Multi-agent Deep Reinforcement Learning for Pursuit Game

AE 598 - Reinforcement Learning
April 25, 2023

Maulik Bhatt

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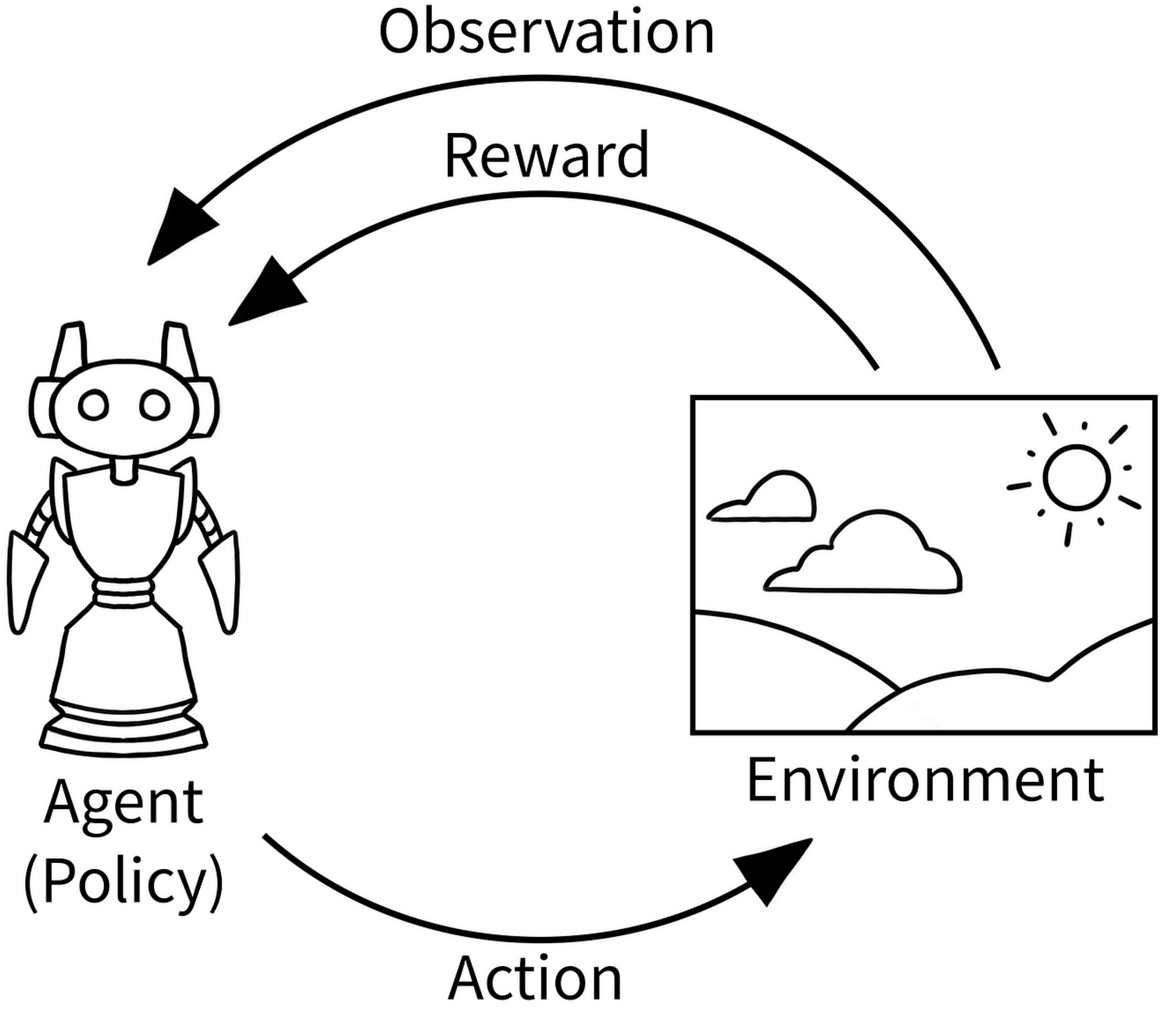

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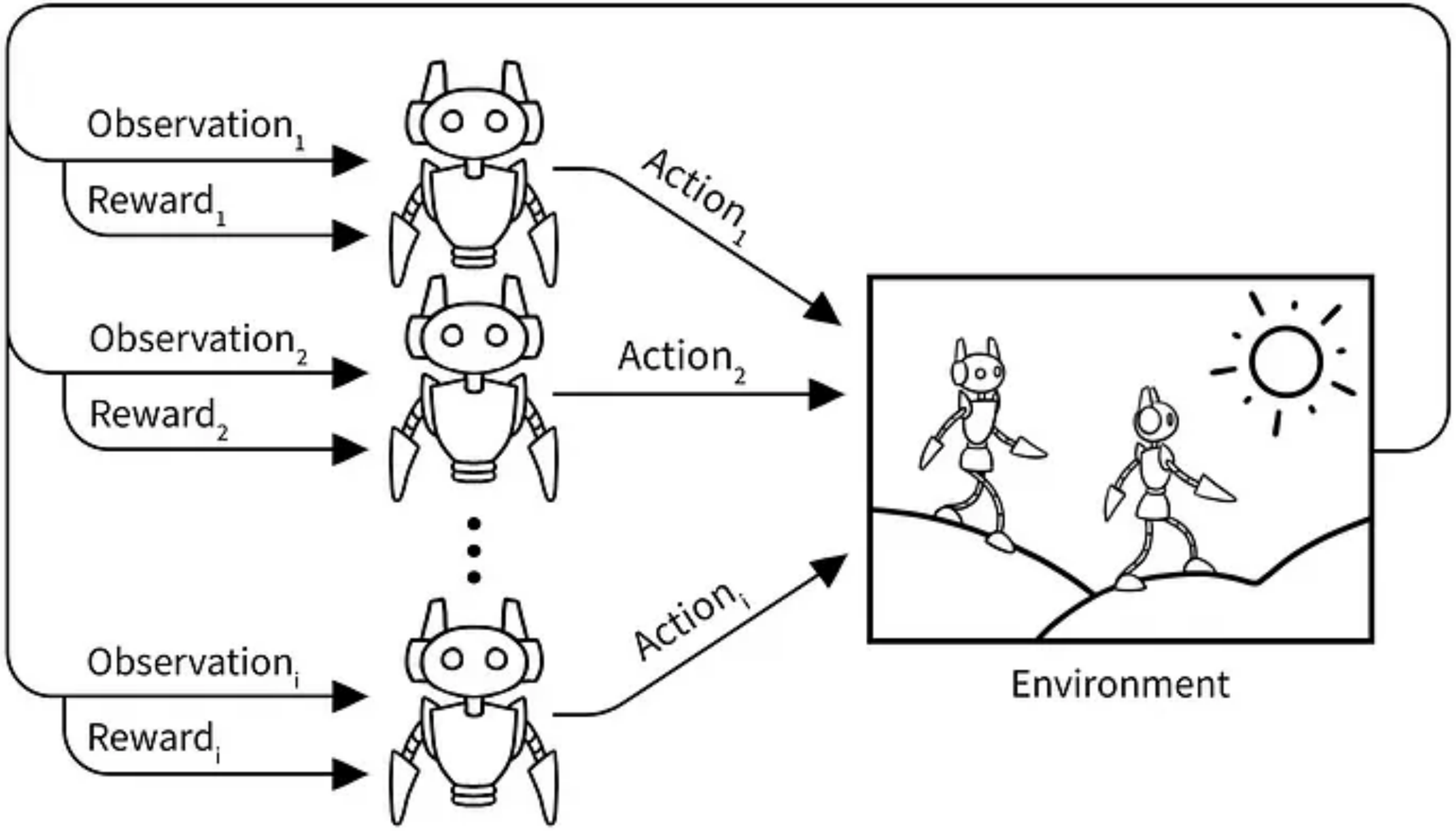

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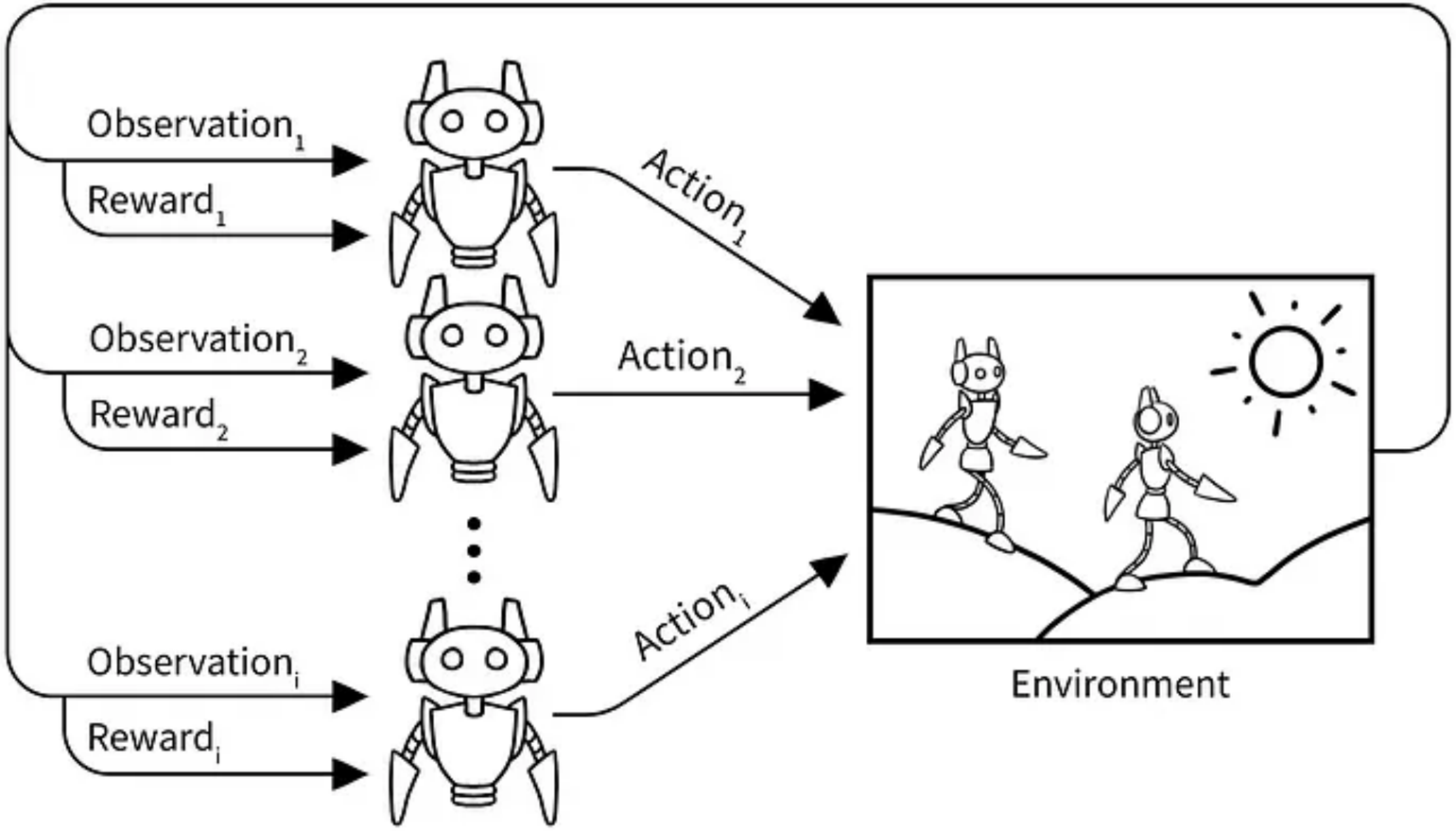

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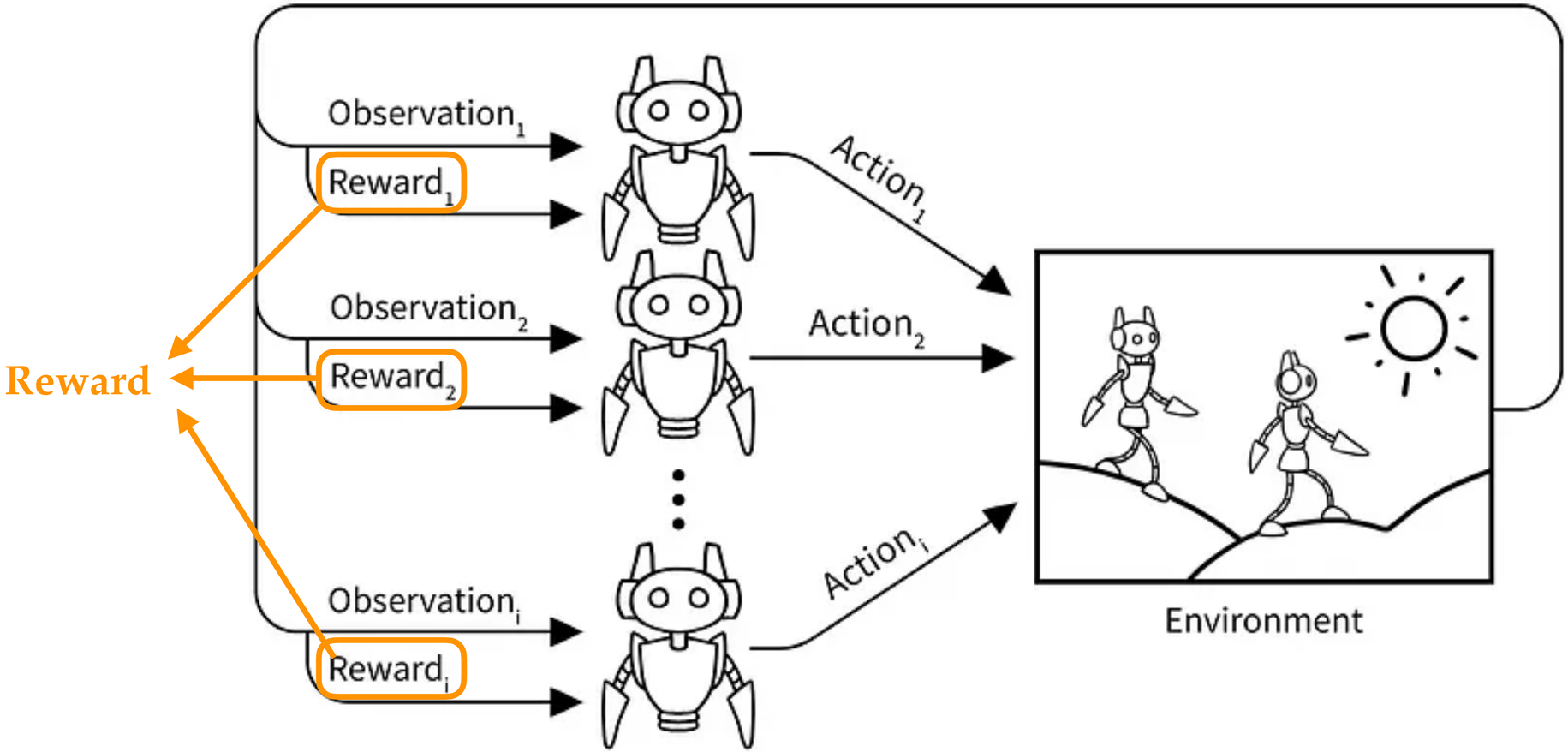

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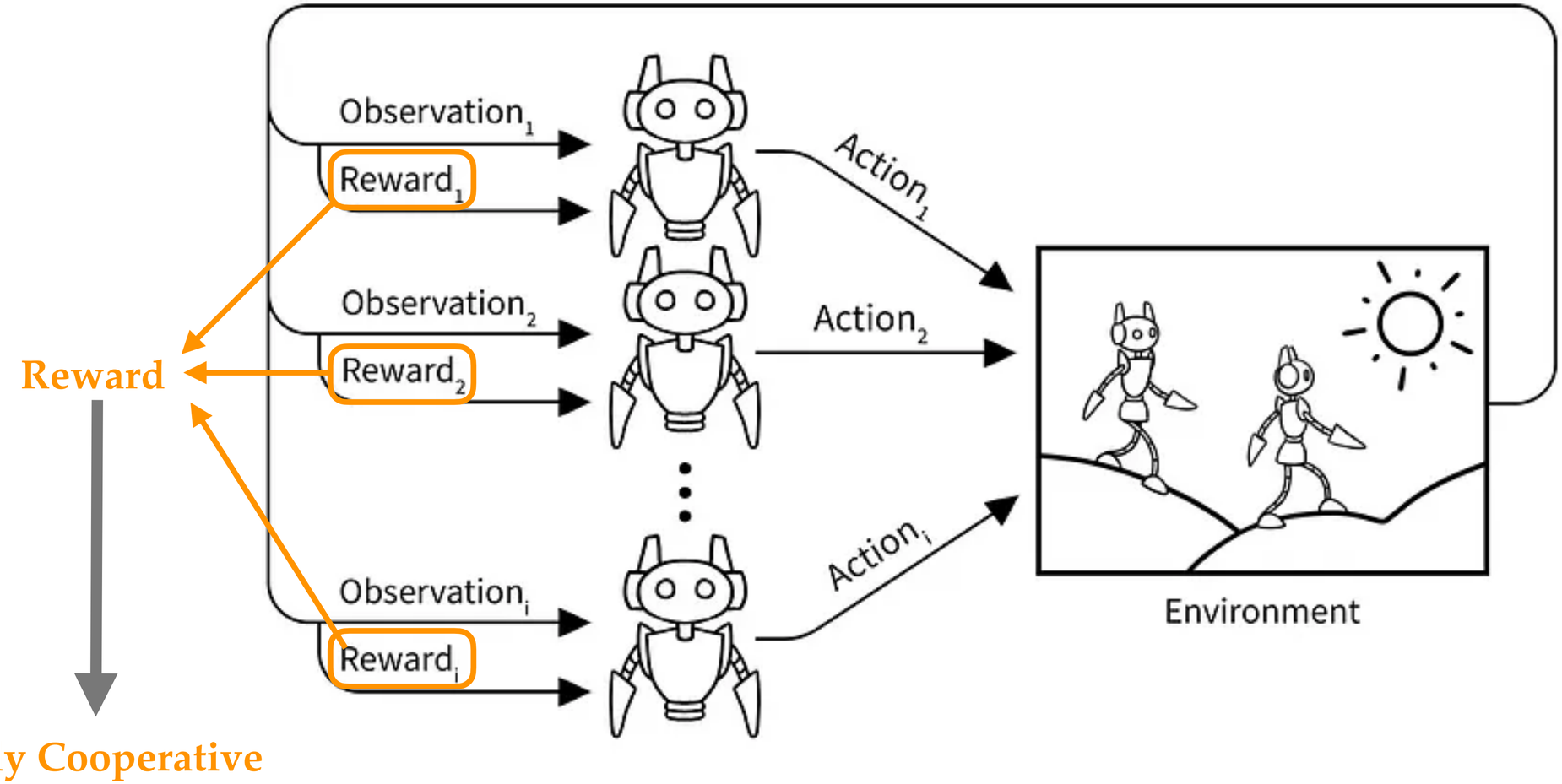

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decentralised partially observable Markov decision process

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$$R_t = \sum_{i=0}^{\infty} \gamma^i r_{t+i}$$

Pursuit Environment [1]

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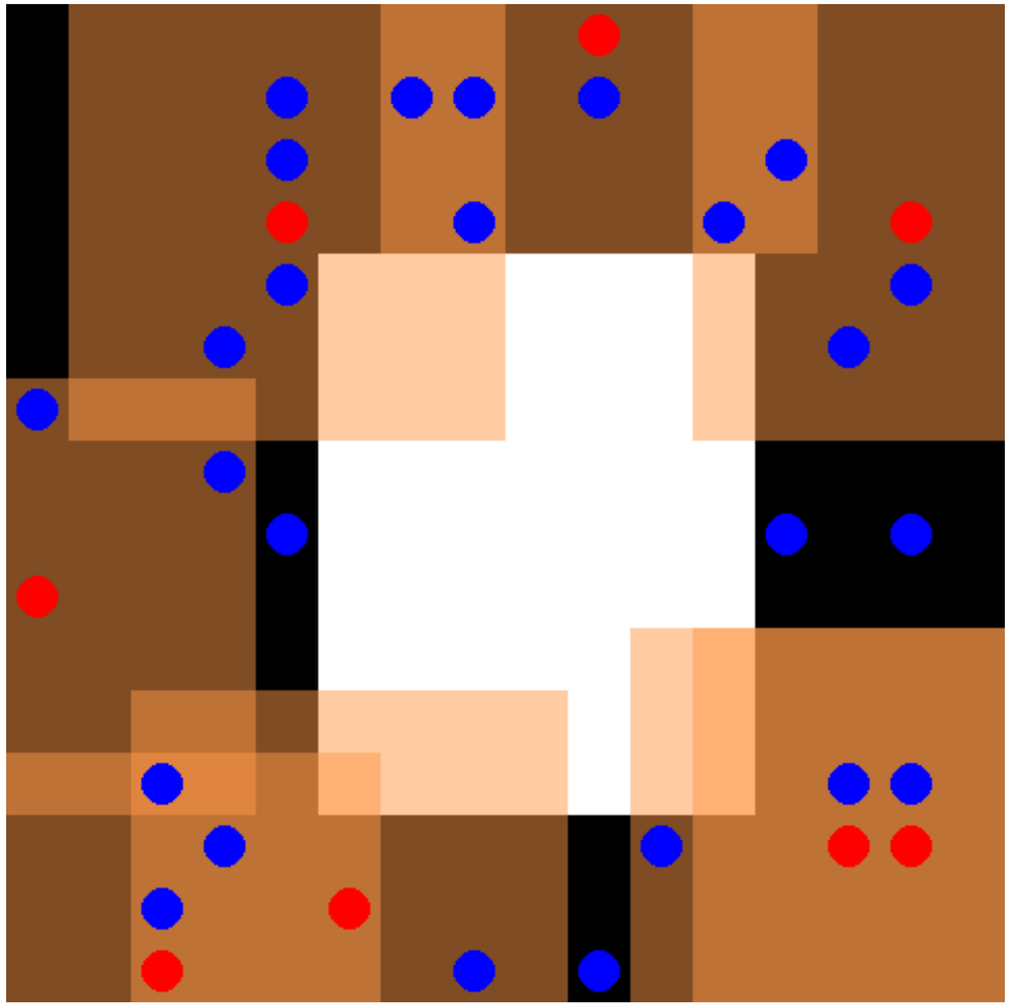

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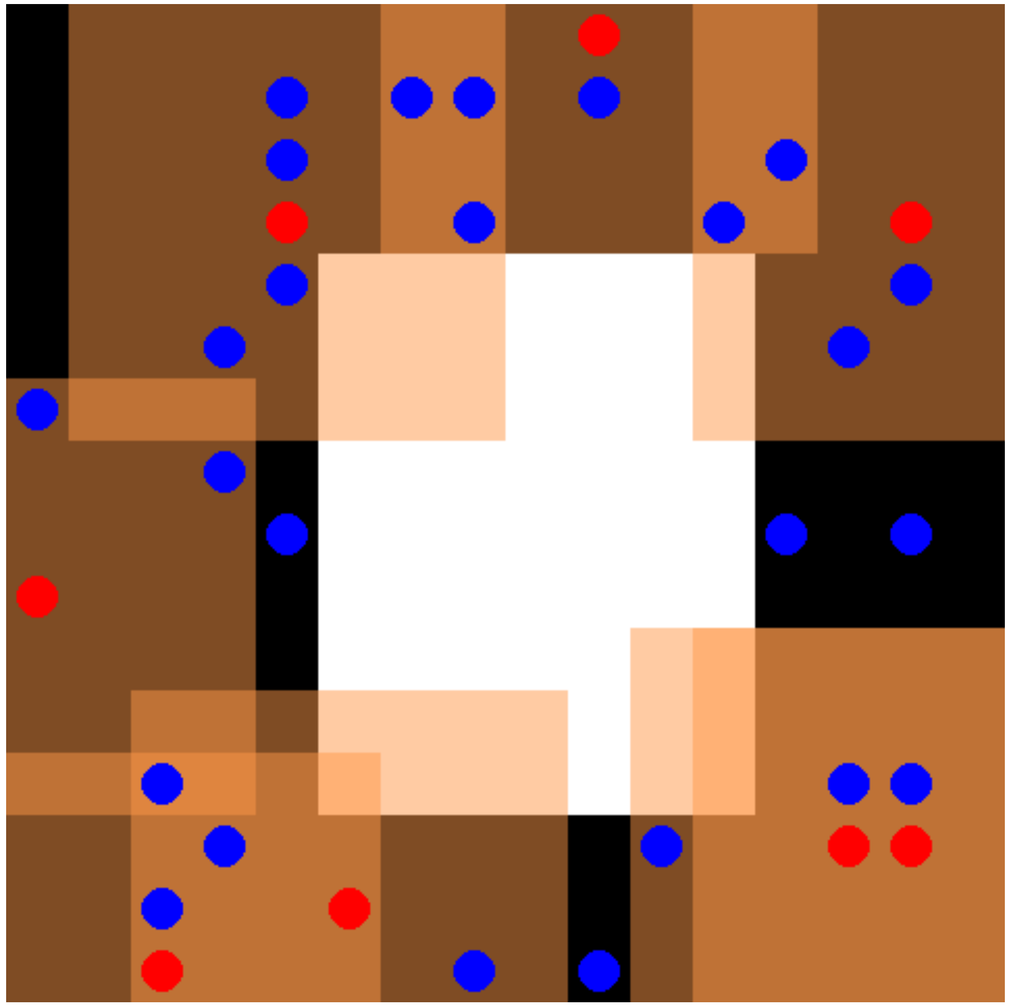


Number of pursuers: 8

Number of evaders: 25

Grid size: 16*16

Observation size: 7*7*3

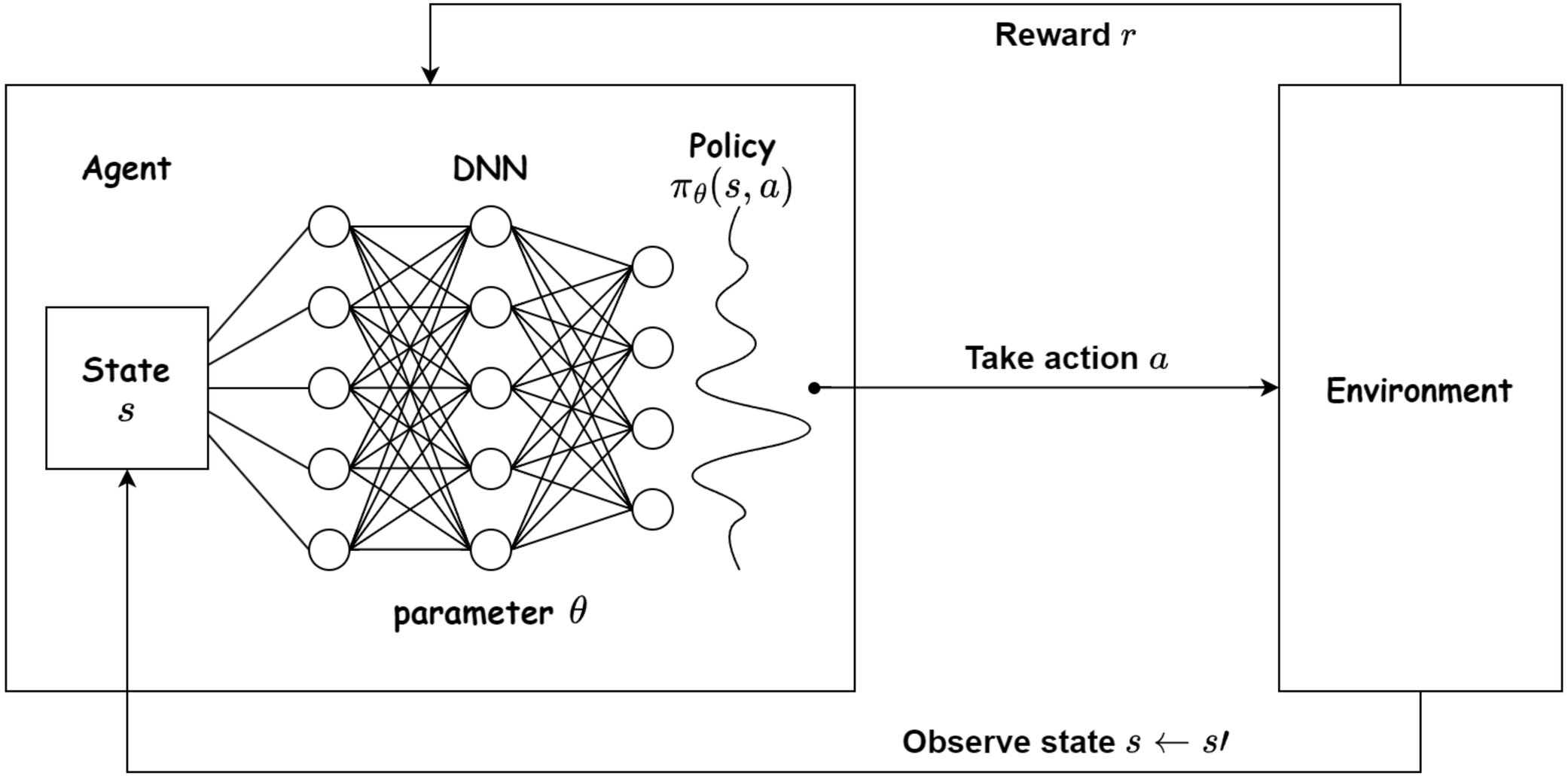
Actions: up, down, left, right, stay

Max Cycles: 500

Deep Q-Learning

Source: https://wikidocs.net/images/page/169312/20_Q_Network.png

Deep Q-Learning



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Independent Q-learning (IQL) decomposes a multi-agent problem into a collection of simultaneous single-agent problems that share the same environment.

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Each learning agent is an *independent learner* without considering its influence into the environment of other agents

Independent DQN-1

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- Define the networks and agents

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- Initialize separate networks for each agent

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Results

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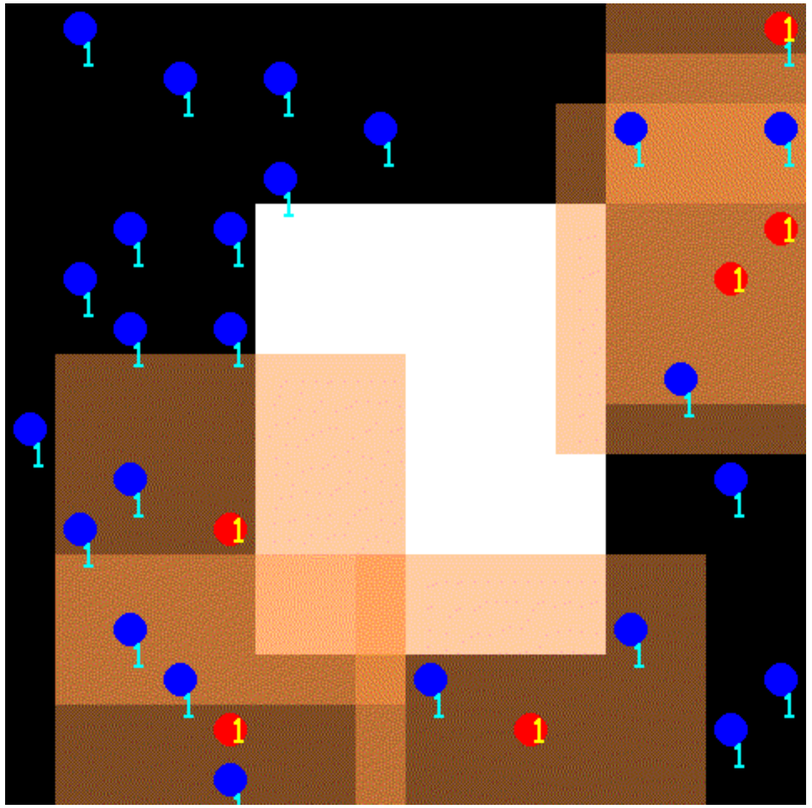

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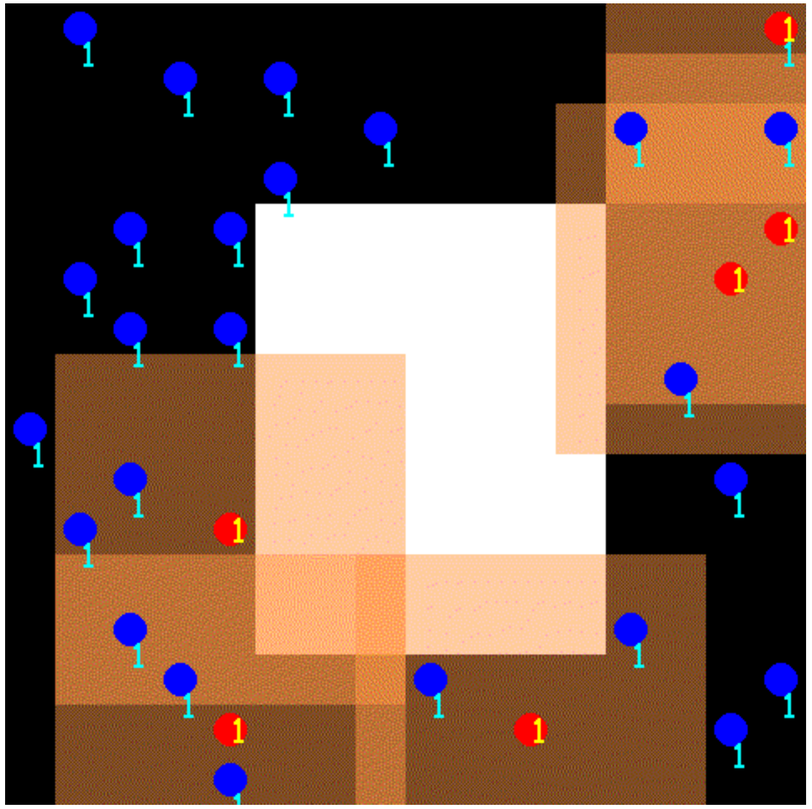

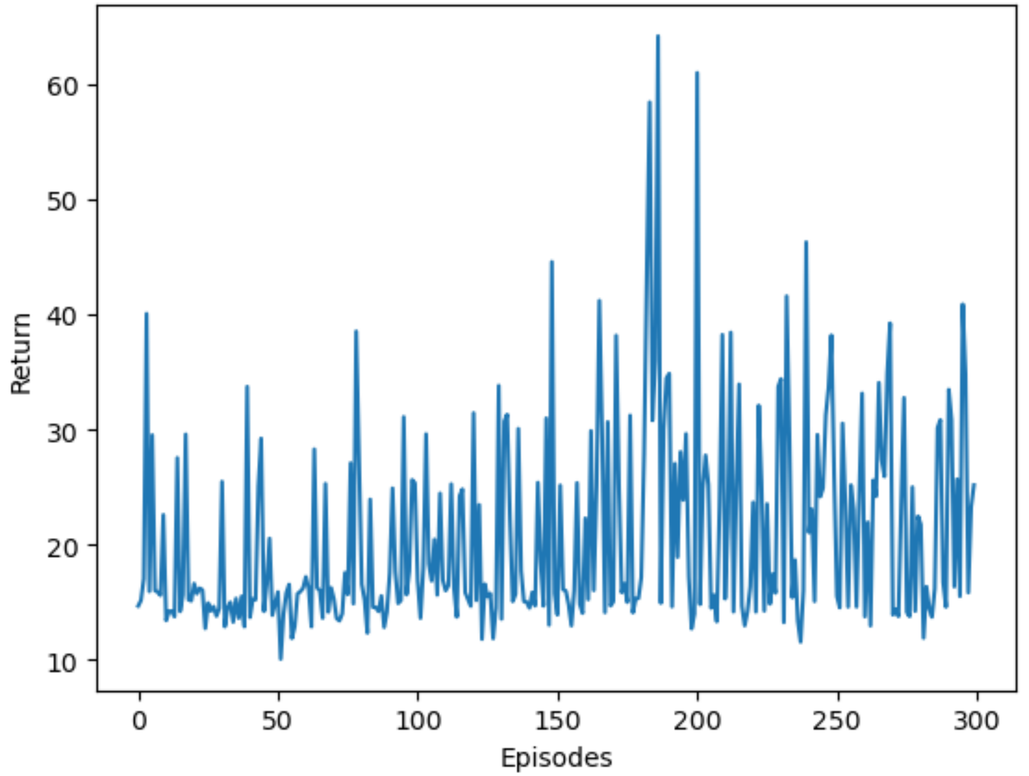

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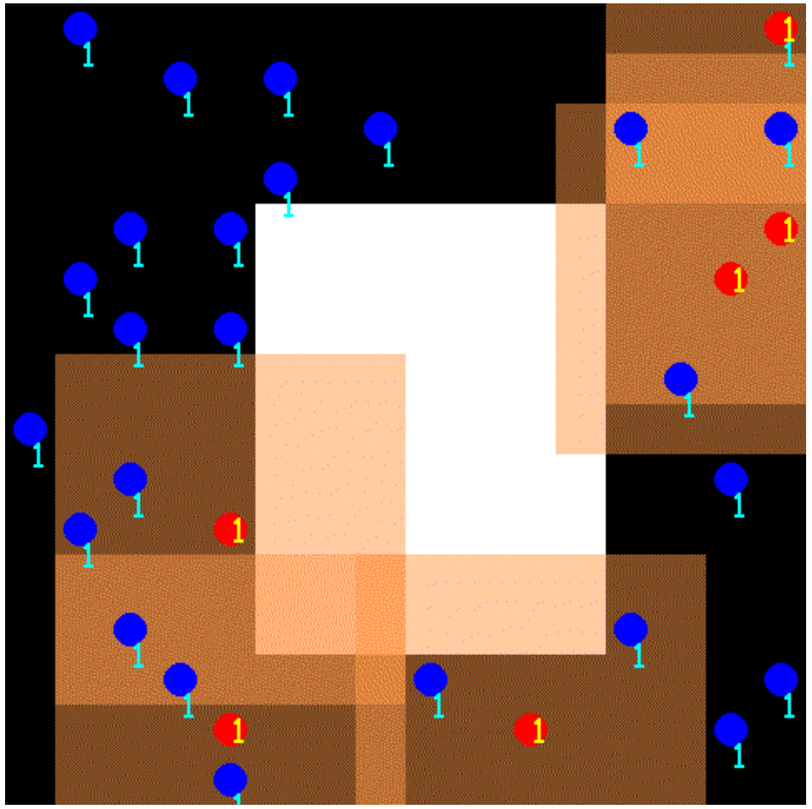

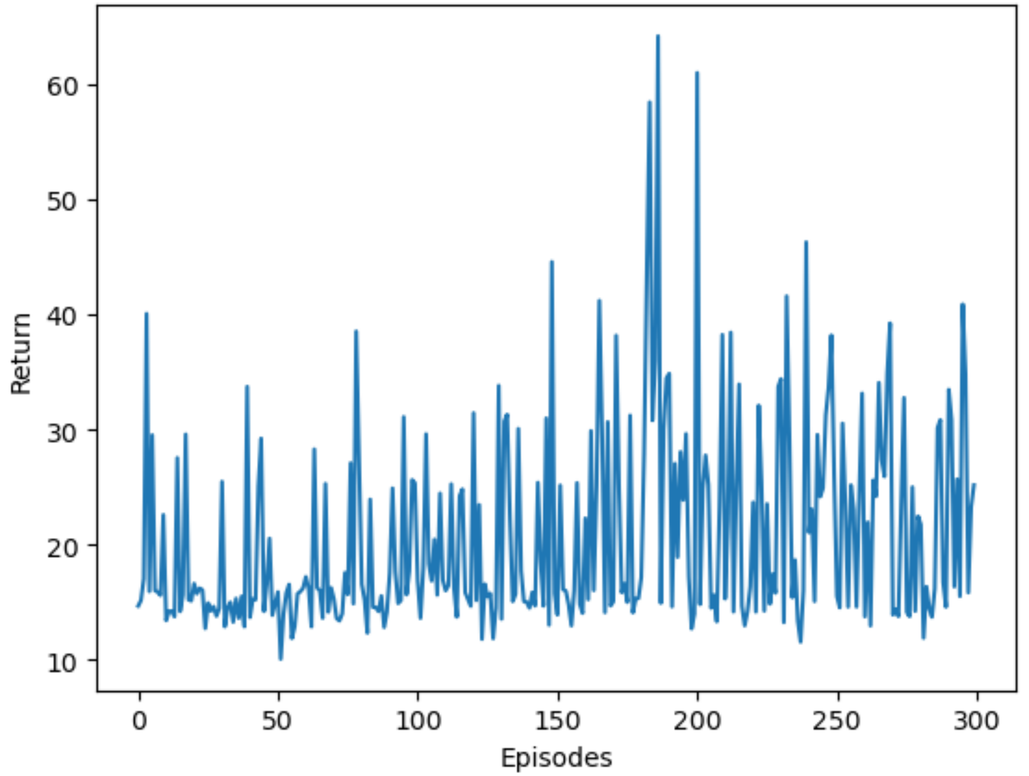

Batch-size = 32, Discount factor = 1, Eps range: 1-0.1
Episodes: 300, Optimizer: RMSProp(lr = 0.00025, alpha = 0.95), Replay Memory Size: 1000000
Target network updated after 5000 iterations

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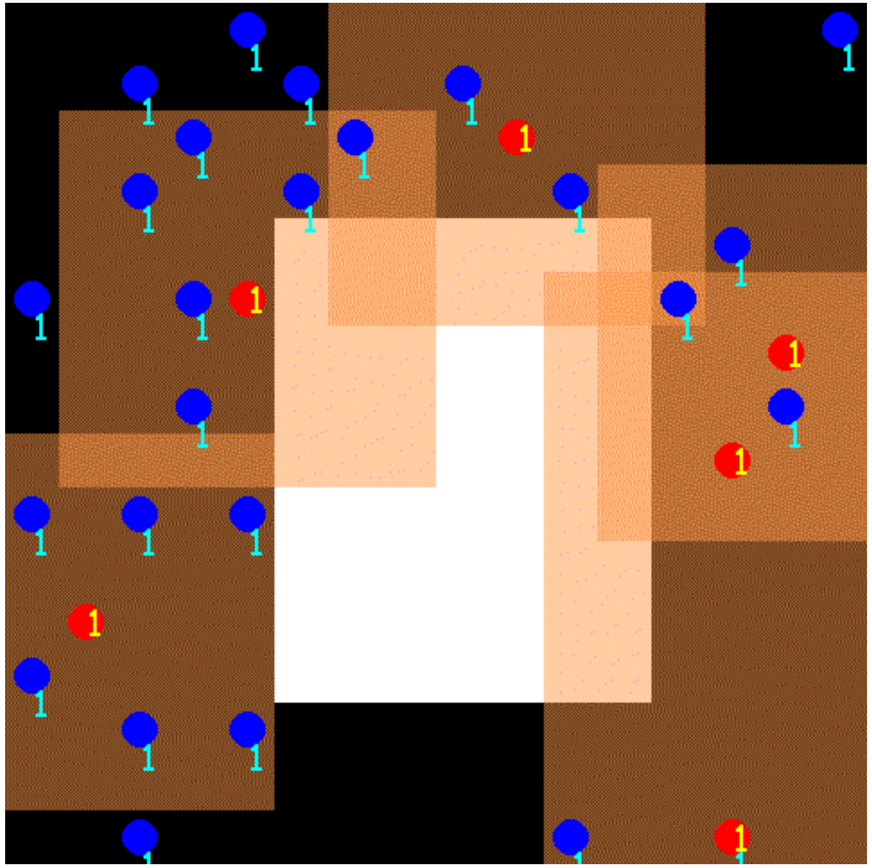

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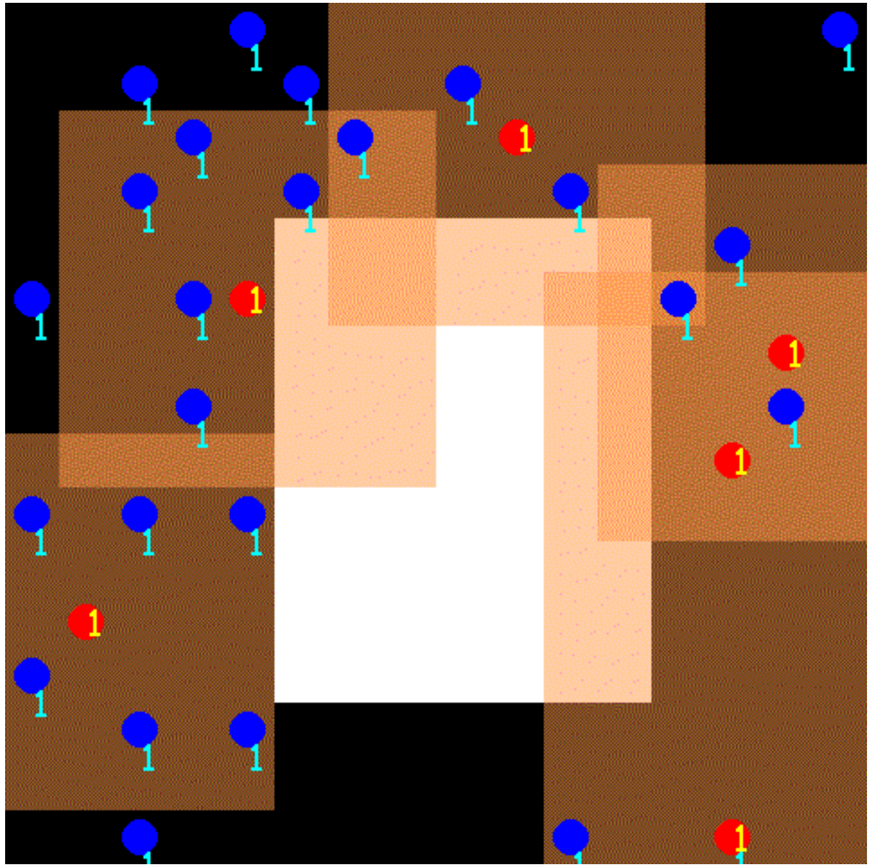

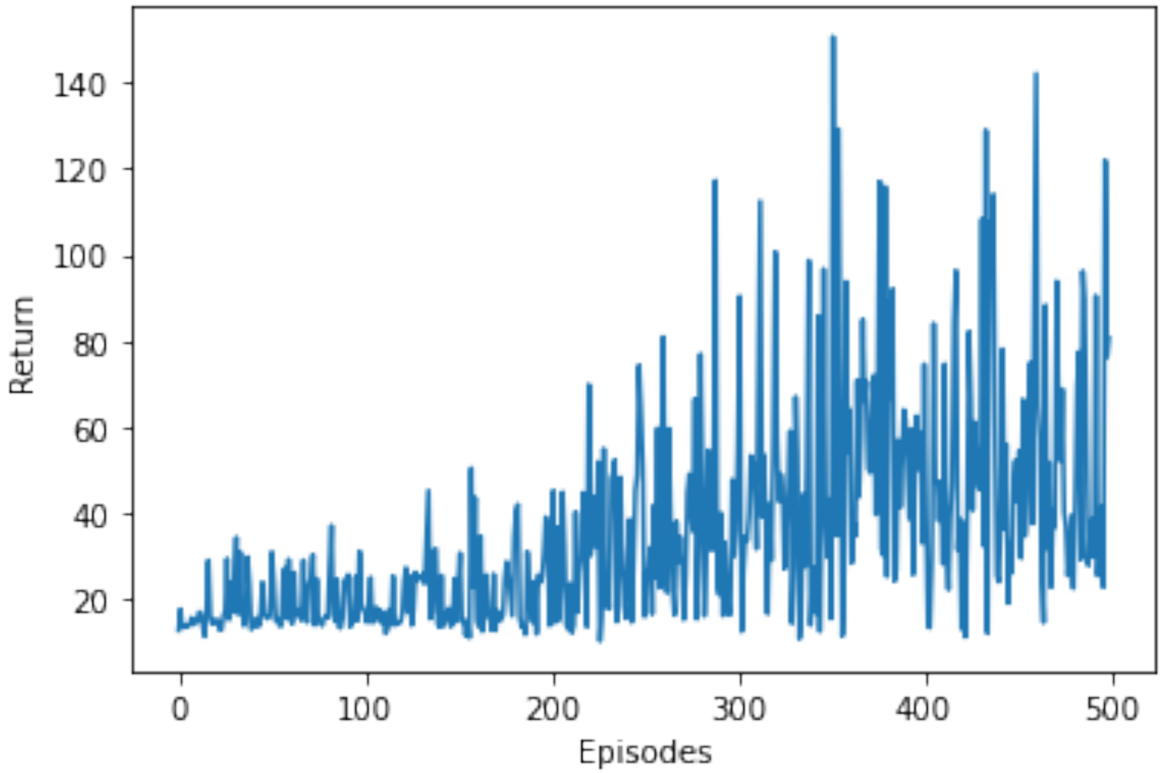

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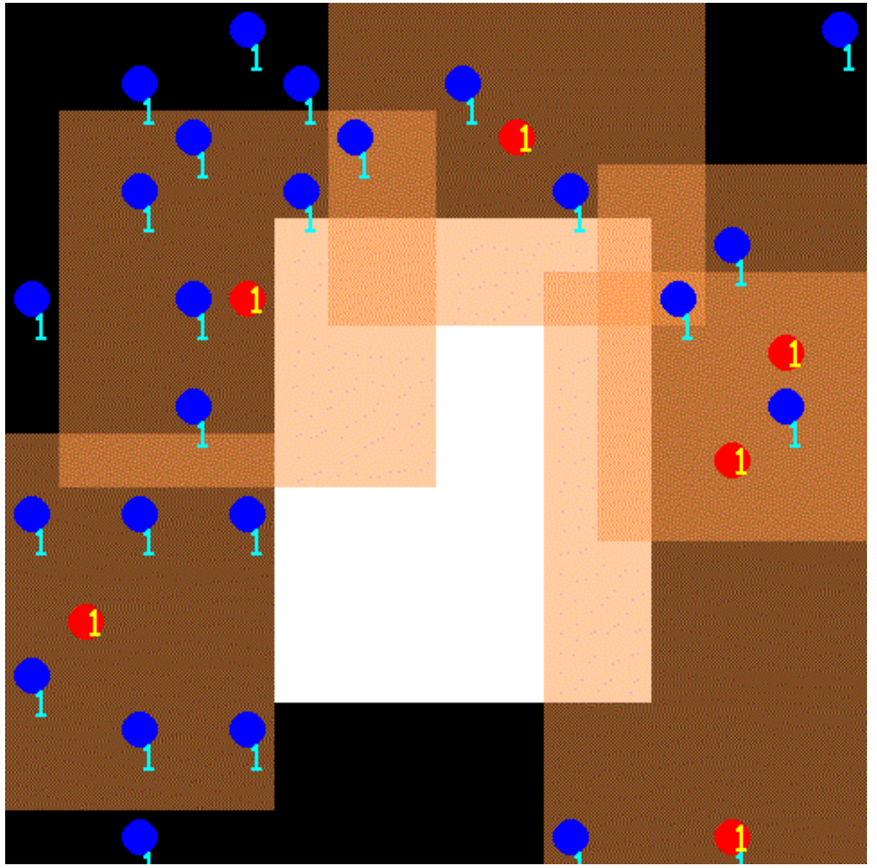

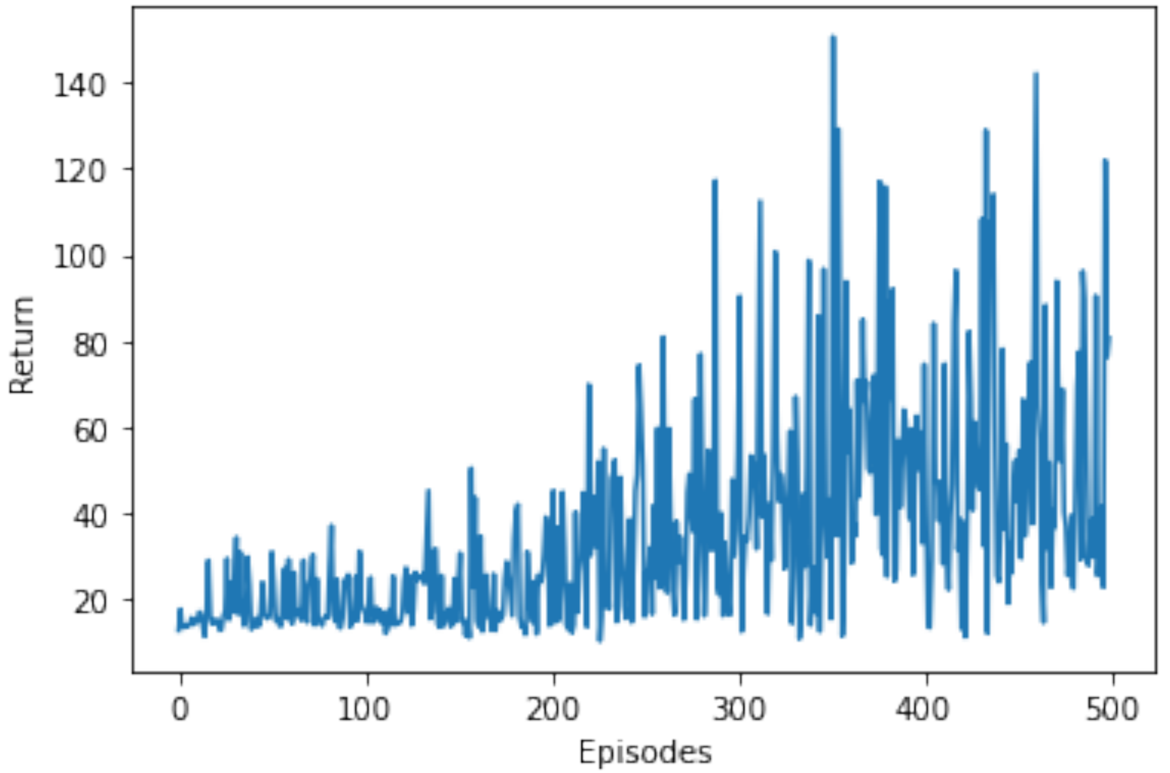

Batch-size = 32, Discount factor = 1, Eps range: 1-0.1
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Results (Evaders Frozen)

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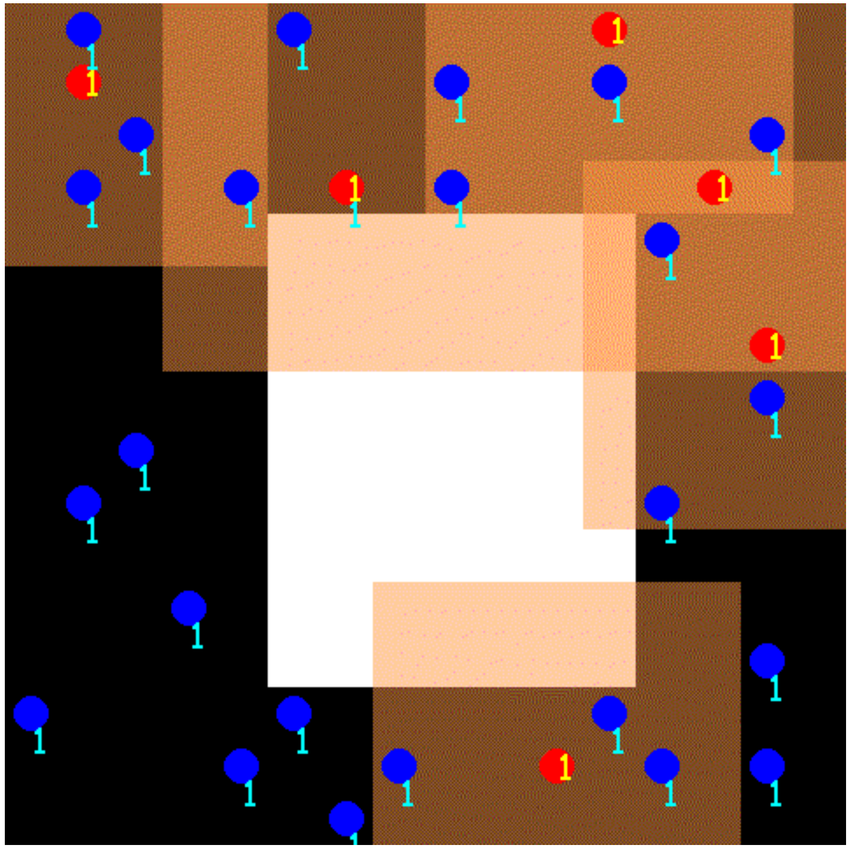

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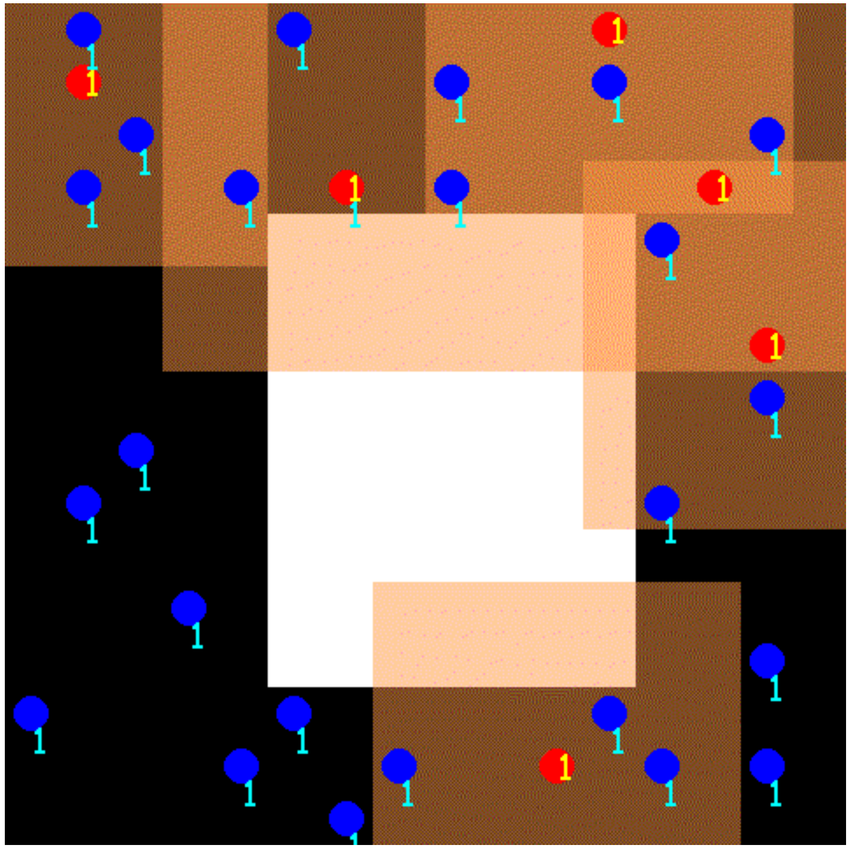

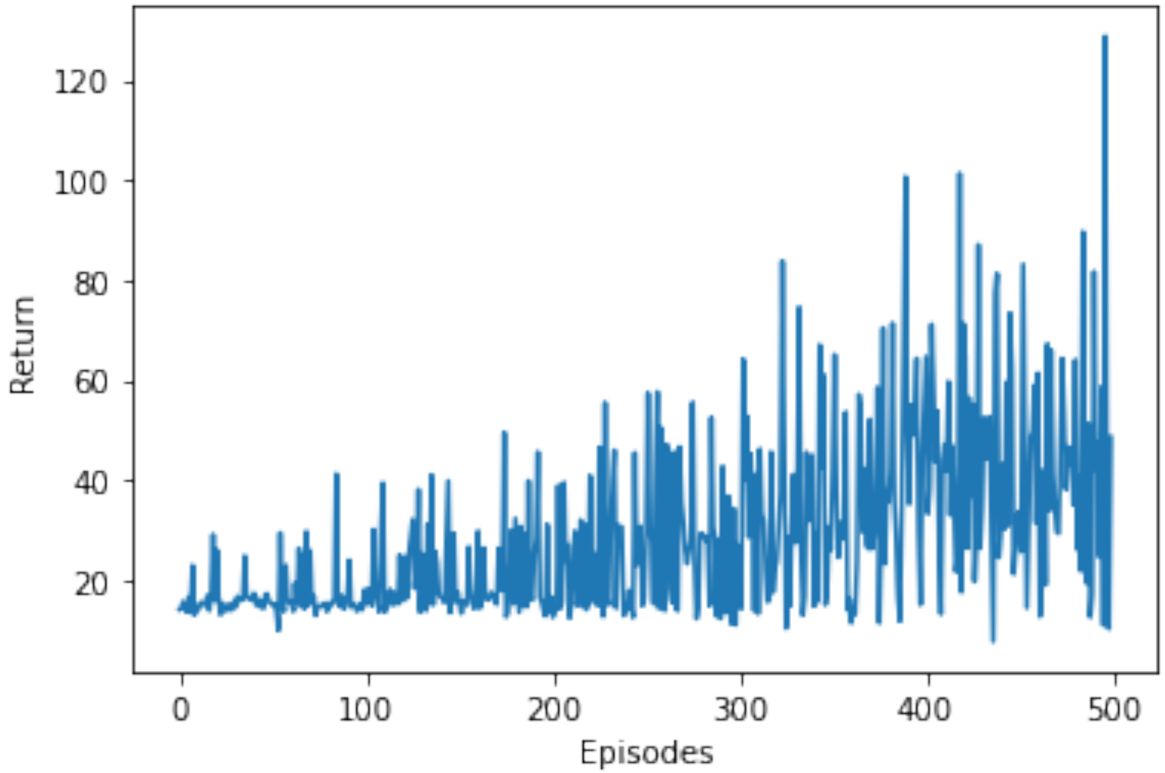

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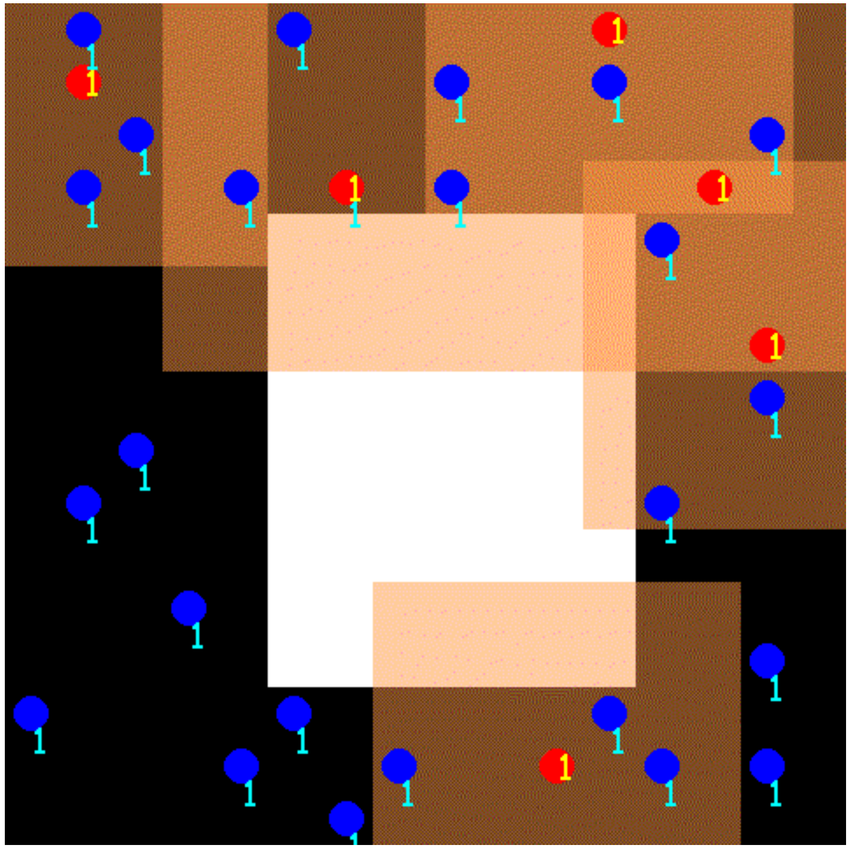

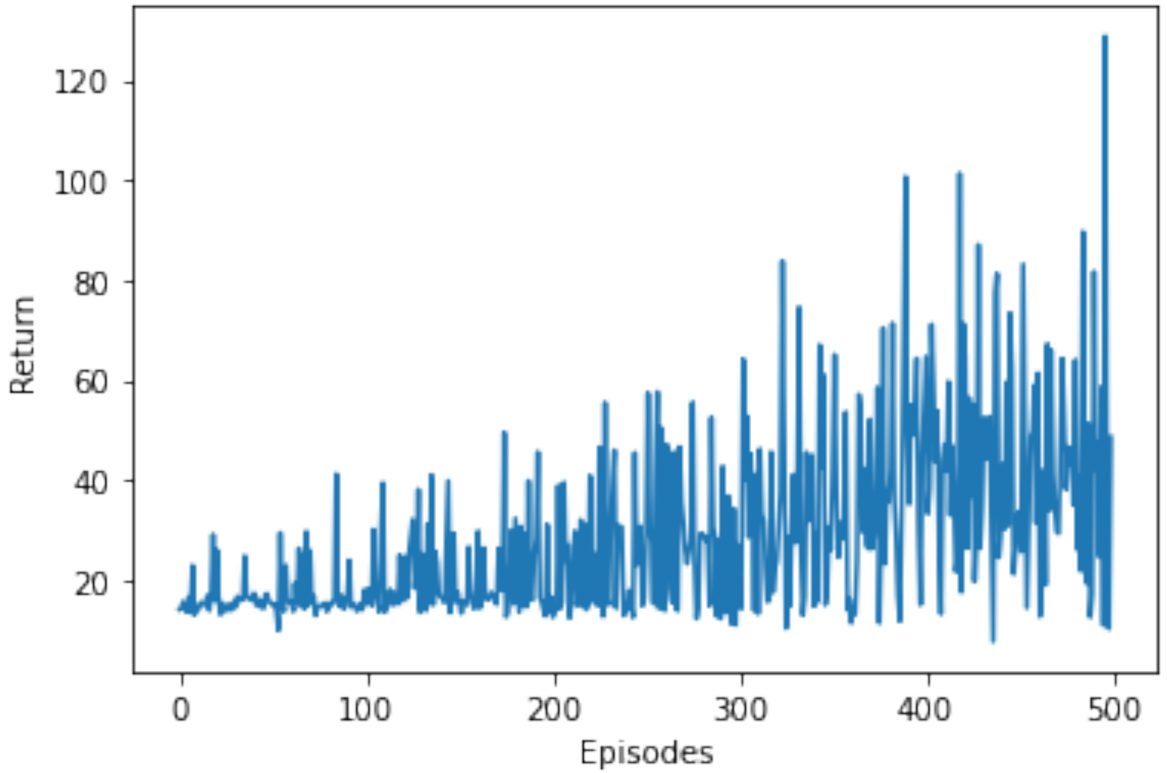

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  Multi-agent deep RL for pursuit game

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- **Key Learning:**

  It is very difficult to train independent DQN. Lots of effort in hyperparameter tuning is required even to get simple results.

- J. Terry, B. Black, N. Grammel, M. Jayakumar, A. Hari, R. Sullivan, L. S. Santos, C. Dieffendahl, C. Horsch, R. Perez-Vicente, and others, "Pettingzoo: Gym for multi-agent reinforcement learning," in Advances in Neural Information Processing Systems, vol. 34, pp. 15032-15043, 2021.
- Mnih, V., Kavukcuoglu, K., Silver, D. et al. Human-level control through deep reinforcement learning. Nature 518, 529–533 (2015). DOI: https://doi.org/10.1038/nature14236

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Thank you!

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