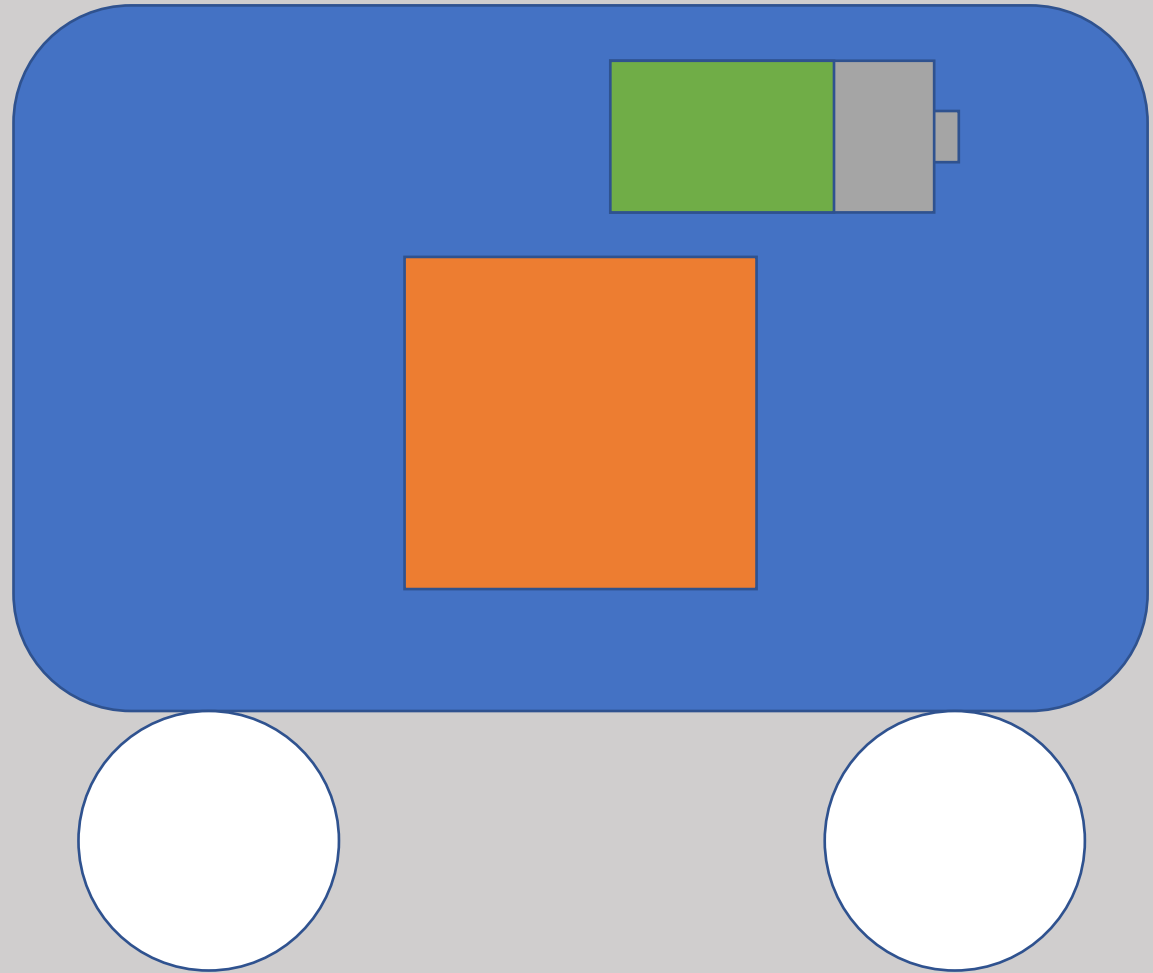
- ## Graph Network
- ## Nodes
- ## Edges

- Tasks

  ■ = (time, origin, destination)

- Navigation

Proposed Simulation

- Vehicles

- Safety

Proposed Simulation

- ## Information

- ## Optimization

- ## Modularity

```
map:
  #Length of each edge in meters
  edge_weights:
    - [0, 50, 50, -1, -1, -1, -1, -1, -1, -1]
    - [0, 0, -1, -1, 30, -1, -1, -1, -1, -1]
    - [0, 0, 0, 20, -1, -1, -1, -1, -1, -1]
    - [0, 0, 0, 0, 10, -1, -1, -1, -1, -1]
    - [0, 0, 0, 0, 0, 10, -1, 10, -1, -1]
    - [0, 0, 0, 0, 0, 0, -1, 15, -1, -1]
    - [0, 0, 0, 0, 0, 0, 0, 40, -1, -1]
    - [0, 0, 0, 0, 0, 0, 0, 0, 30, -1]
    - [0, 0, 0, 0, 0, 0, 0, 0, 0, 20]
    - [0, 0, 0, 0, 0, 0, 0, 0, 0, 0]


randomize_cargo_spawn_probability: no


# This only matters if 'randomize_cargo_spawn_probability' is set to 'no'
cargo_spawn_probability: [0, 0.001, 0, 0.0005, 0, 0.0005, 0, 0.001, 0, 0]


randomize_chargers: no


number_of_random_chargers: 2


# This only matters if 'randomize_chargers' is set to 'no'
charger_nodes: [4, 7]
```
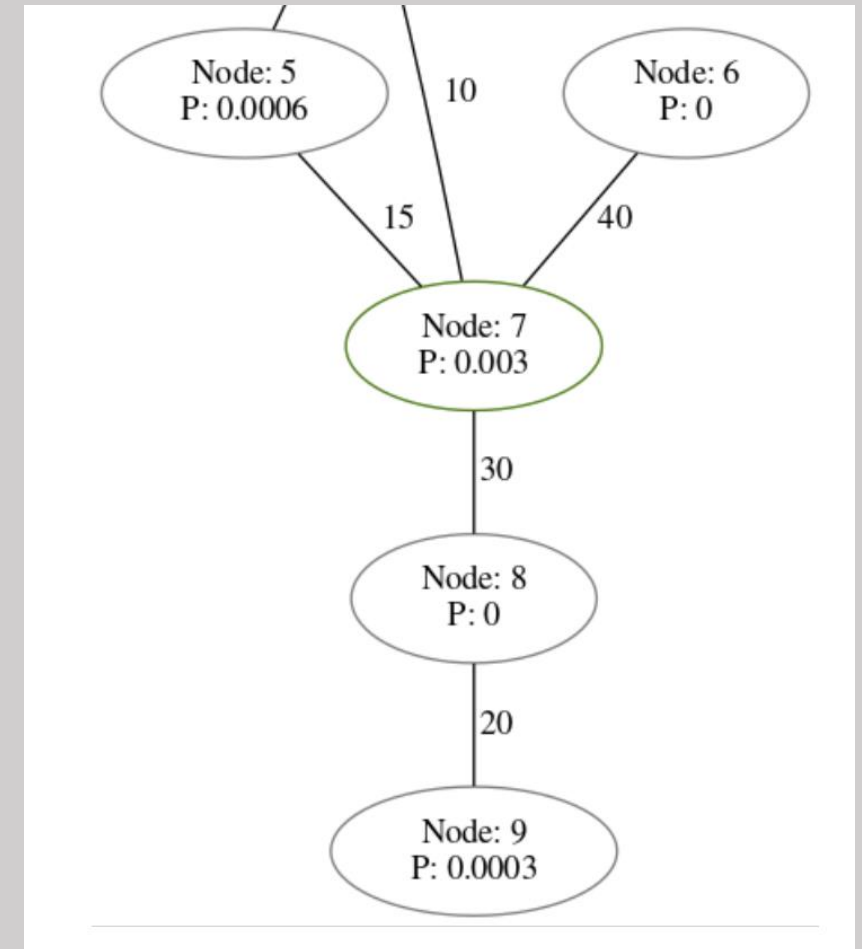
A quick note

Reinforcement Learning

- ## Task Spawning Rates

- ## Proximal Policy Optimization

Reinforcement Learning
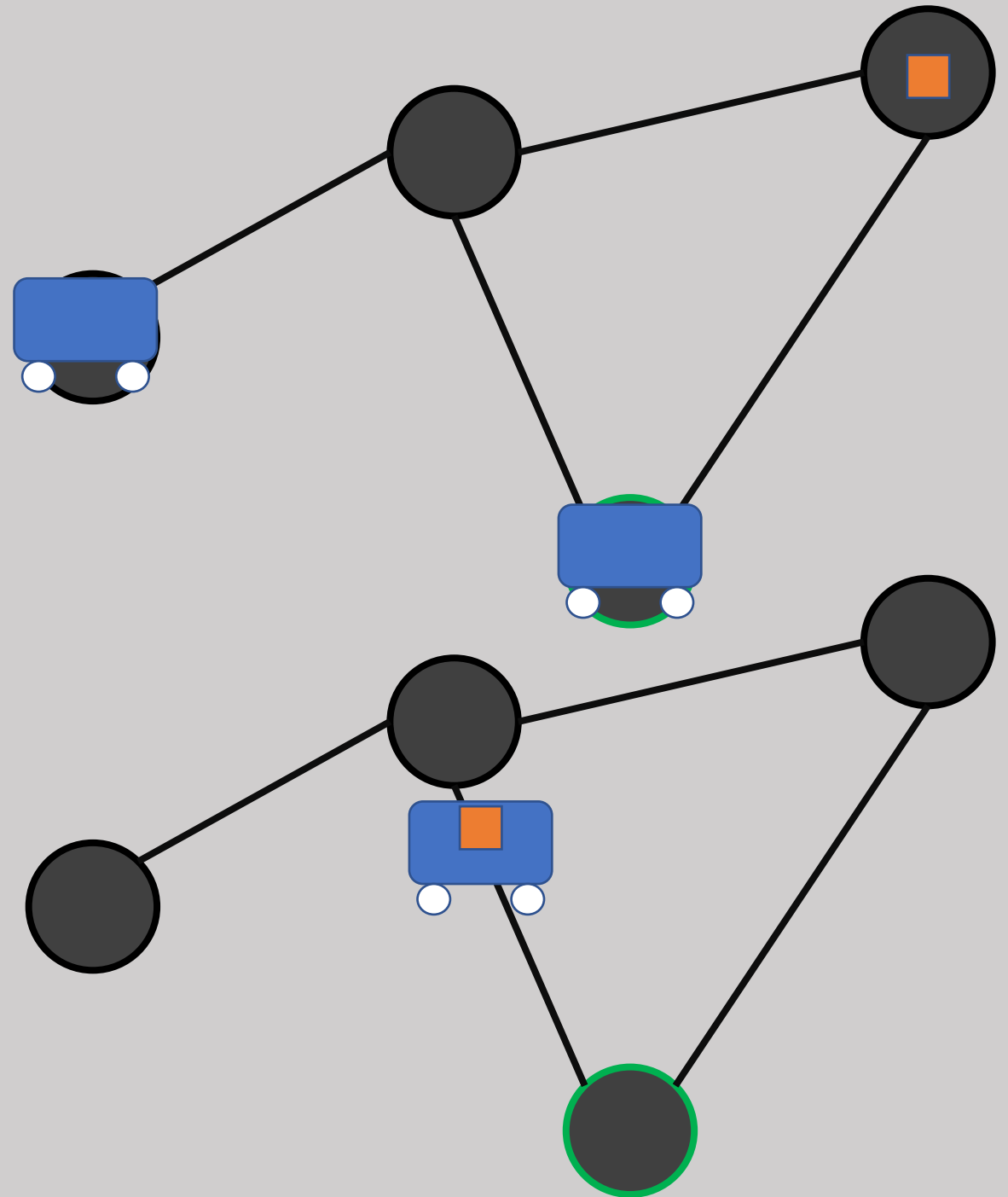
- # Pre-task

- # Post-task

Reinforcement Learning

- Pre-task
- Post-task
- Reward
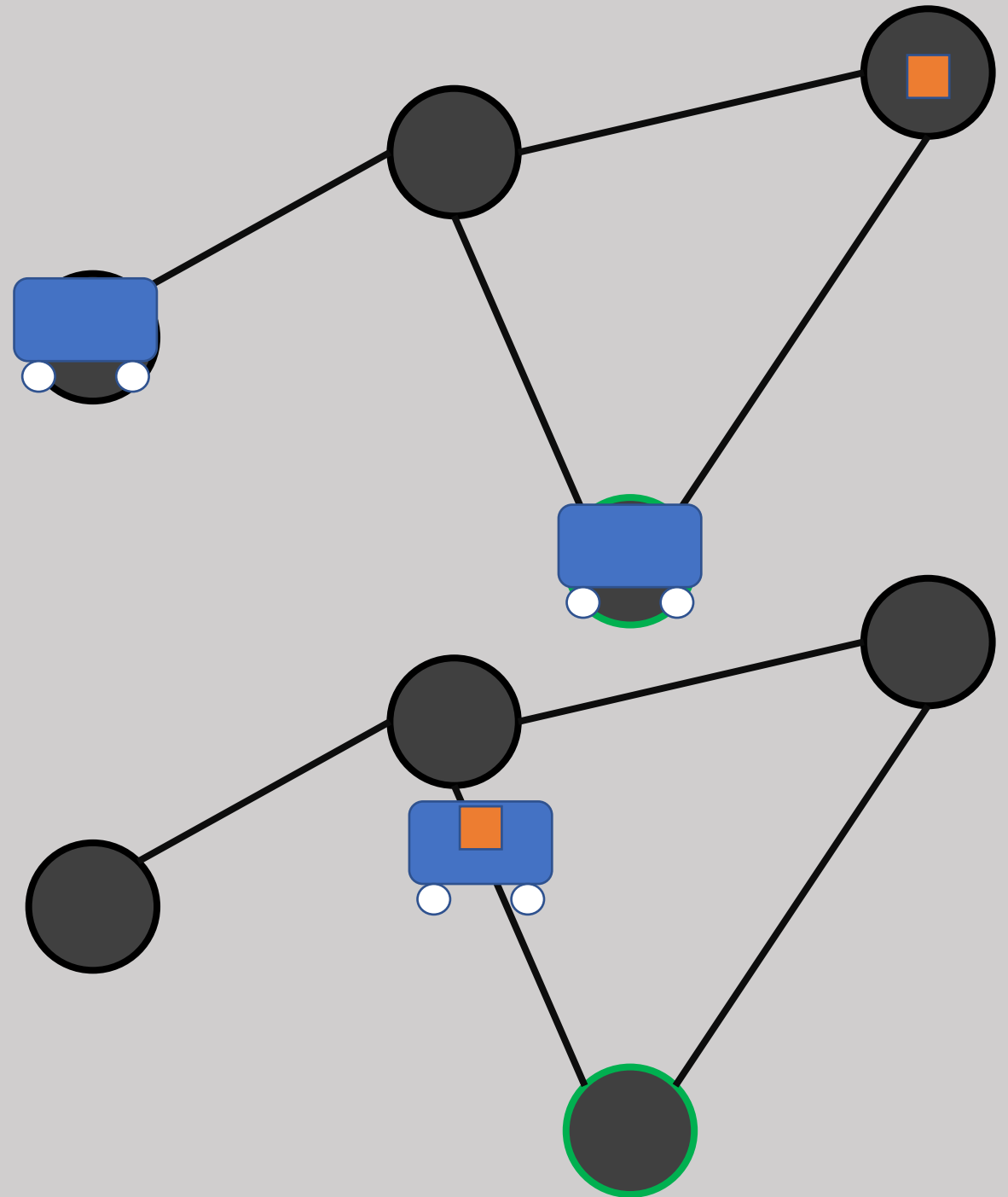
Reinforcement Learning

- Greedy dispatcher

- Pre-task

- Post-task

Greedy, Random, and RL Dispatchers
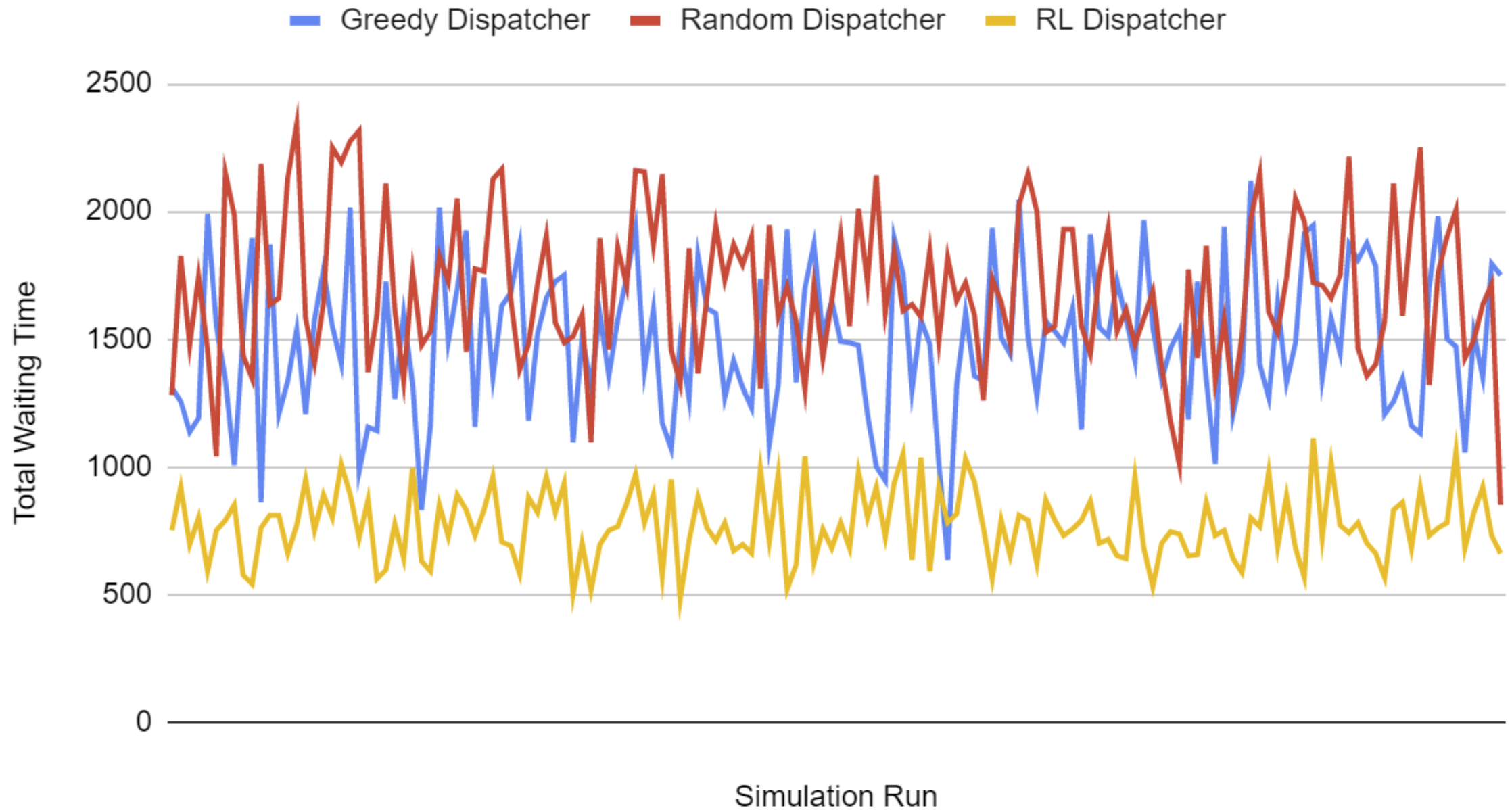
Greedy Dispatcher, Random Dispatcher and RL Dispatcher
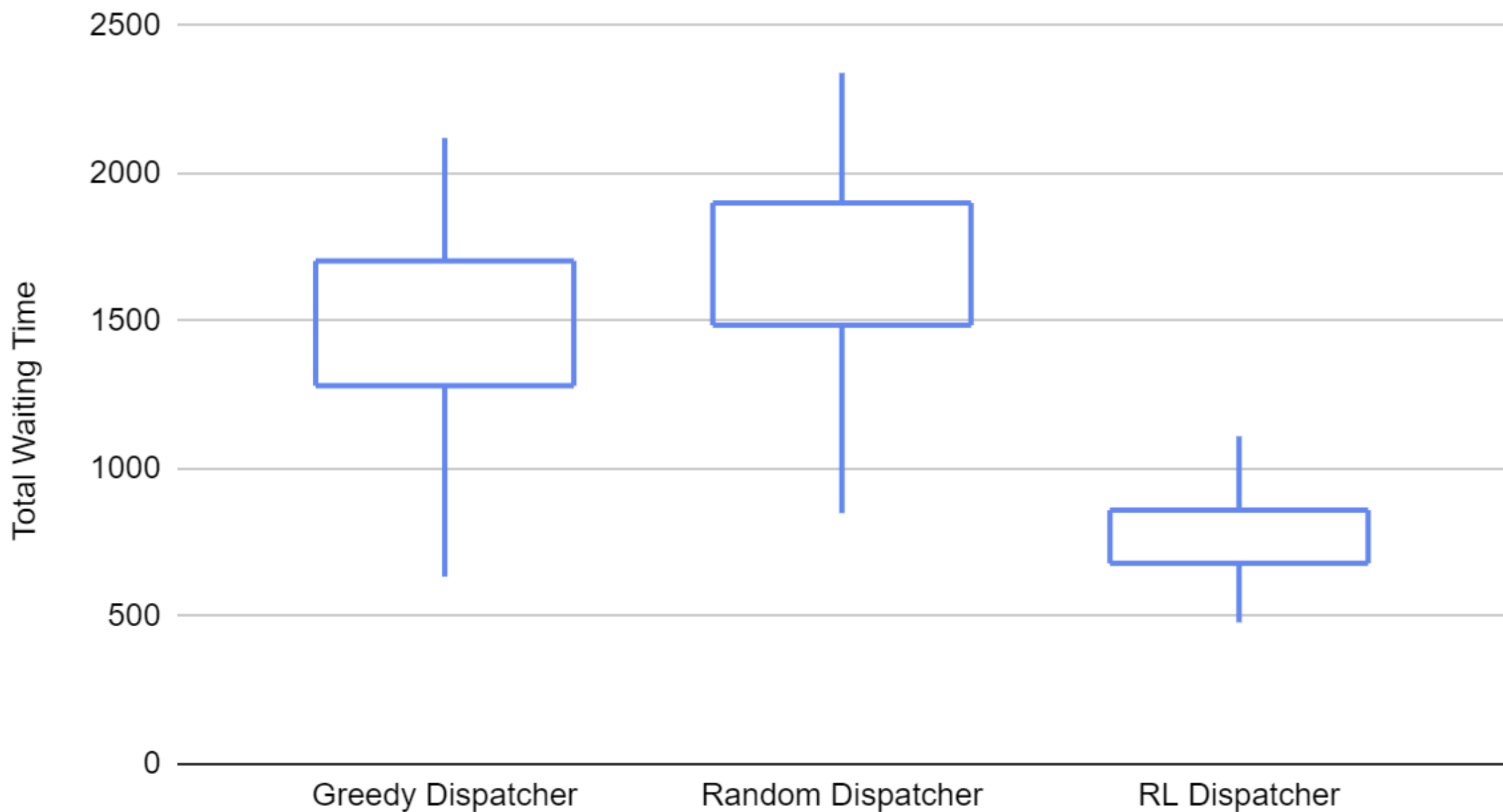
Optimized Dispatcher

- Post-task
- Human design
- Importance

Optimized Dispatcher

- Hopeful dispatcher

- Leverage Spawning Probabilities
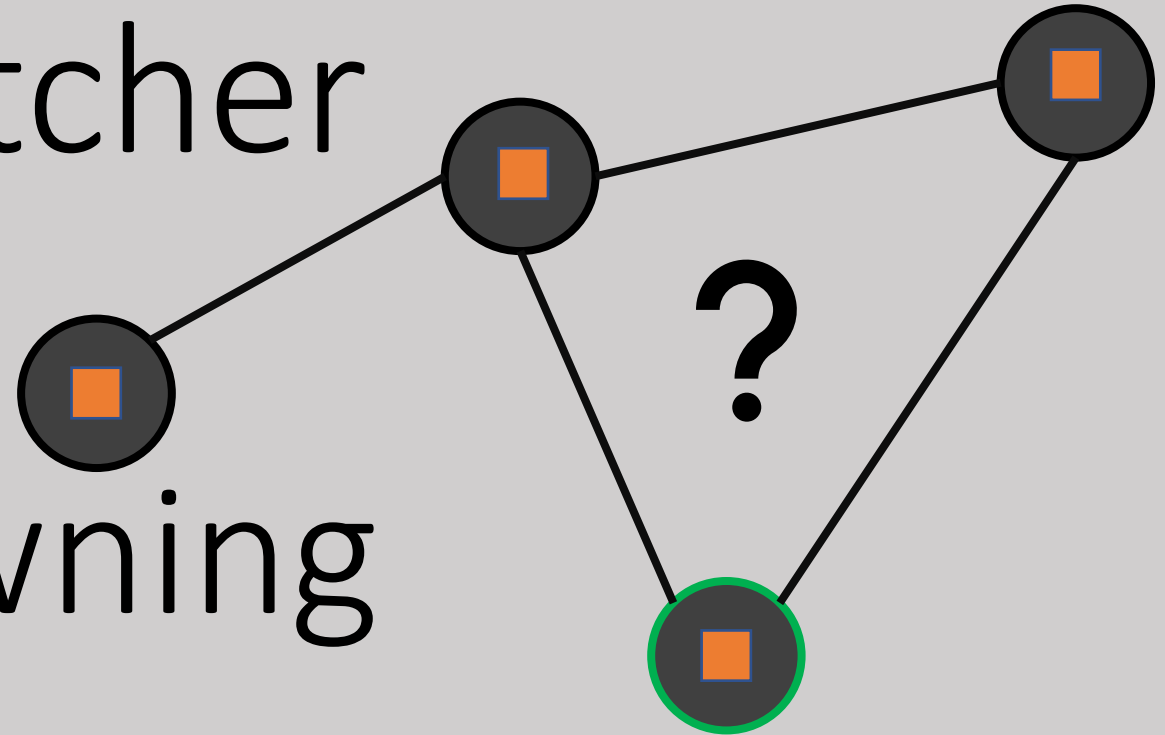
Optimized Dispatcher

- Brute-force optimization

- Nelder–Mead method

Hopeful Dispatcher vs. Optimized Dispatcher
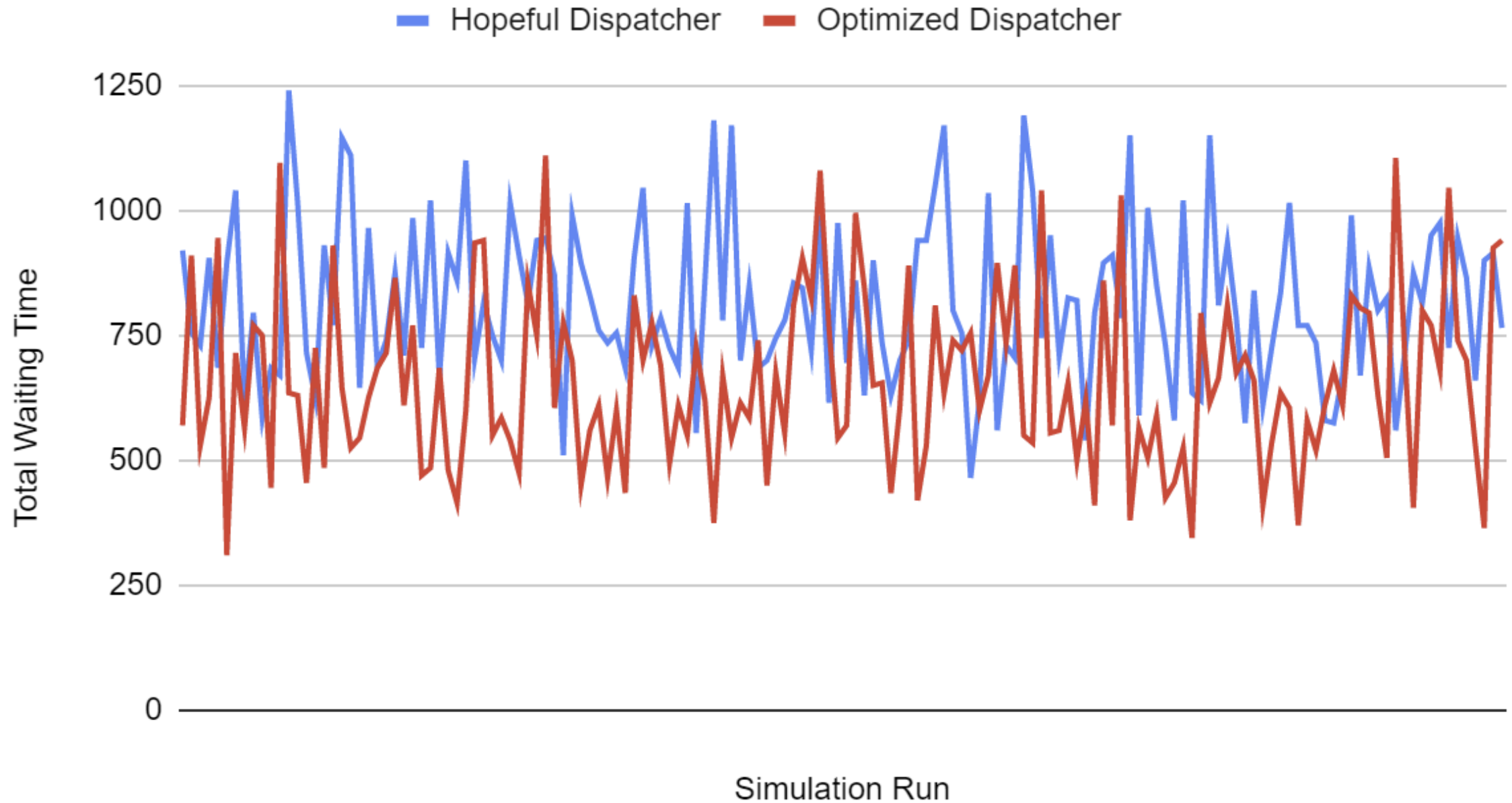
Hopeful Dispatcher vs. Optimized Dispatcher   p < 0.0001

- Importance of simulation

- Dispatching heuristics

- People, companies, world

Conclusion

Thank you!

Conclusion

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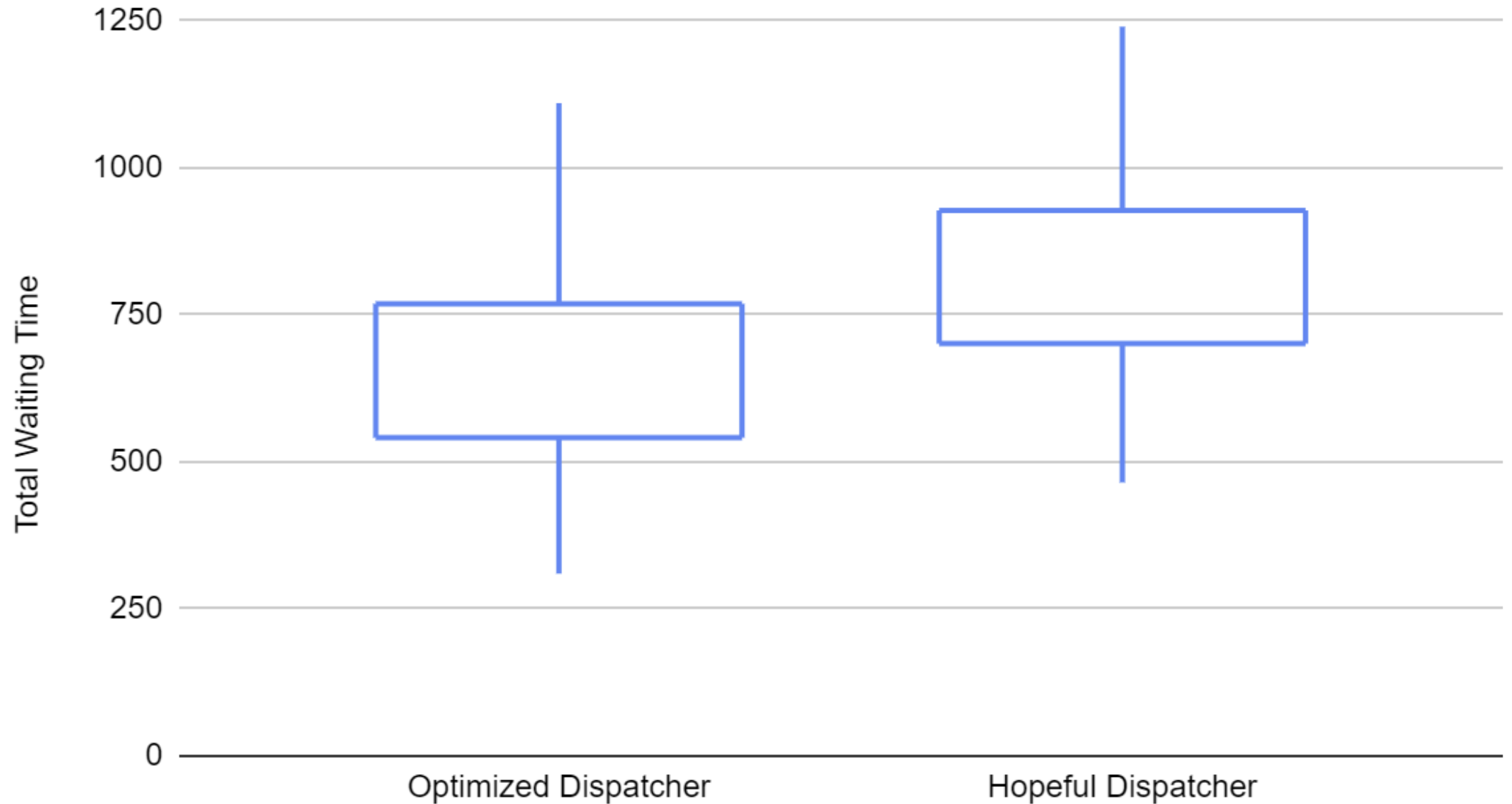
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