Regulating Self-Adaptive Multi-Agent Systems with Real-Time Interventions

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Outline

- Background, Challenges and Objectives
- The Jiao Tong Game
- Regulating Multi-Agent Systems (MAS) with unlimited interventions
- Regulating MAS with limited interventions
- Conclusions and future work

Background

- Dynamic Resource Allocation: real-world applications, e.g.,
  - Transportation Systems
  - Building Management Systems
  - Power Grids
  - Water Supply Systems
- Existing approaches:
  - Mechanism Design
  - Approximation Algorithms
  - Machine Learning Algorithms
  - Human Supervisory Control

Challenges

- Environment:
  - highly dynamic
  - very complex
- Agents:
  - autonomous and self-interested
  - have partial information of the environment
  - reactive or adaptive to the dynamic environment
- Regulators:
  - have no or little knowledge of the decision-making process of agents
  - do not have full control over the agents
  - interventions available to influence the decision-making of the agents.

Objectives

- To better understand the general principles of human interventions in MAS.
- To investigate:
  - whether
  - under what conditions
  - to what extent

  people are able to create effective interventions.

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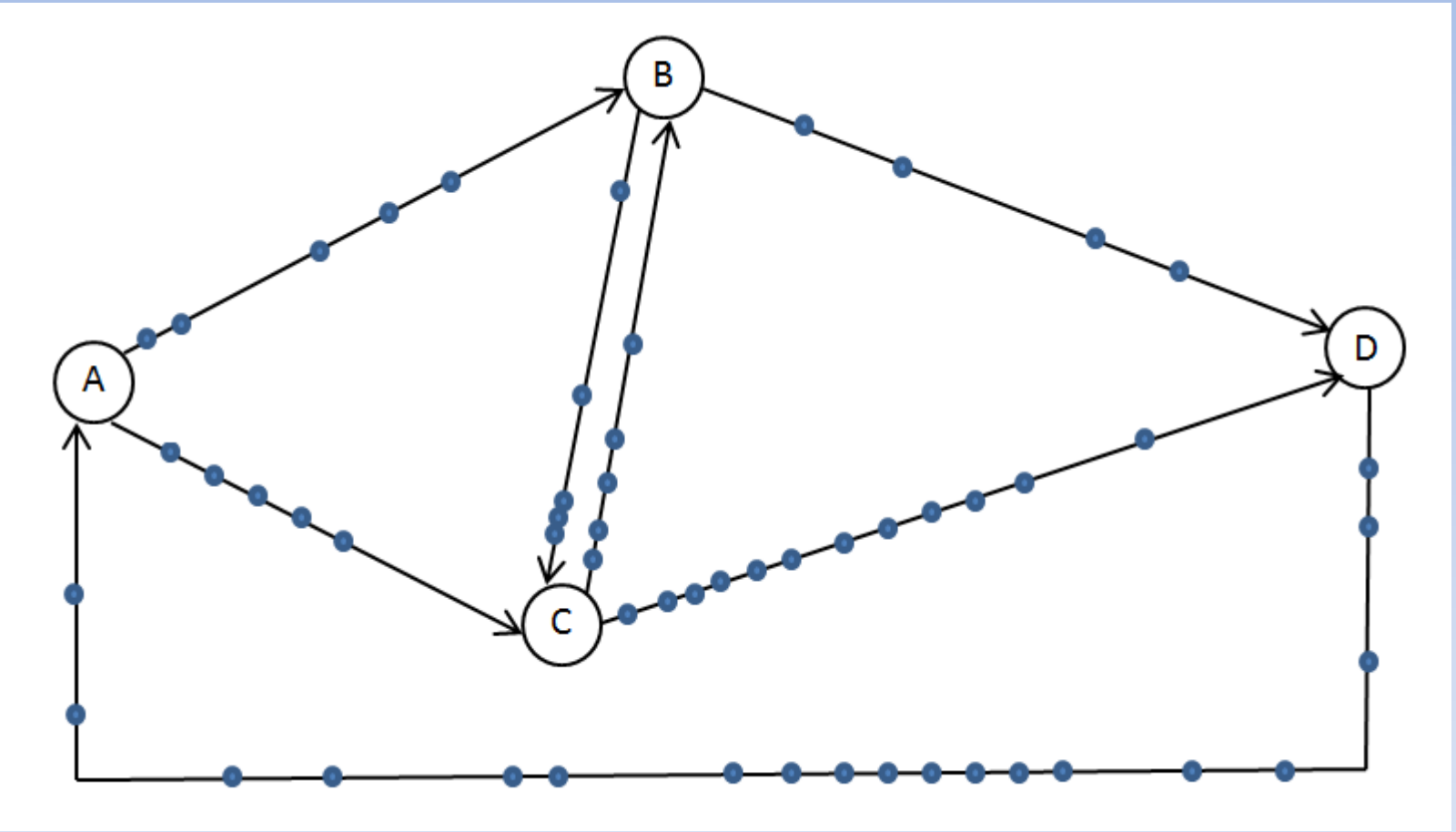
The Jiao Tong Game



The Jiao Tong Game

- Metrics:
  - running throughput (main)
  - sliding throughput
- The agents:
  - learning agents
  - static agents
- The regulator

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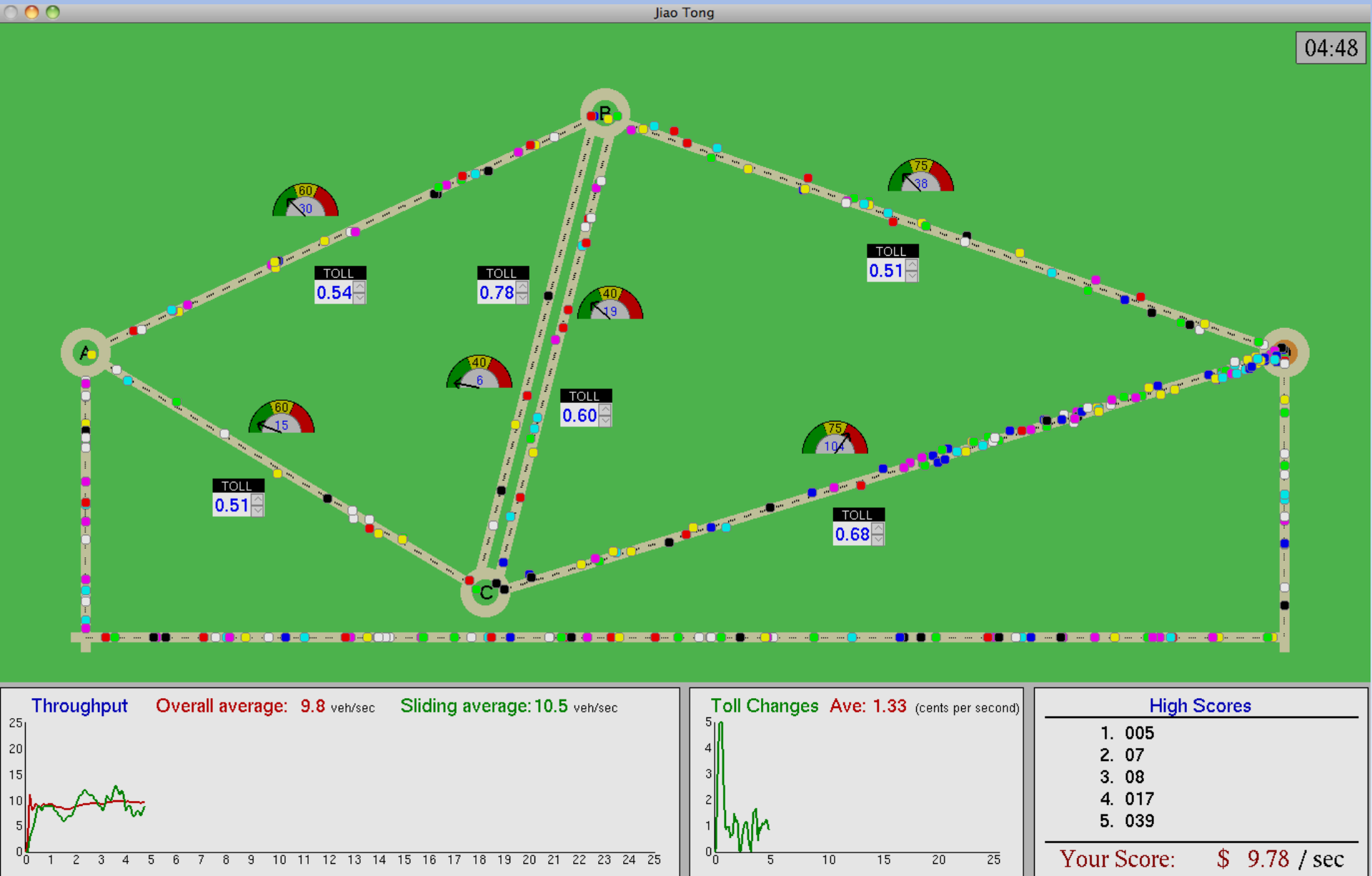
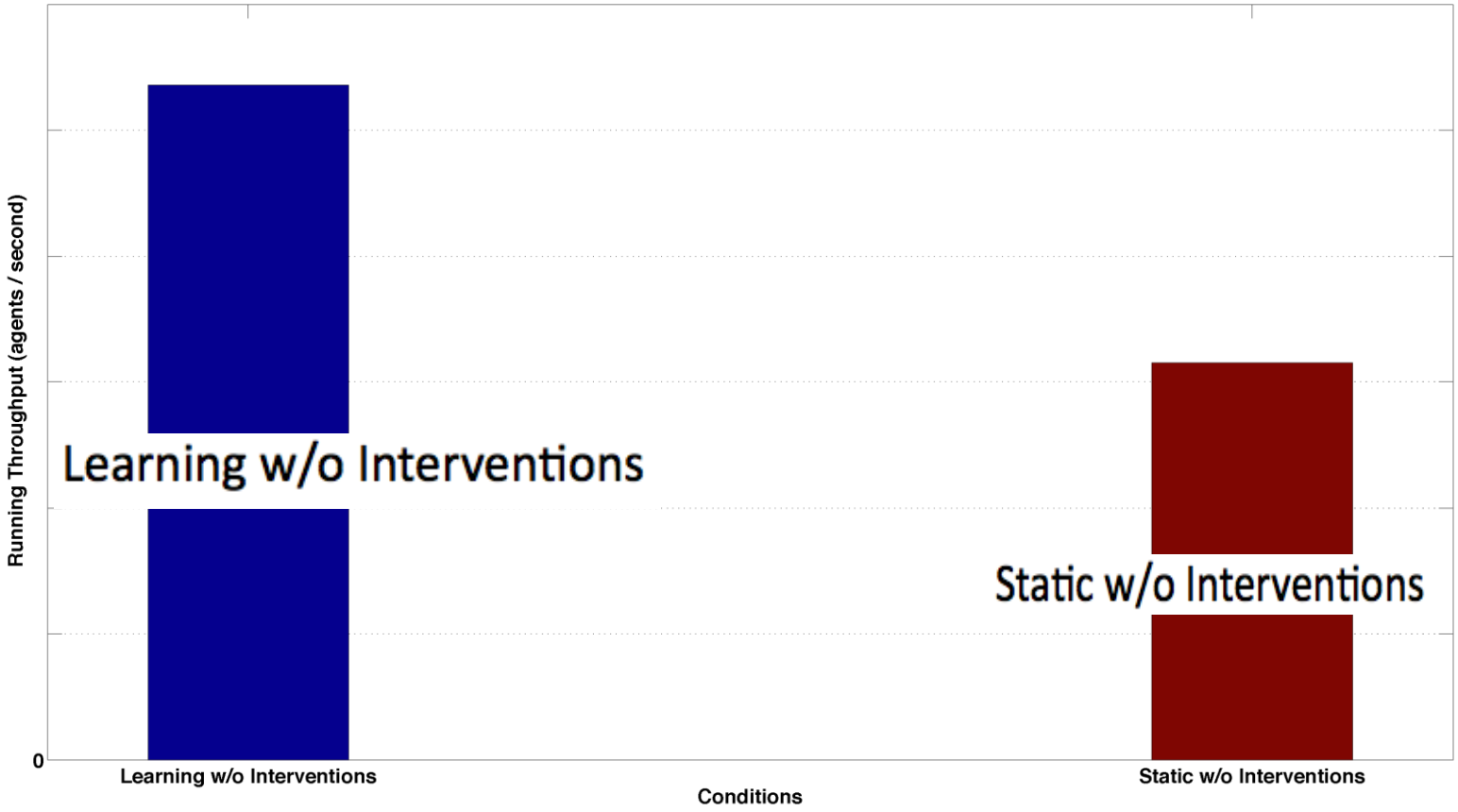
Regulating MAS with Unlimited Interventions



Hypothesis 1 (Unlimited Interventions)



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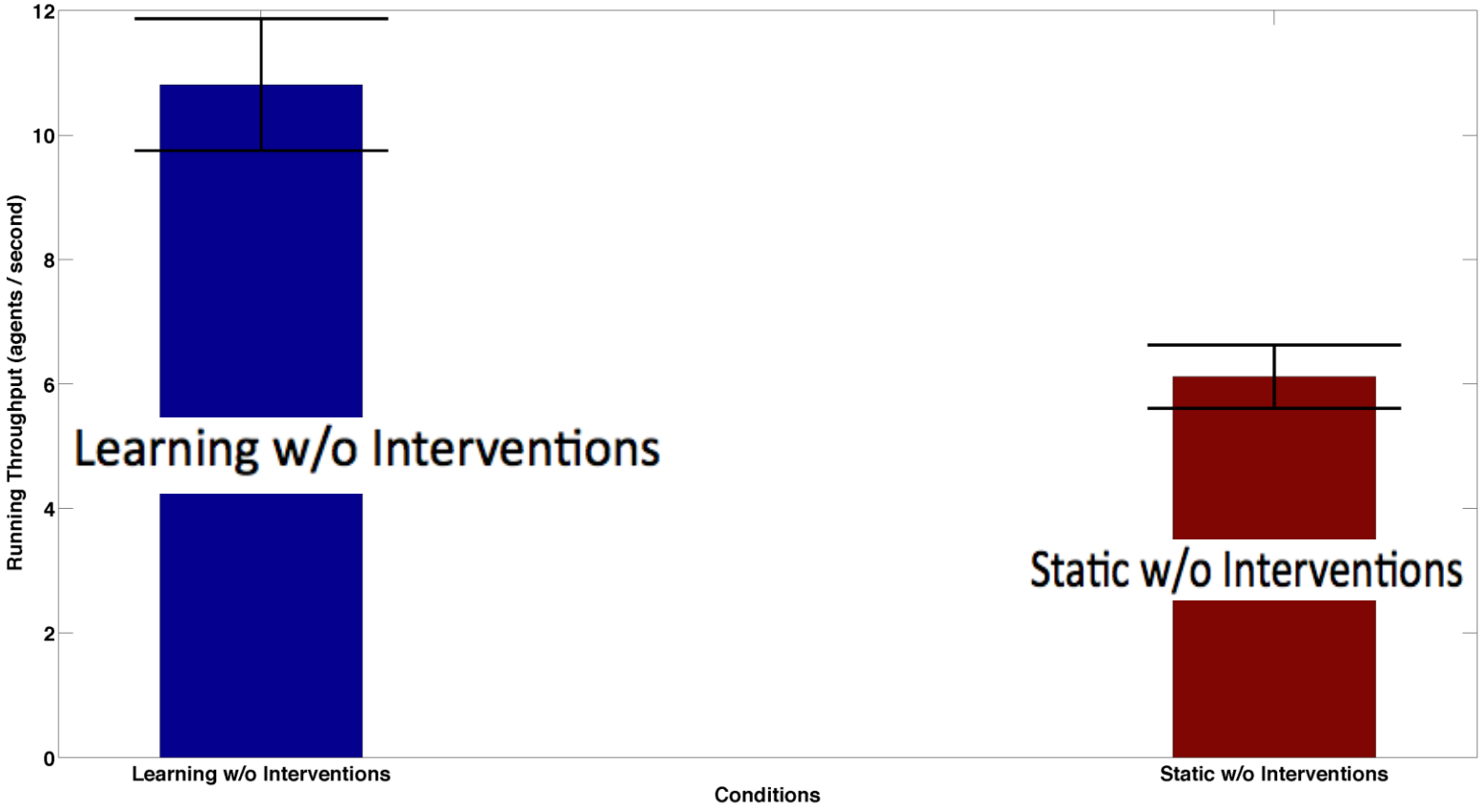

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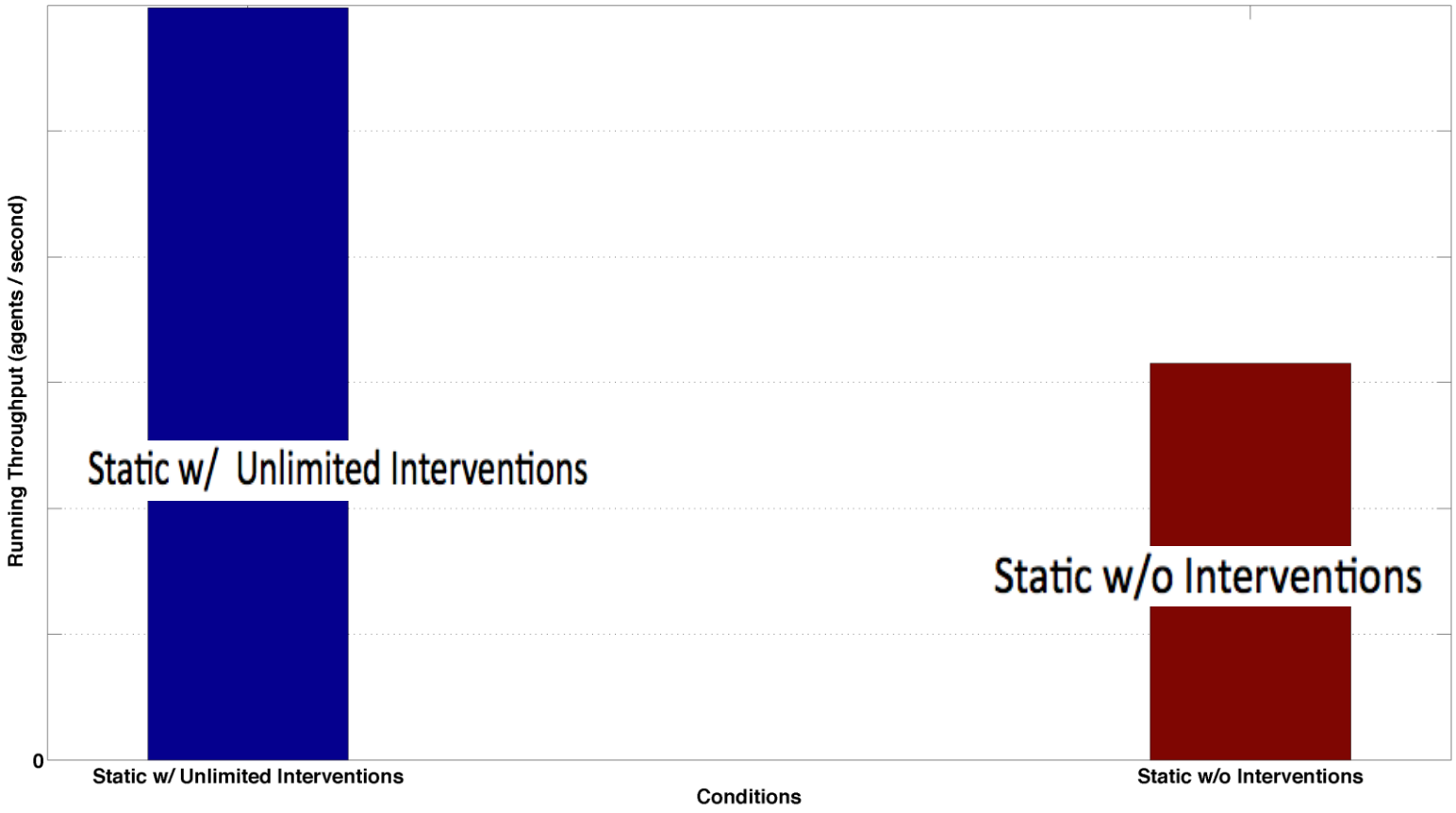

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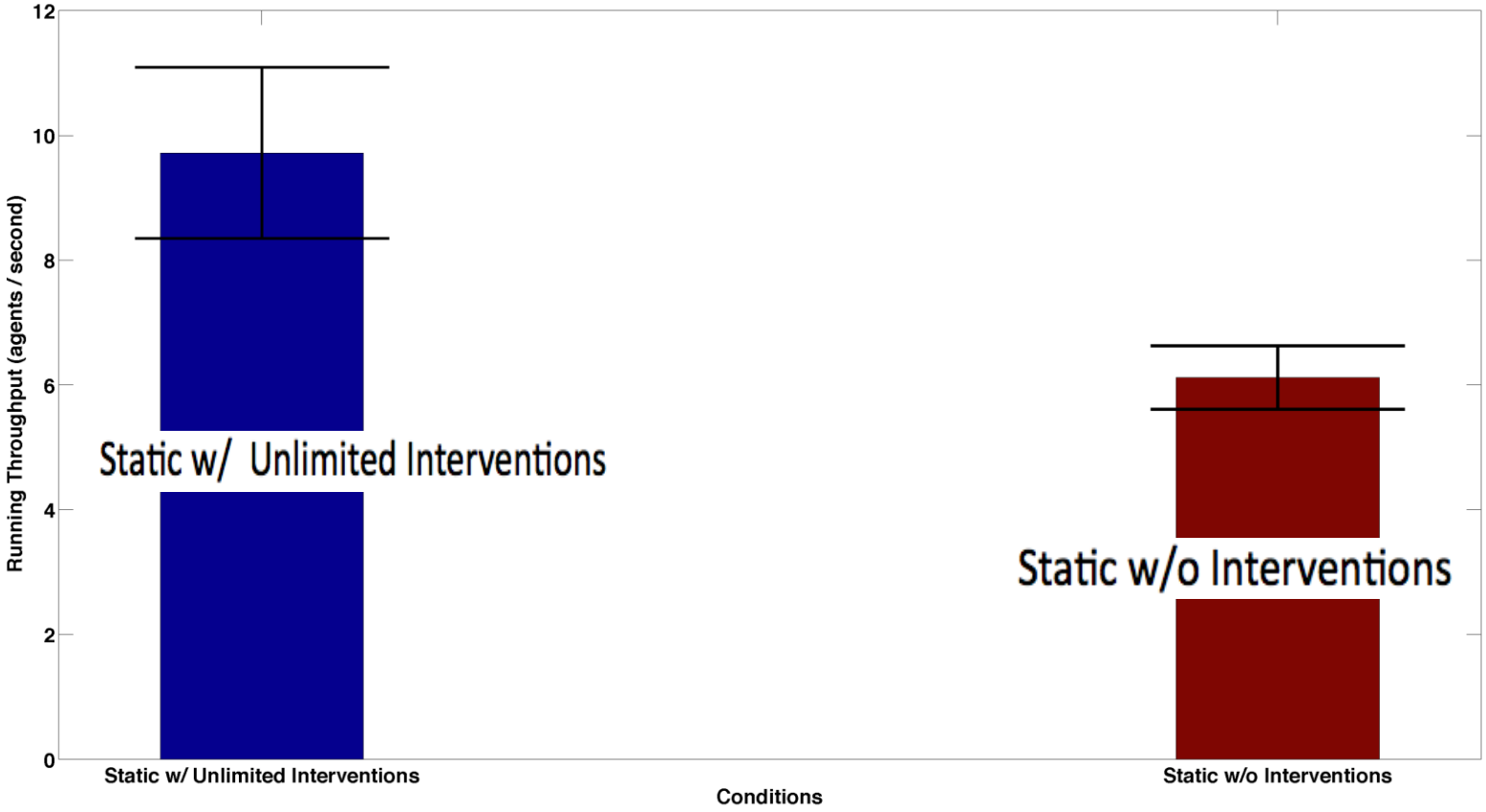

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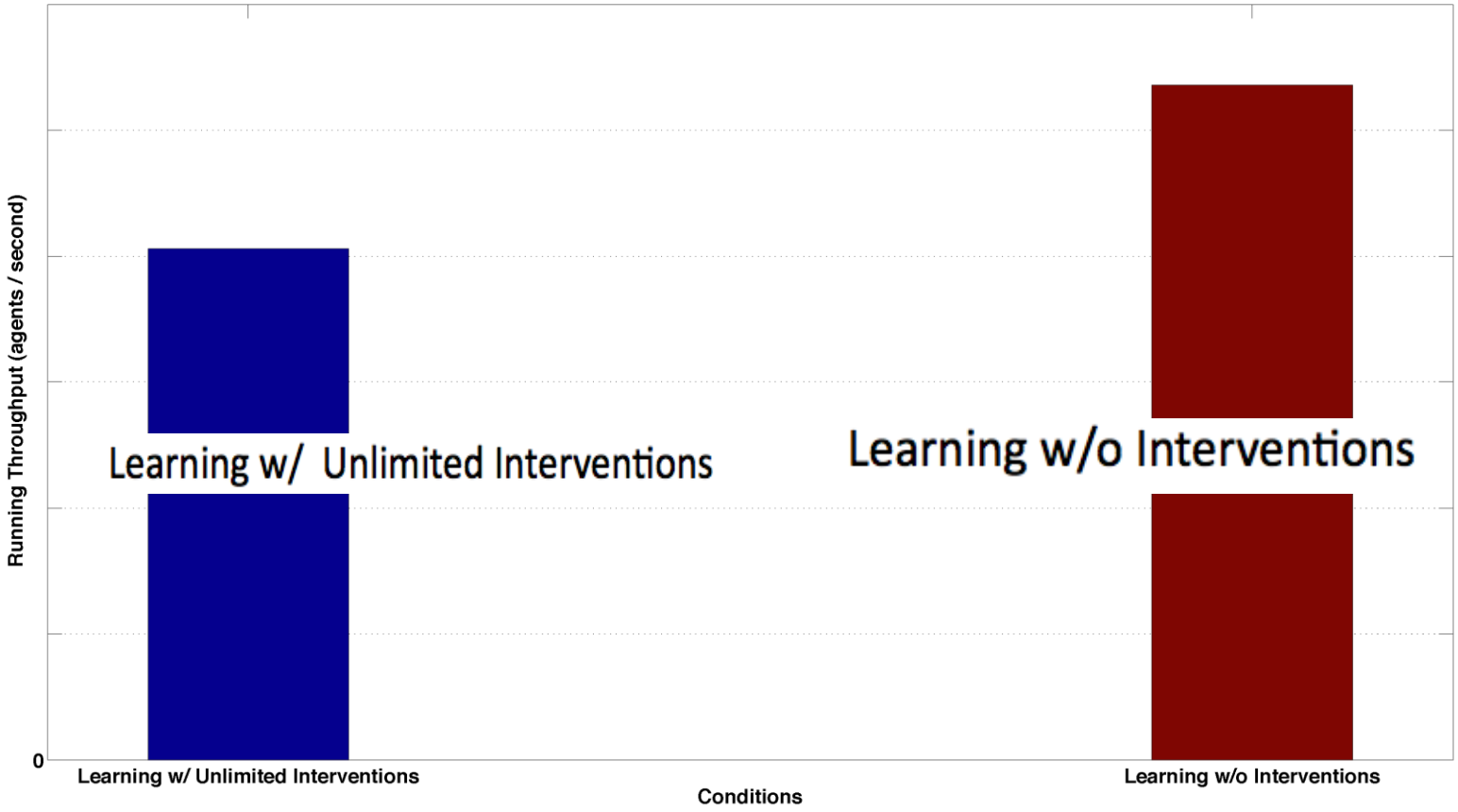

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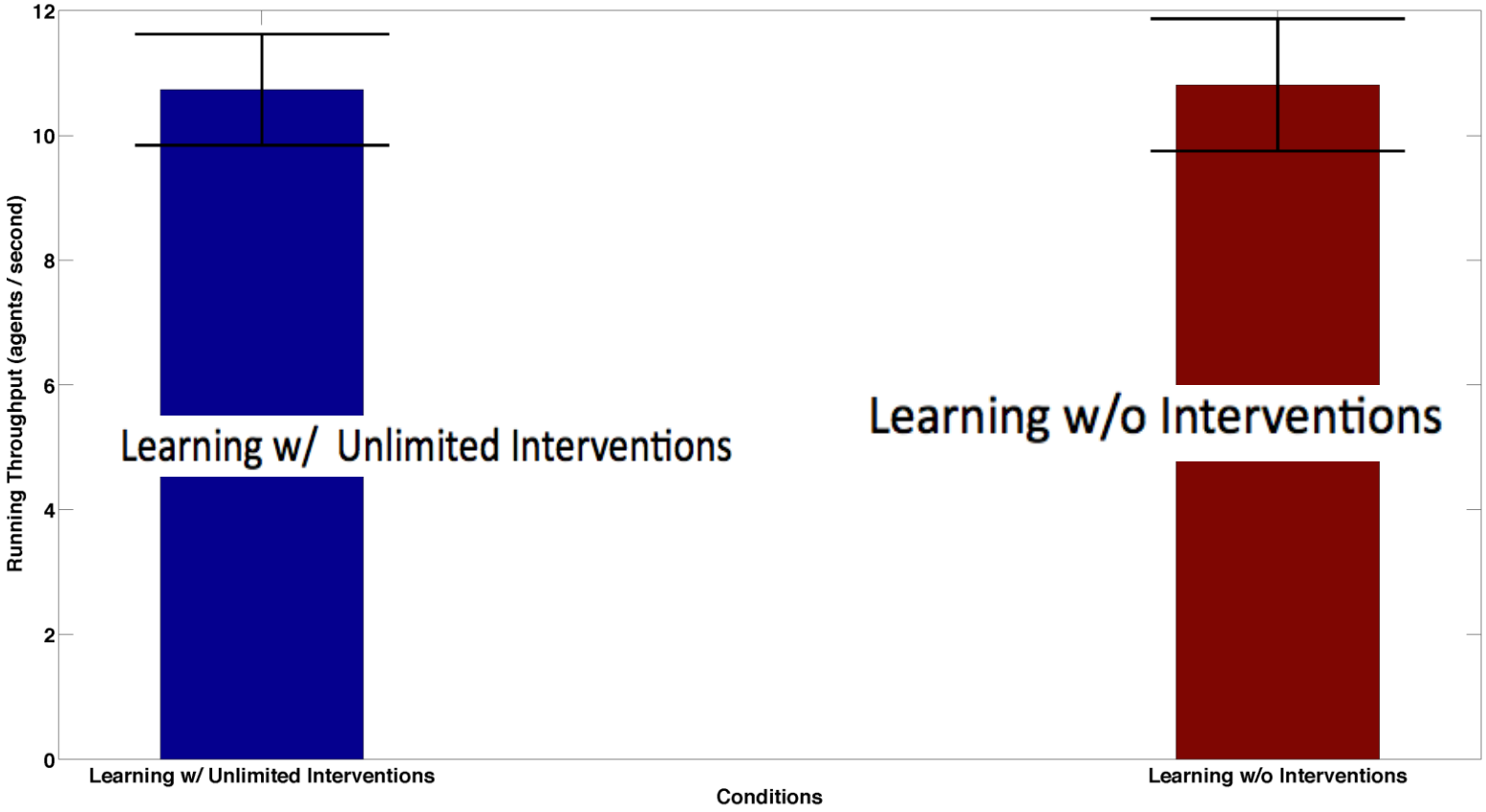

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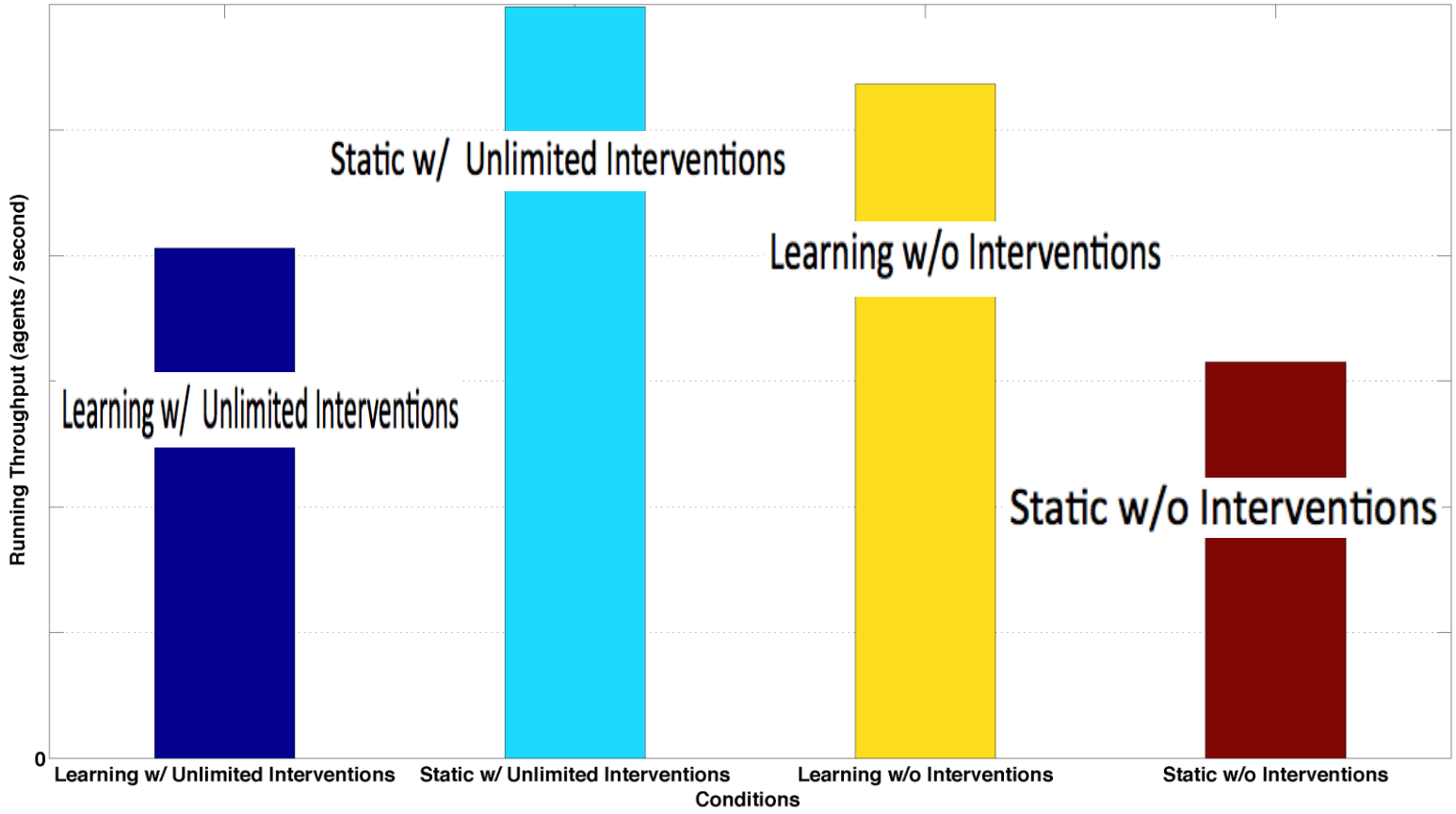

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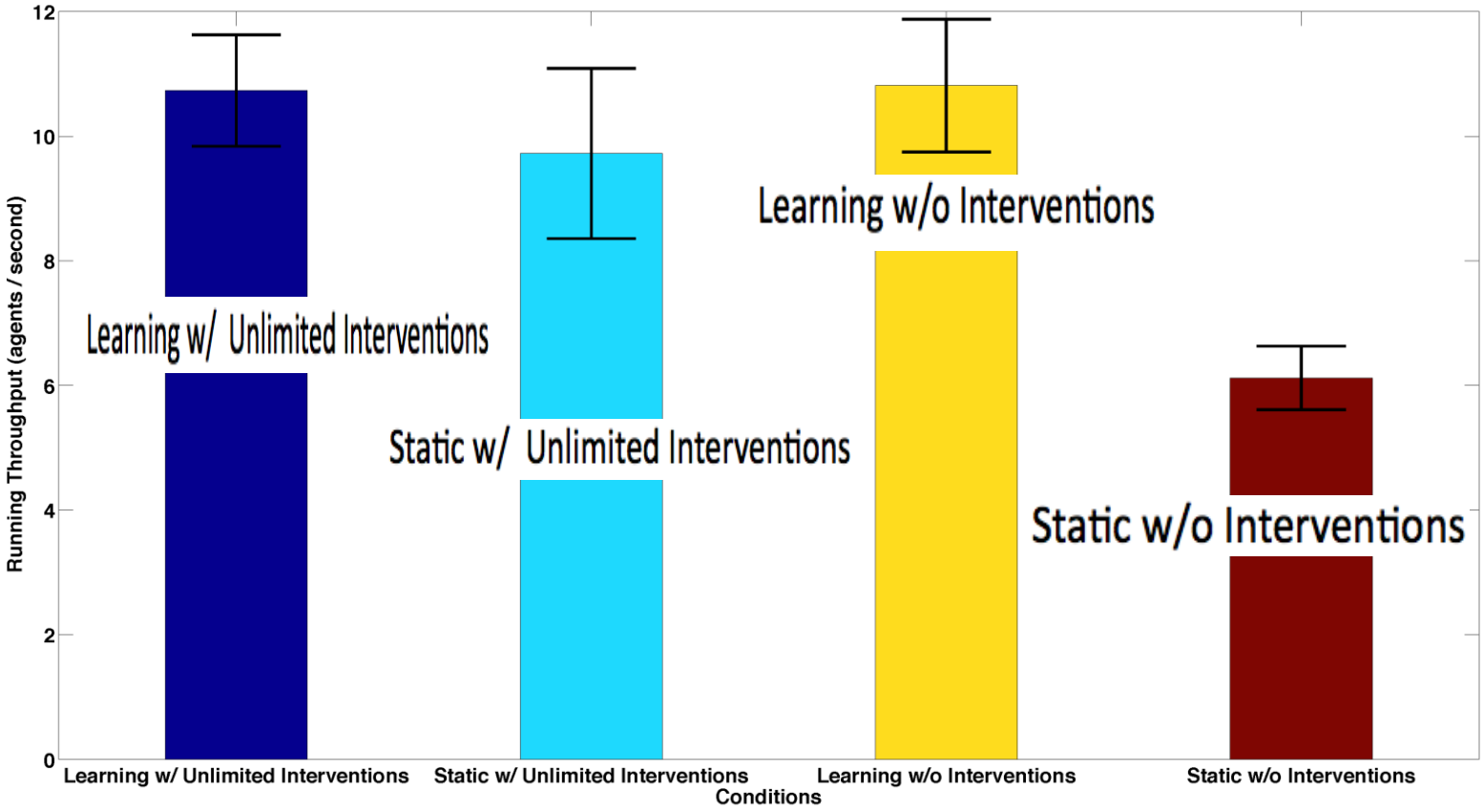
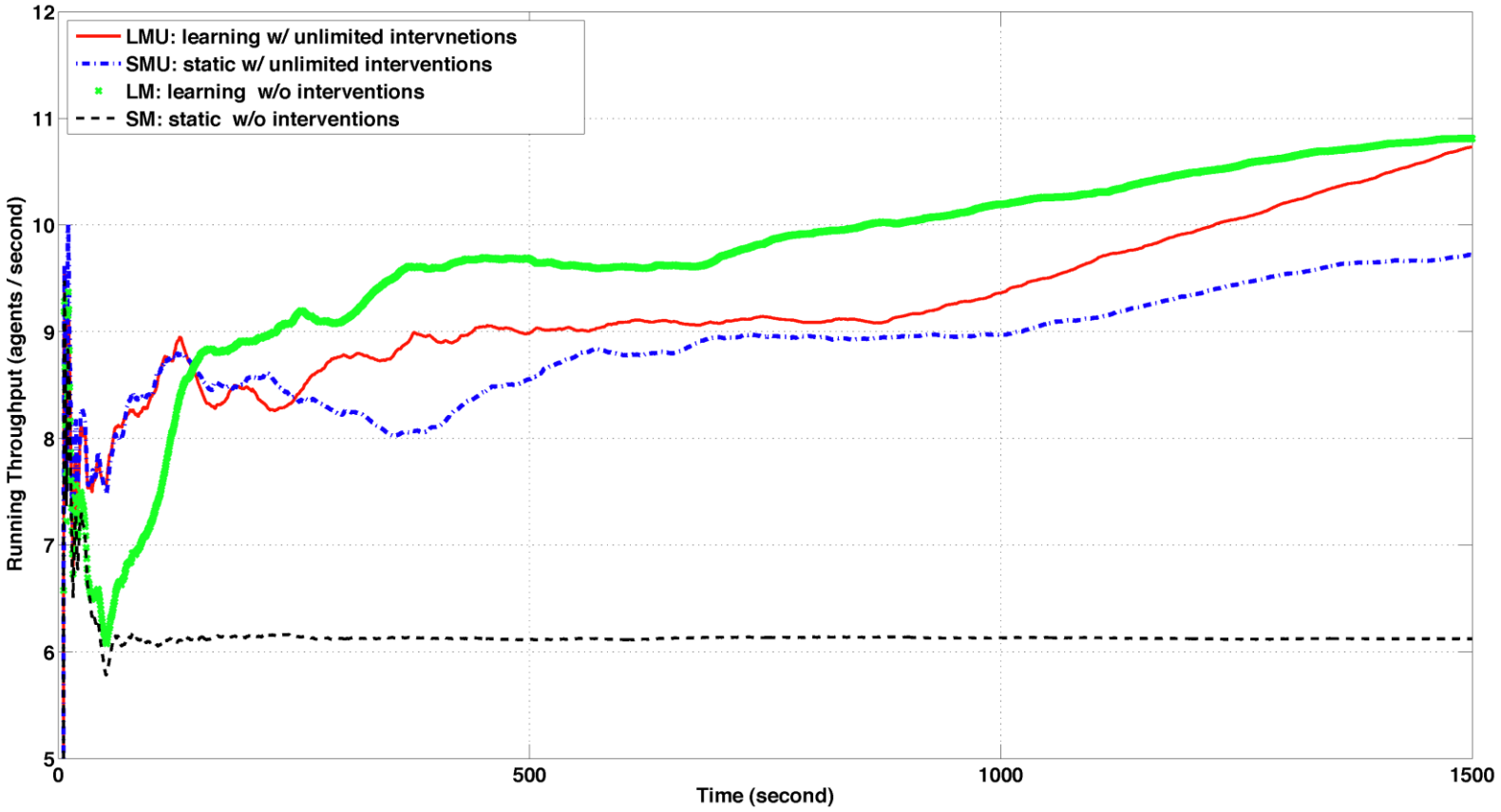


Running Throughput Over Time



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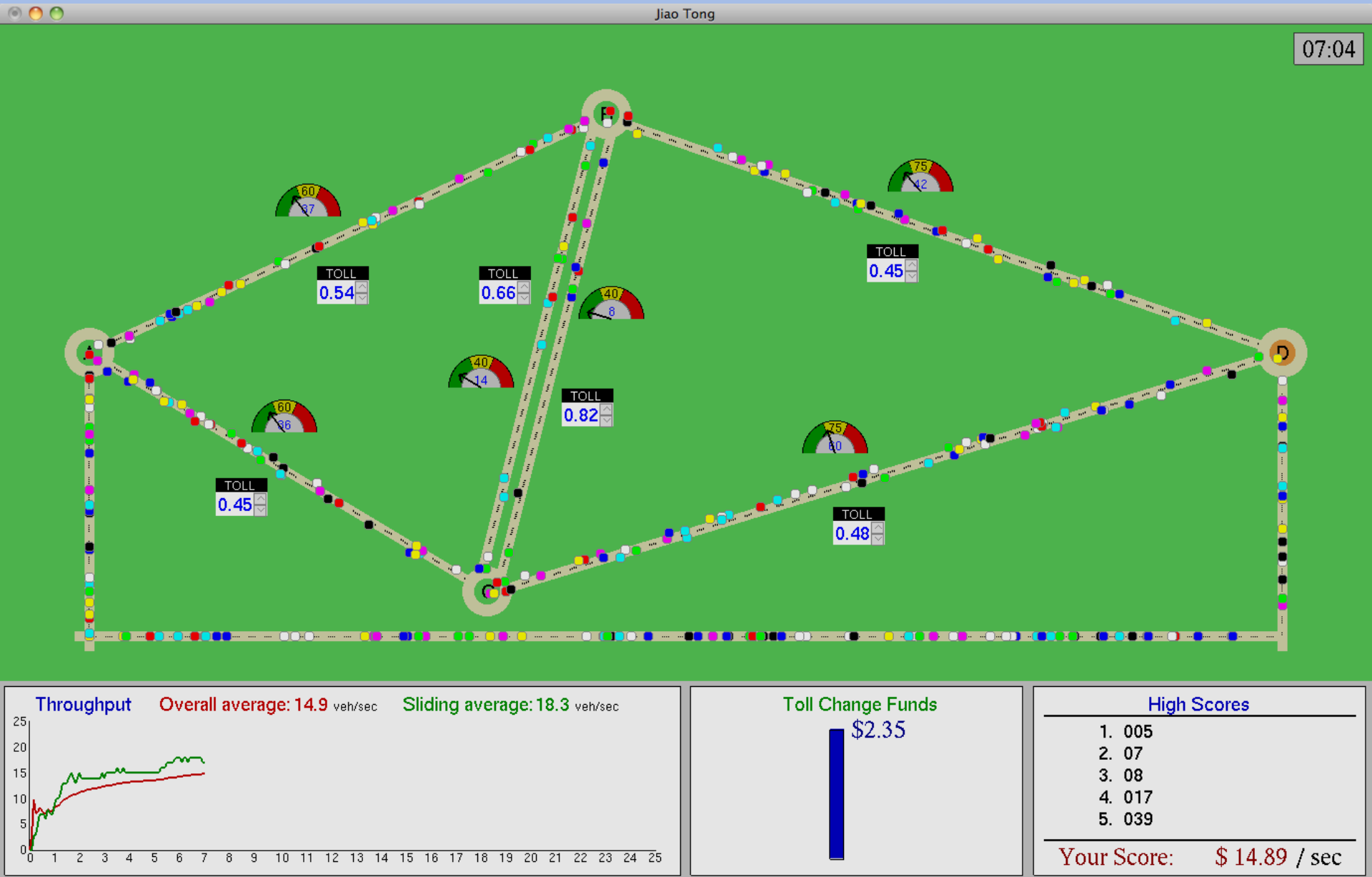
Regulating MAS with Limited Interventions



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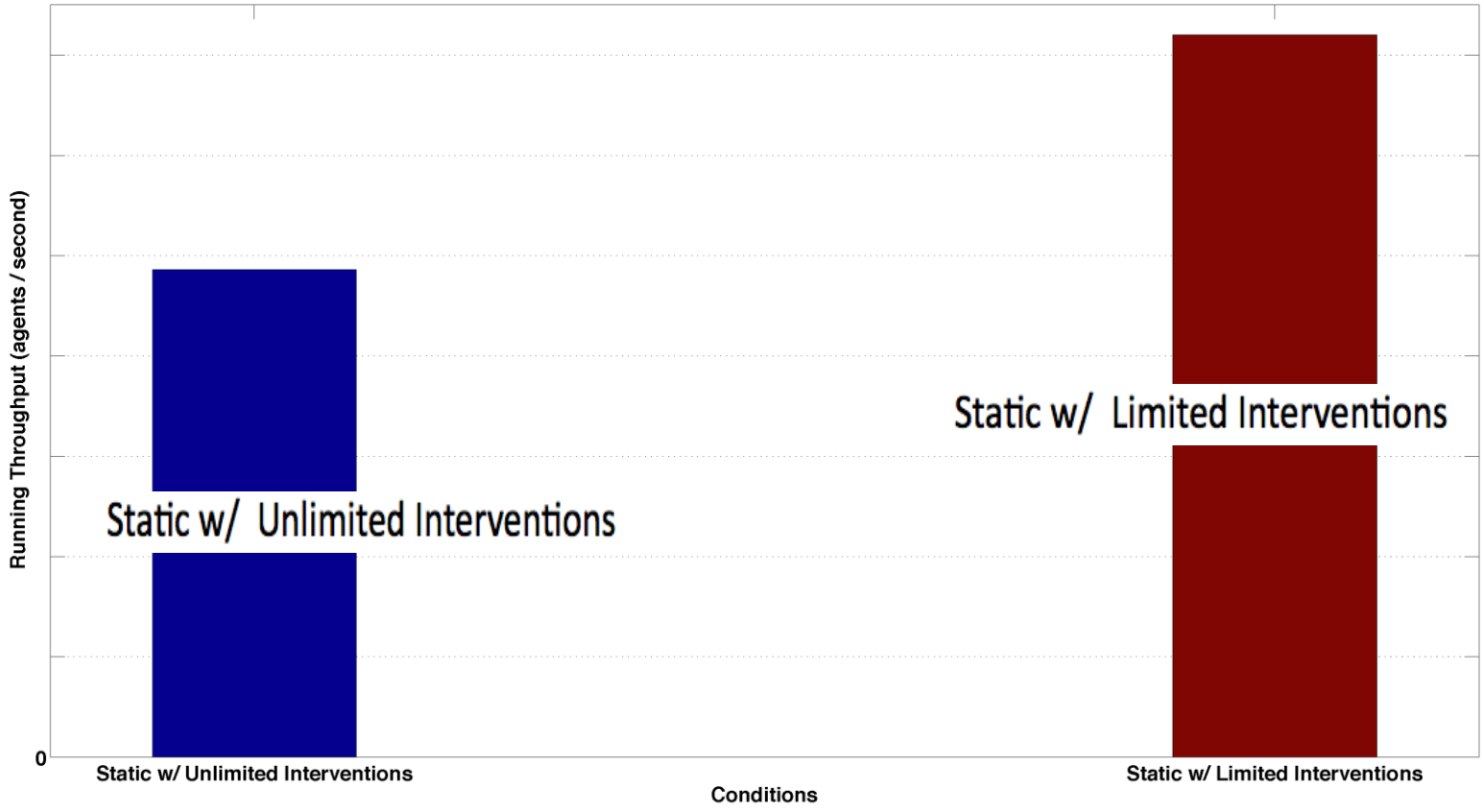

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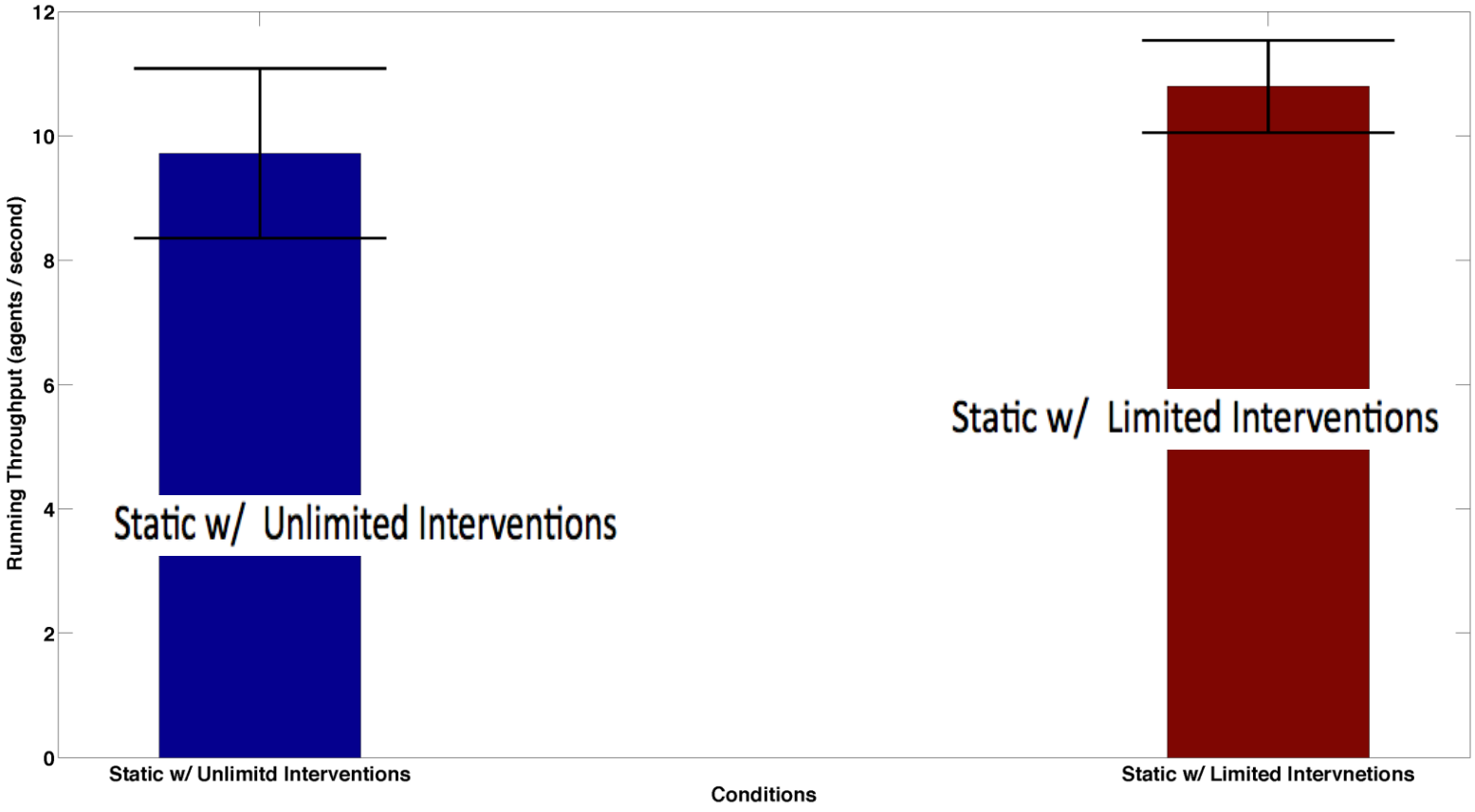

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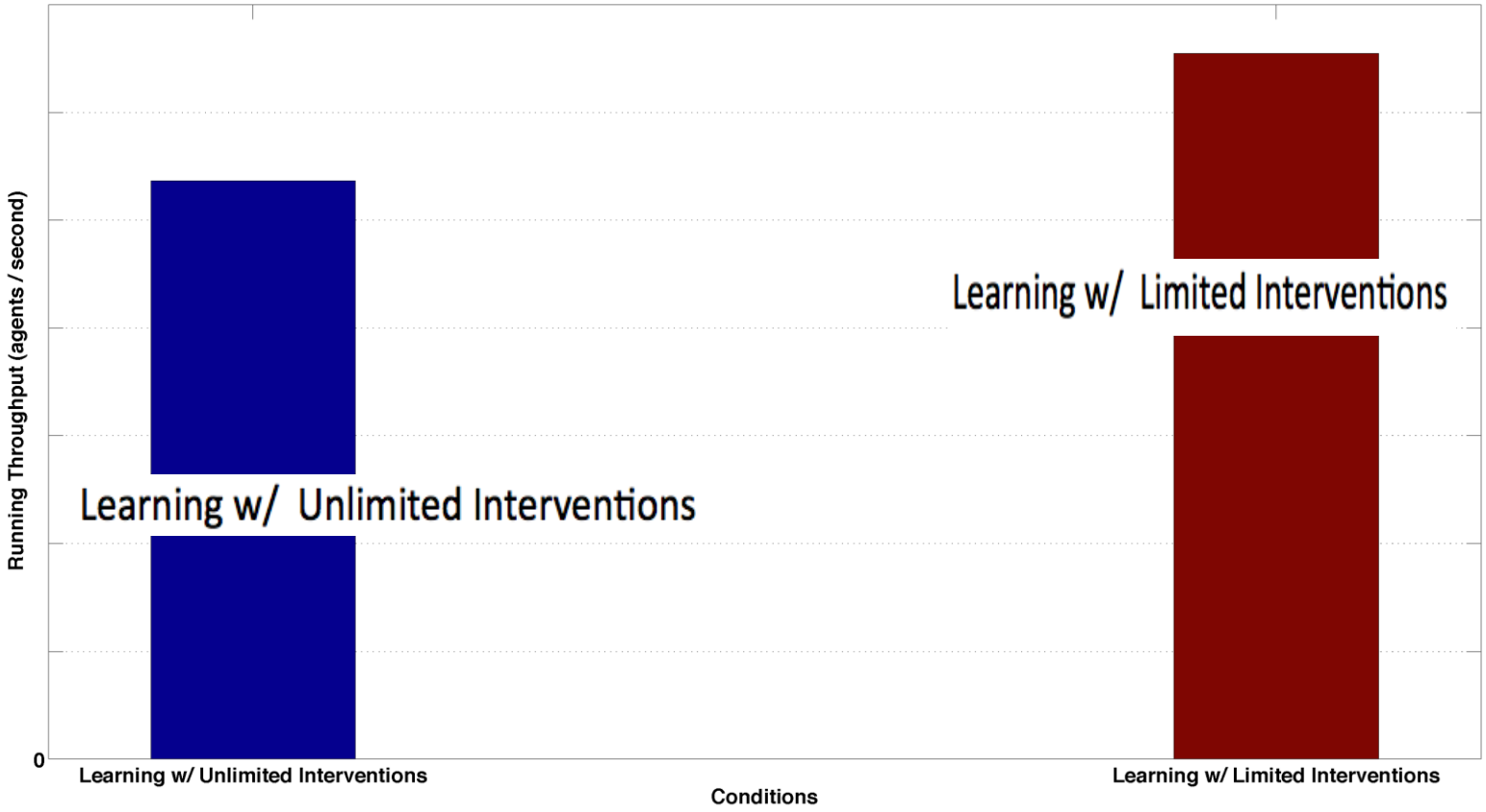

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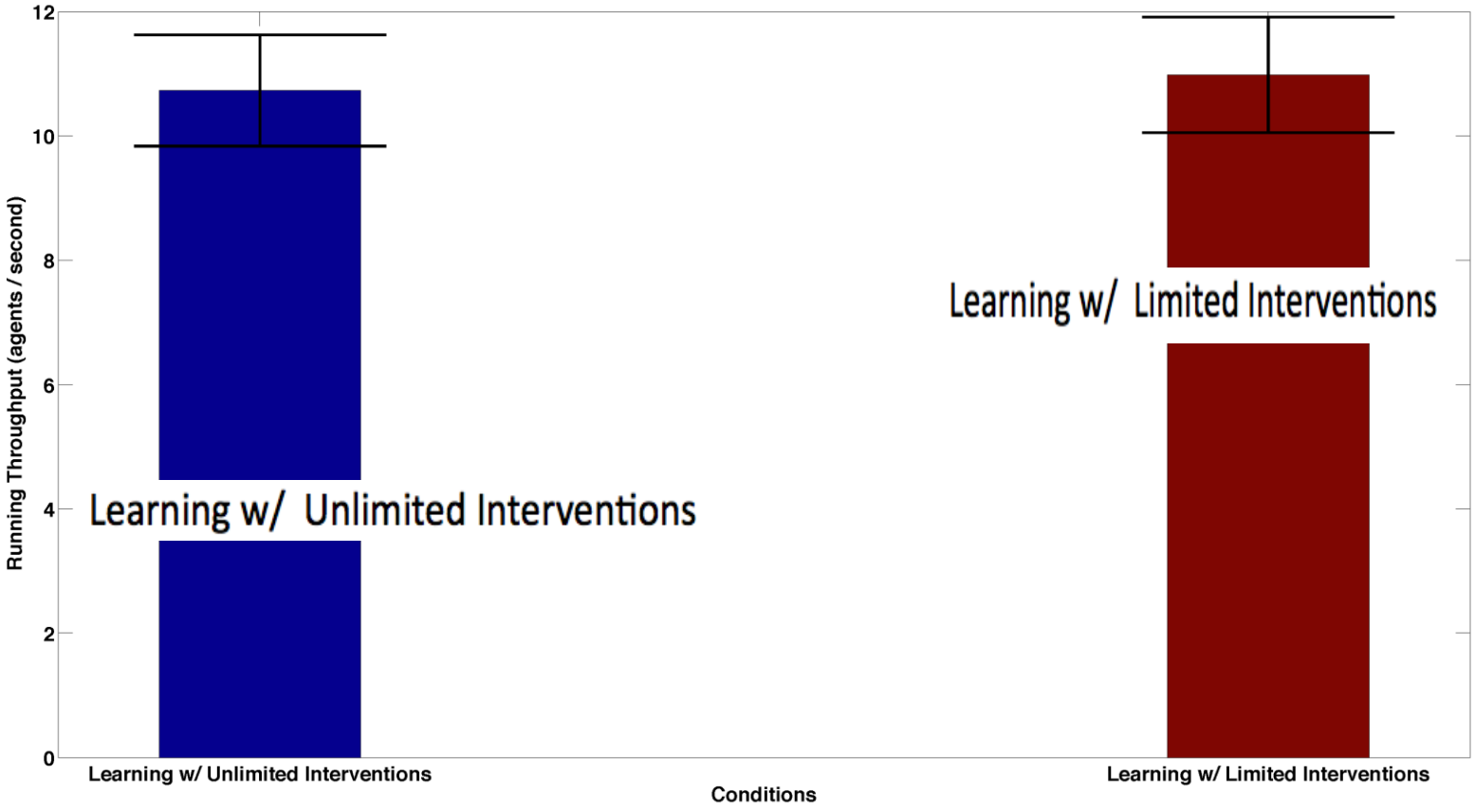

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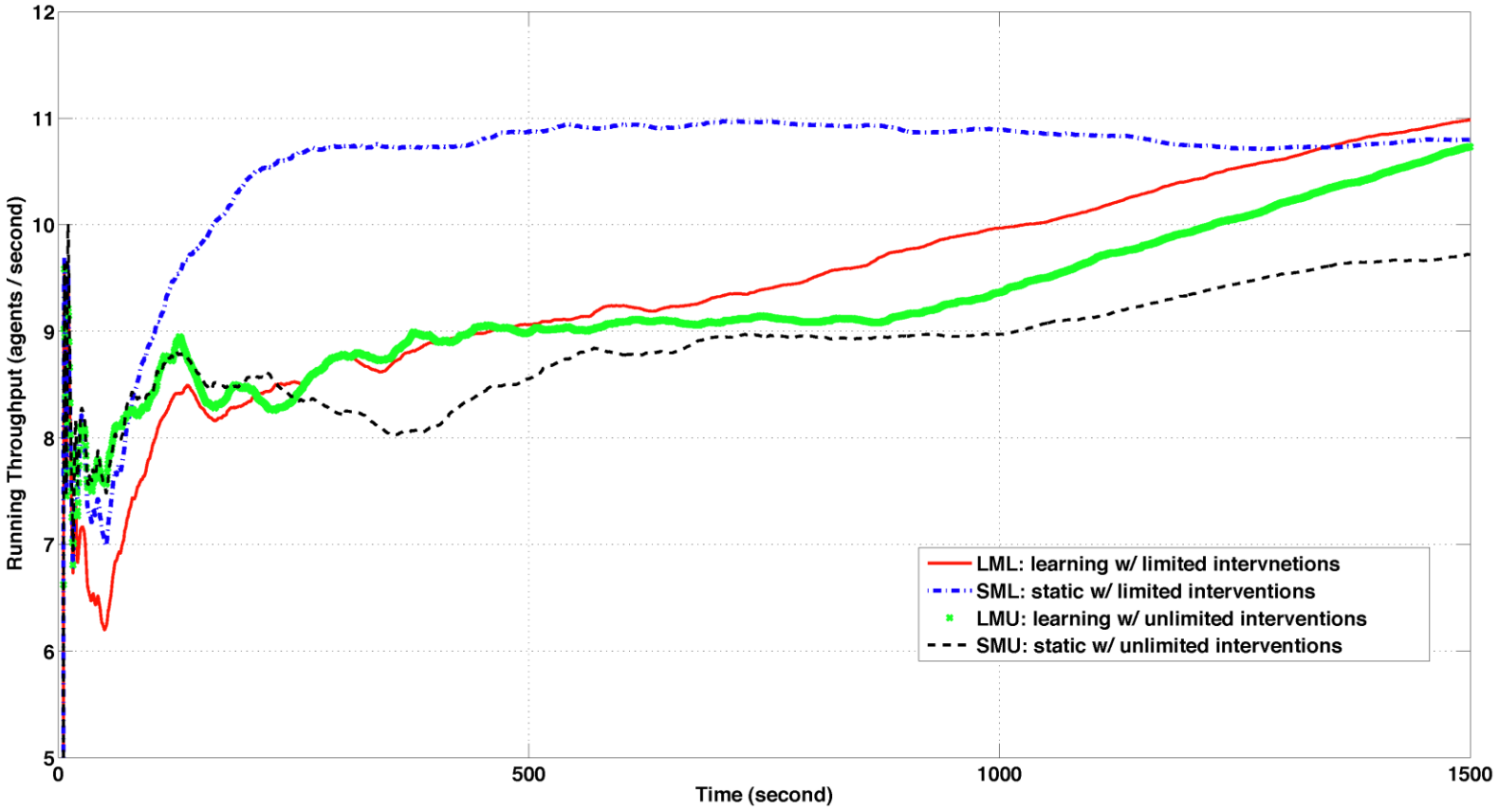

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Conclusion

- Without interventions:
  - learning > static
- With unlimited interventions:
  - static: ↑
  - learning: =
- People are better at regulating static agents than learning agents.
- With limited interventions:
  - static : short term ↑ long term =
  - learning : =

Future Work

- How to help regulators improve their understandings of agents' behavior?

- How to help them create better interventions?

QUESTIONS
ANSWERS

thank you!