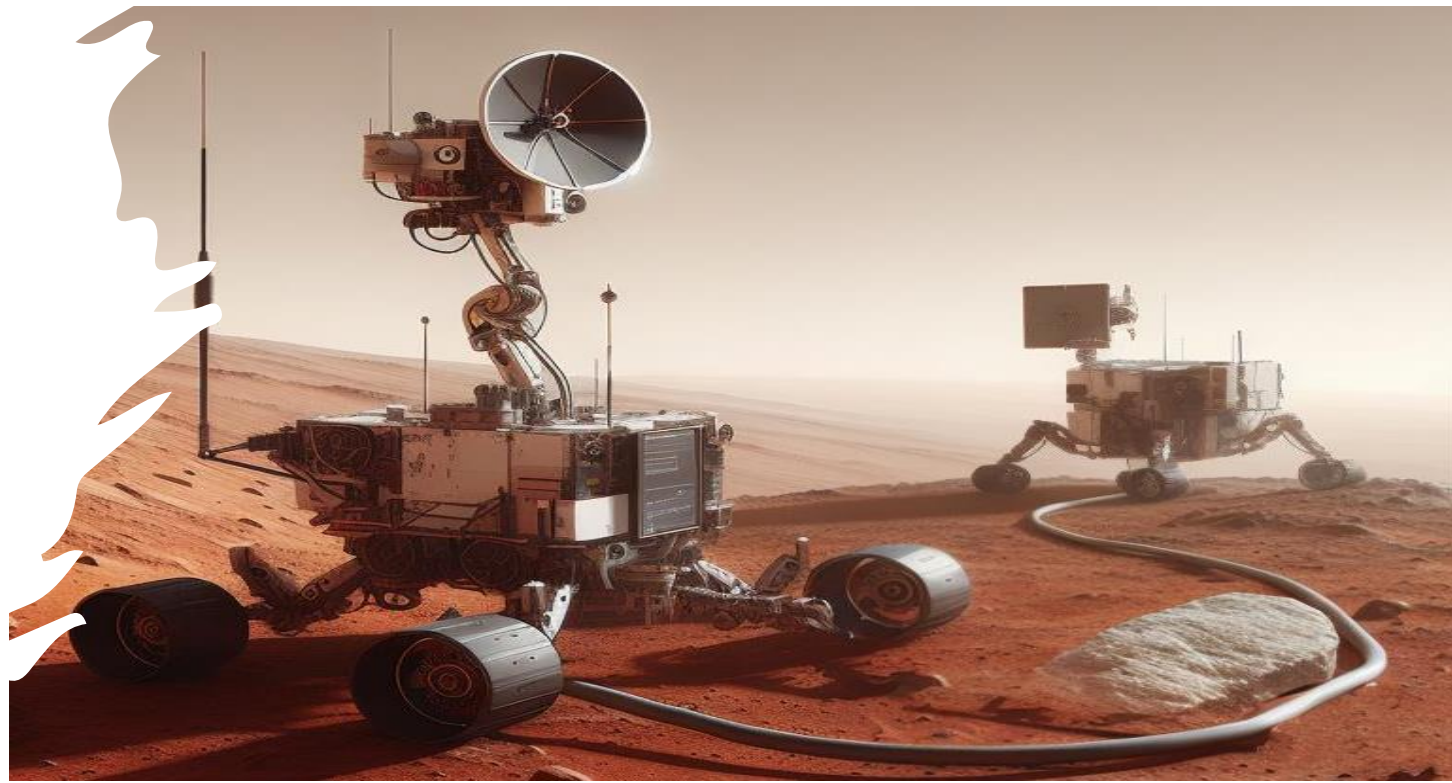
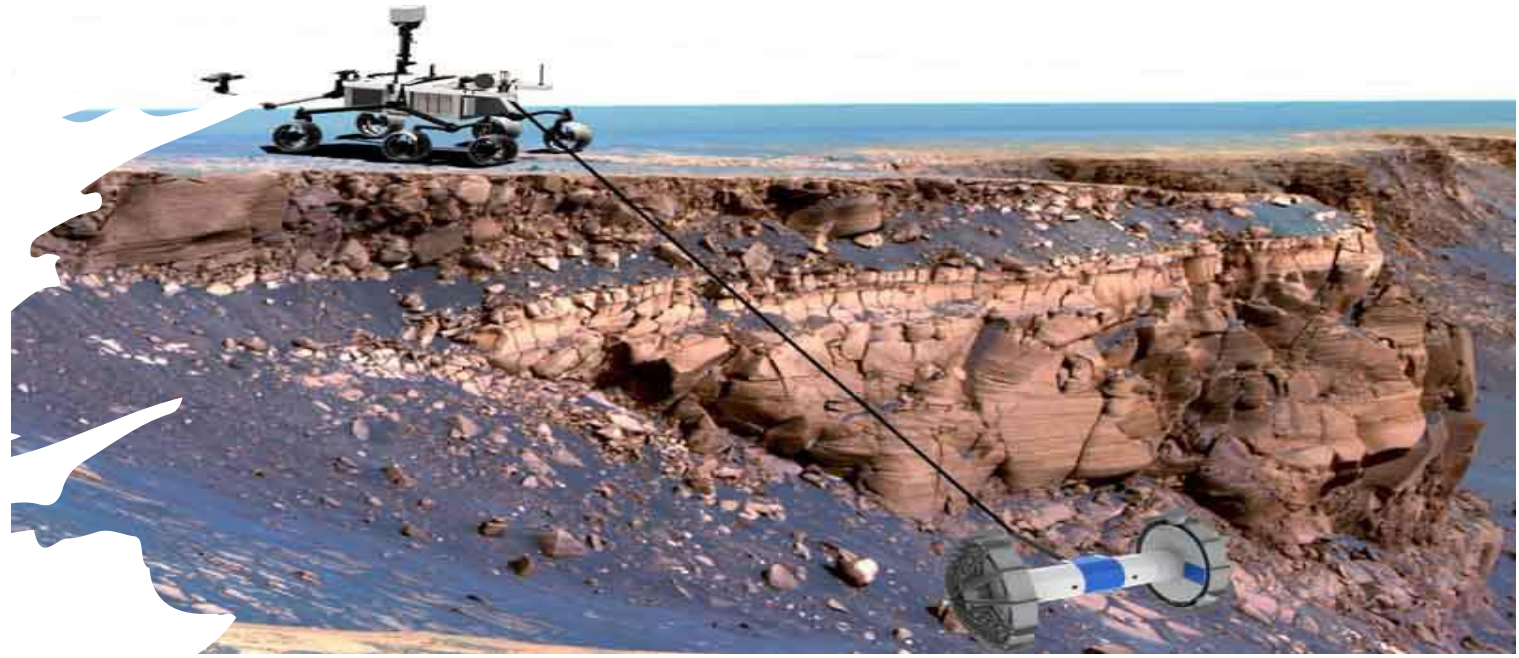


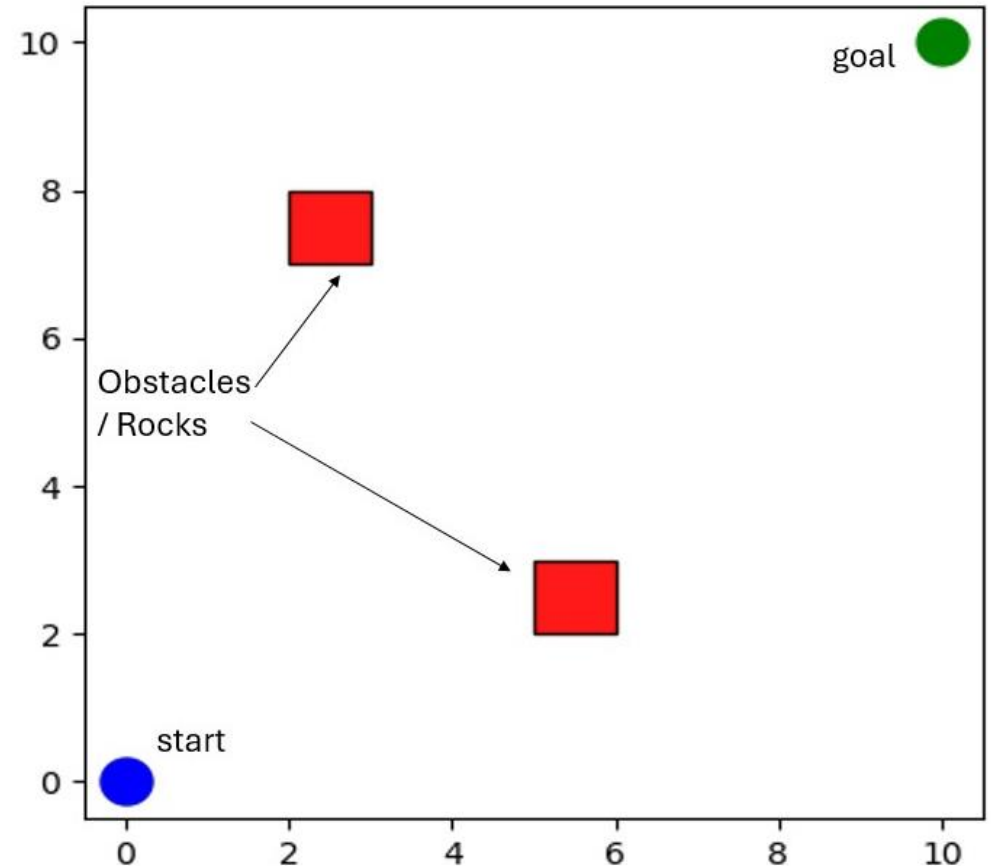
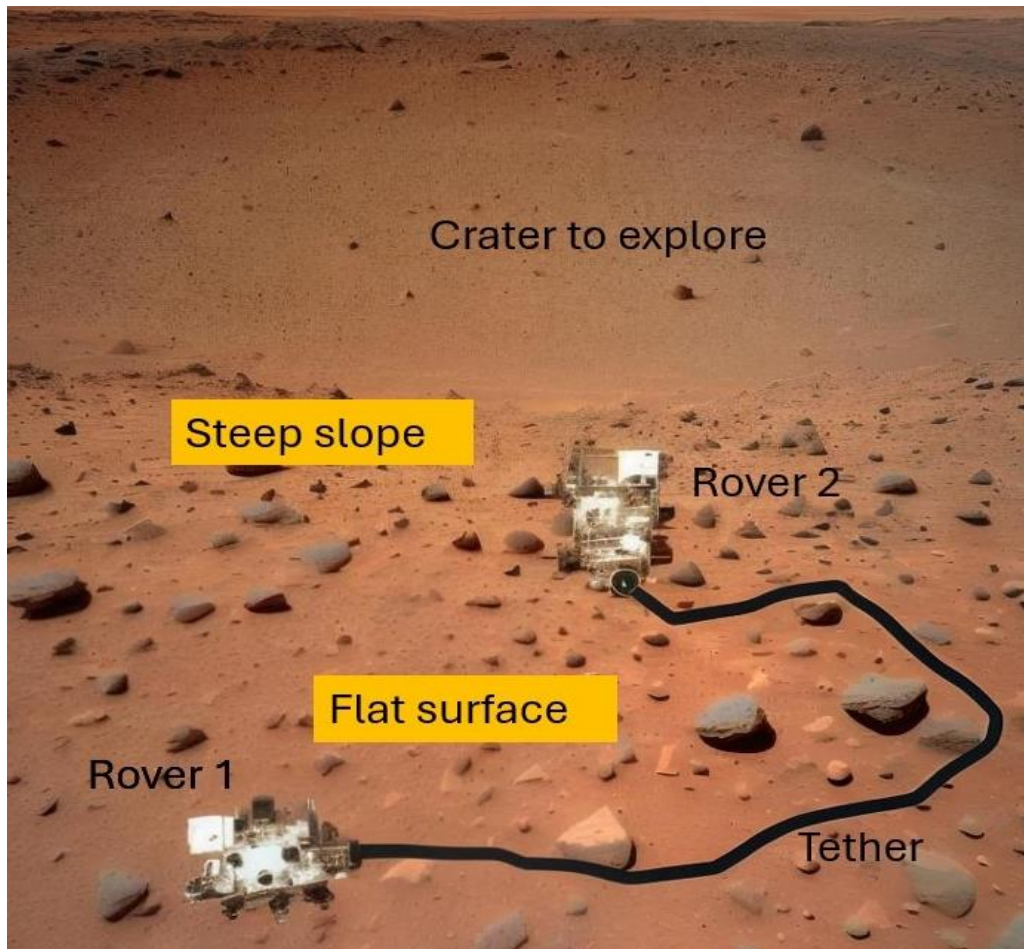
Tension-Aware Path Planning for Tethered Robots on Extreme Terrain Using Reinforcement Learning

- Rahul Kumar



Problem Statement

Objective is to find a path from start state s to a goal state g while satisfying winding constraint angle denoted by θ s.t. $\theta > \theta_d$.



Goal-conditioned MDP (S, A, T, R, γ, G)

State Space, $S \rightarrow (X, Y) / (X, Y, \theta)$

Action Space, $A \rightarrow (L, R, U, D)$

Reward Function

If $\theta_{a,t} < \theta_d$, then

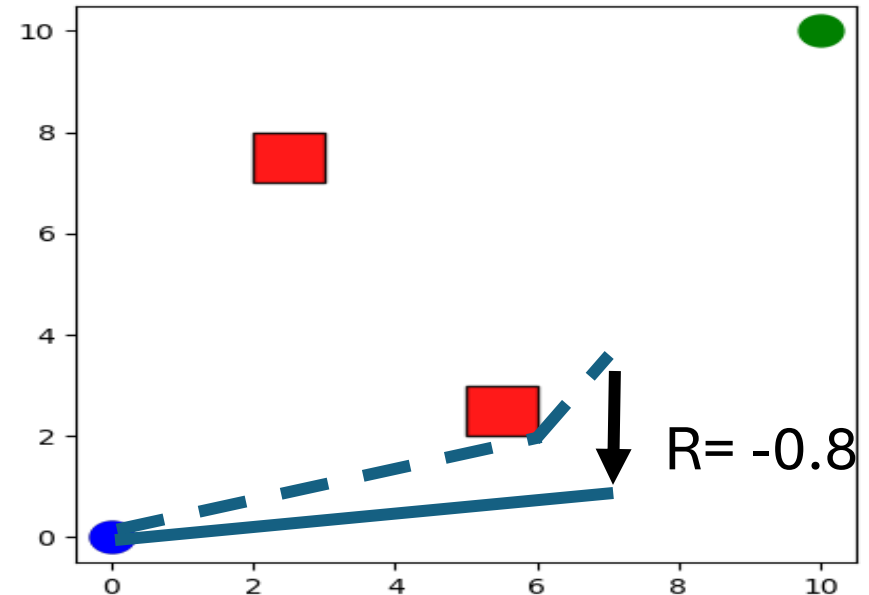
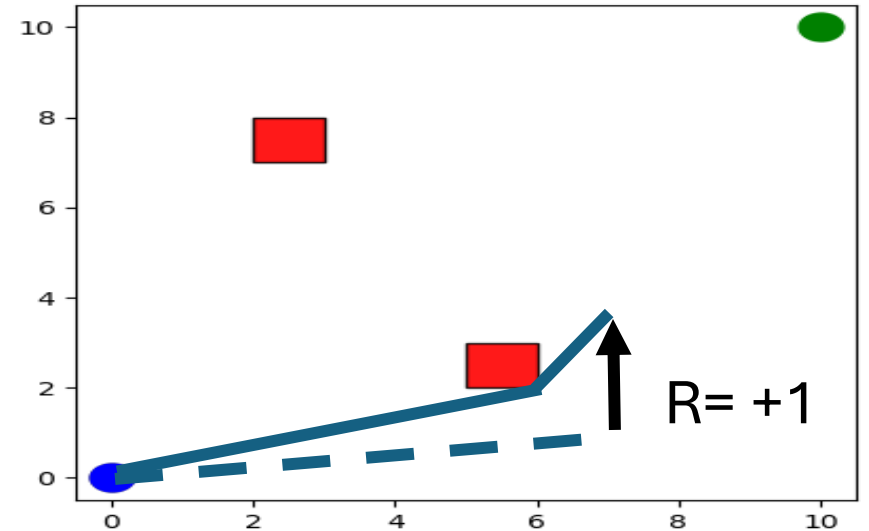
 If $\theta_{a,t} > \theta_{a,t-1}$, then Reward = 1

 Else if $\theta_{a,t} < \theta_{a,t-1}$, then Reward = -0.8

 Else Reward = -0.1

Else

 Reward = - Euclidean distance to goal

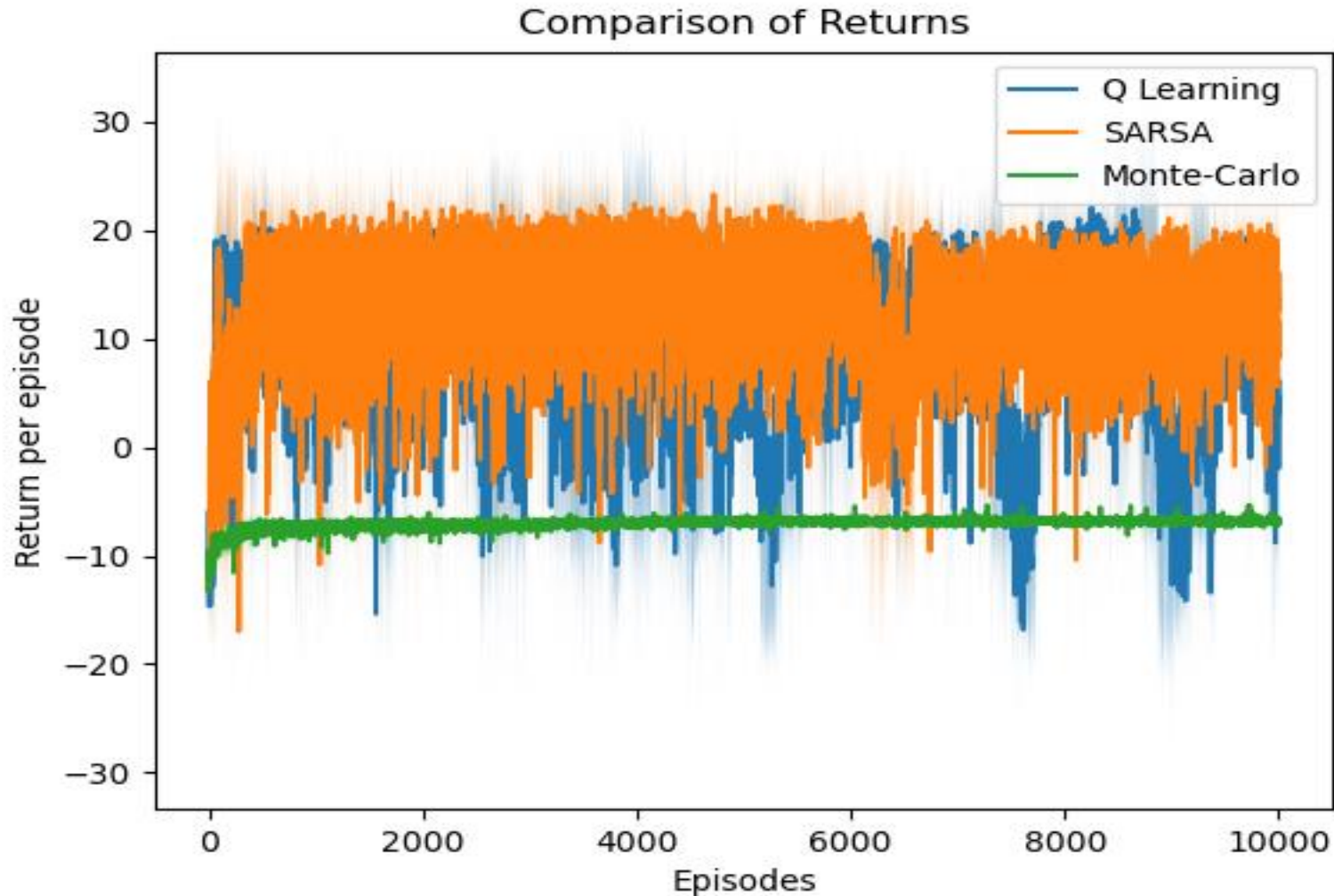


Results

Constant Exploration (Eps = 0.2)

State Space, $S \rightarrow (X, Y)$

Gamma = 0.99, Step size = 0.3

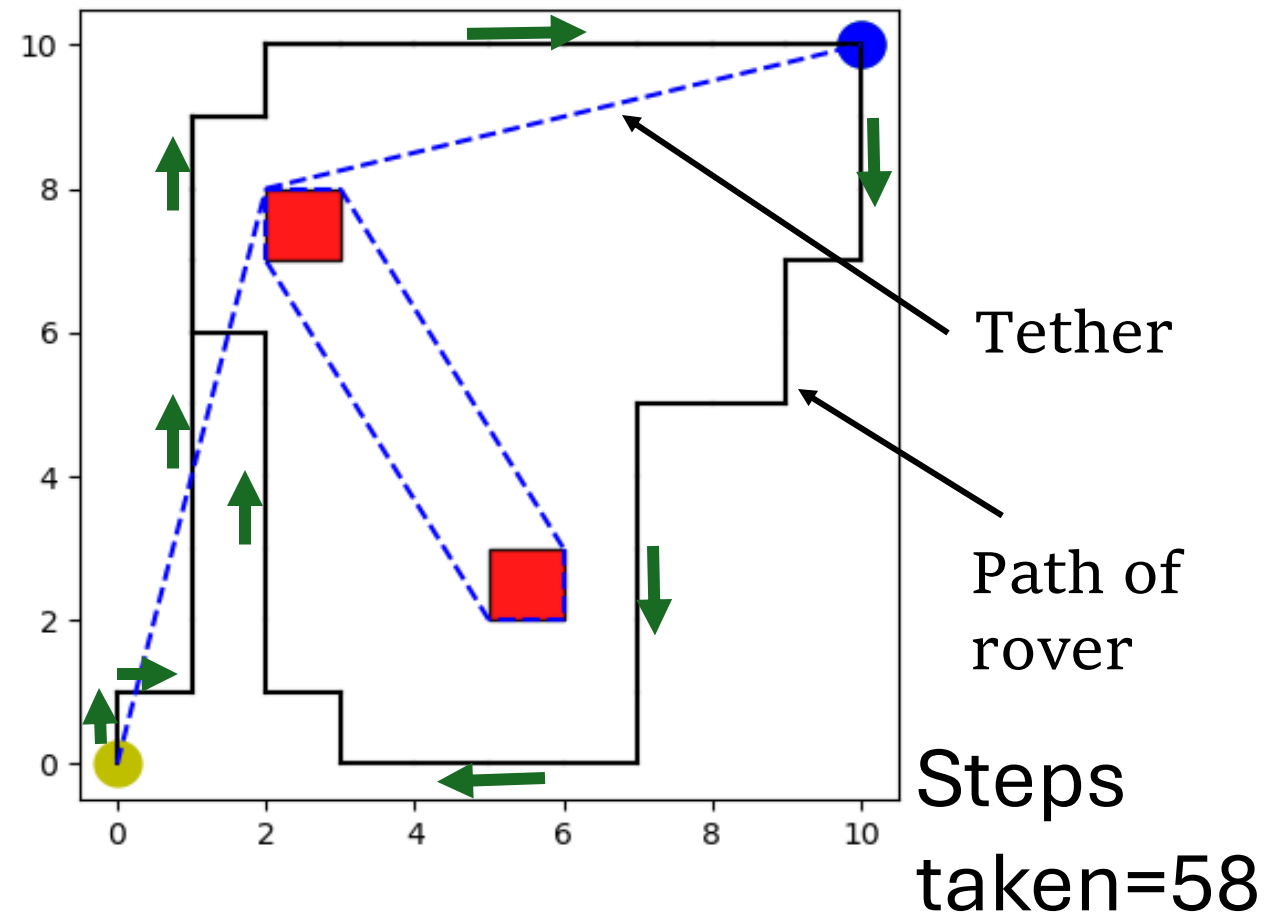
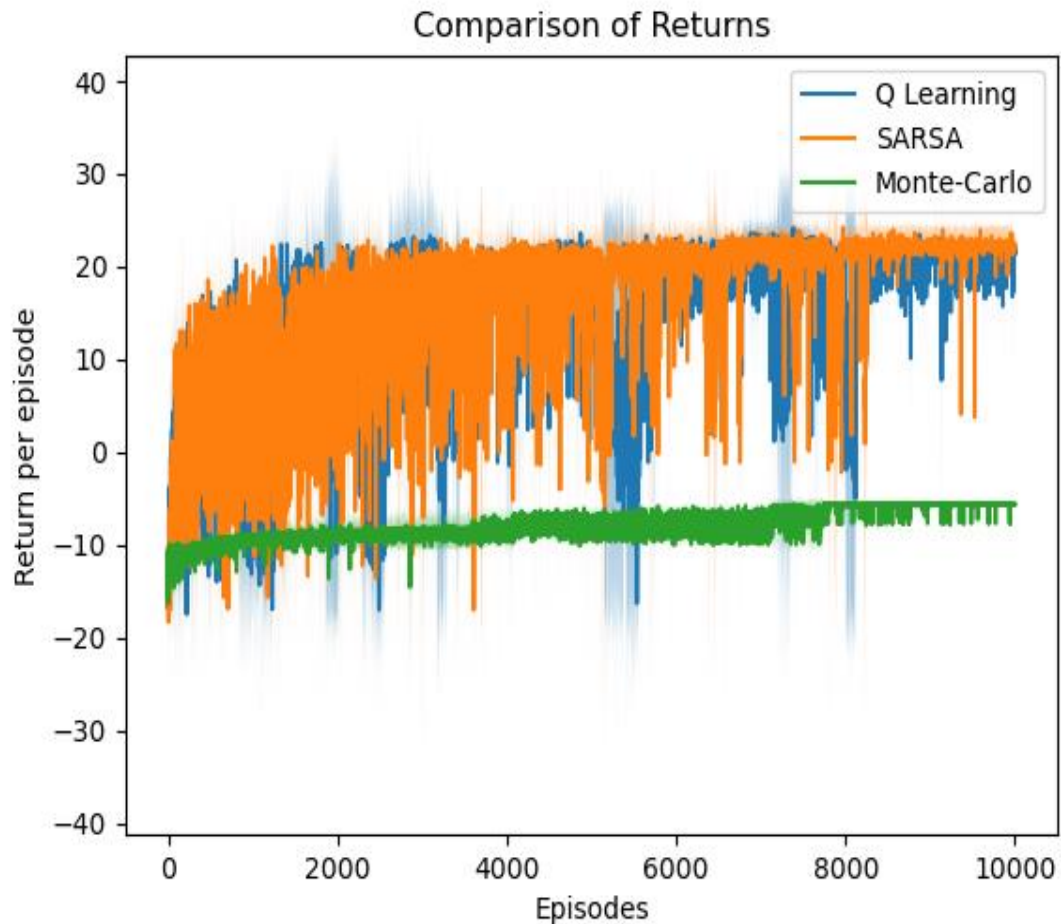


Results

Variable Exploration ($\text{Eps} = 0.5 \rightarrow 0.01$)

State Space, $S \rightarrow (X, Y)$

$\text{Gamma} = 0.99$, Step size = 0.3

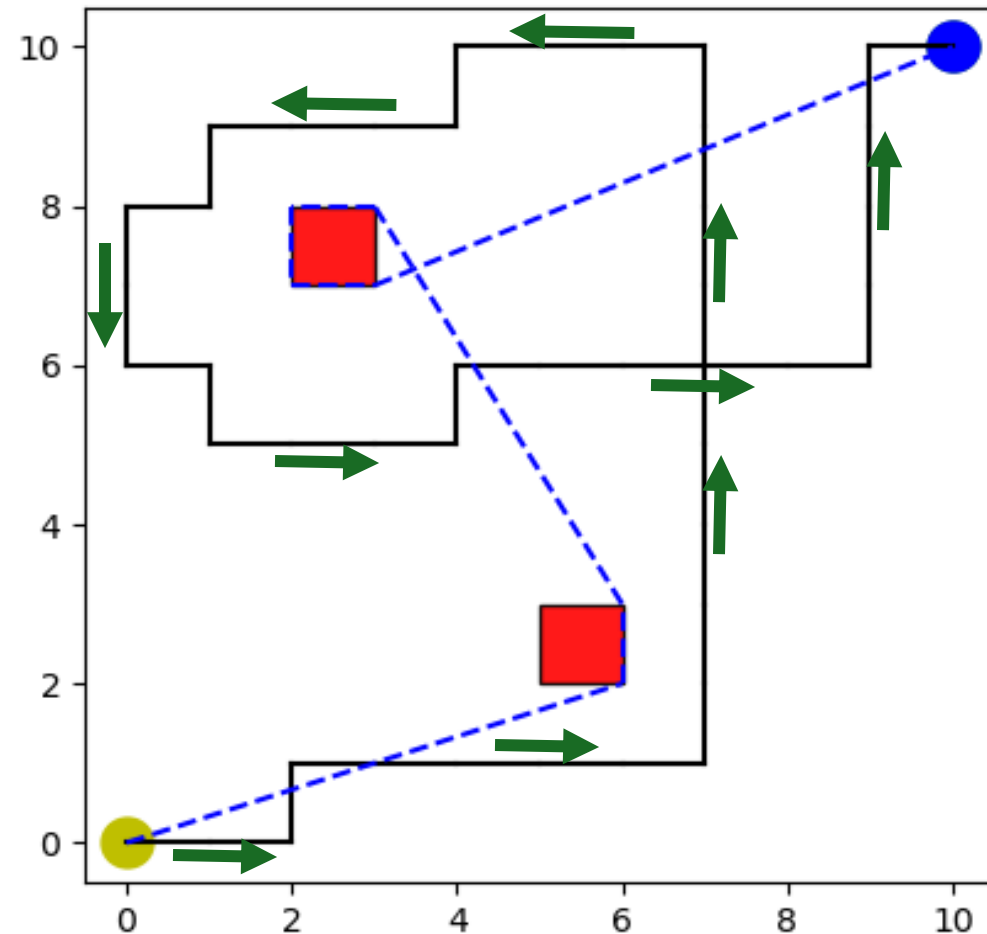
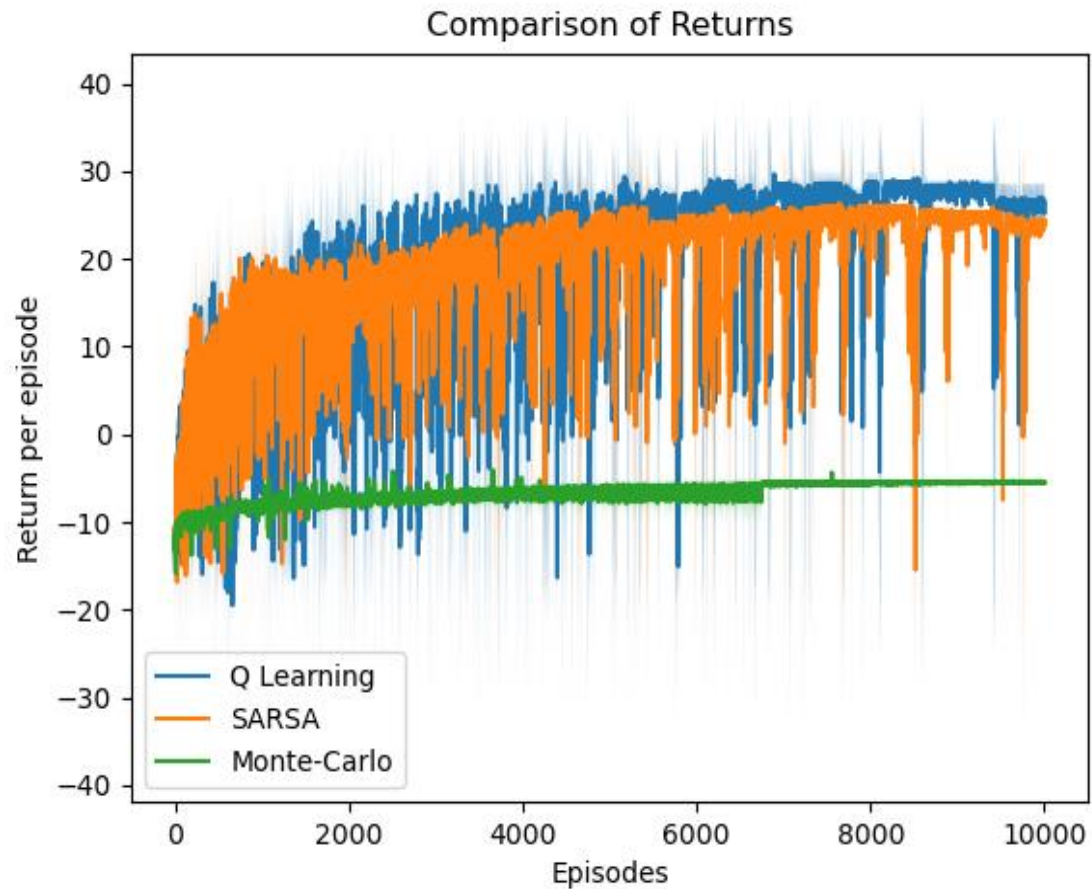


Results

Variable Exploration (Eps = 0.5 \rightarrow 0.01)

State Space, $S \rightarrow (X, Y, \theta)$

Gamma = 0.99, Step size = 0.3



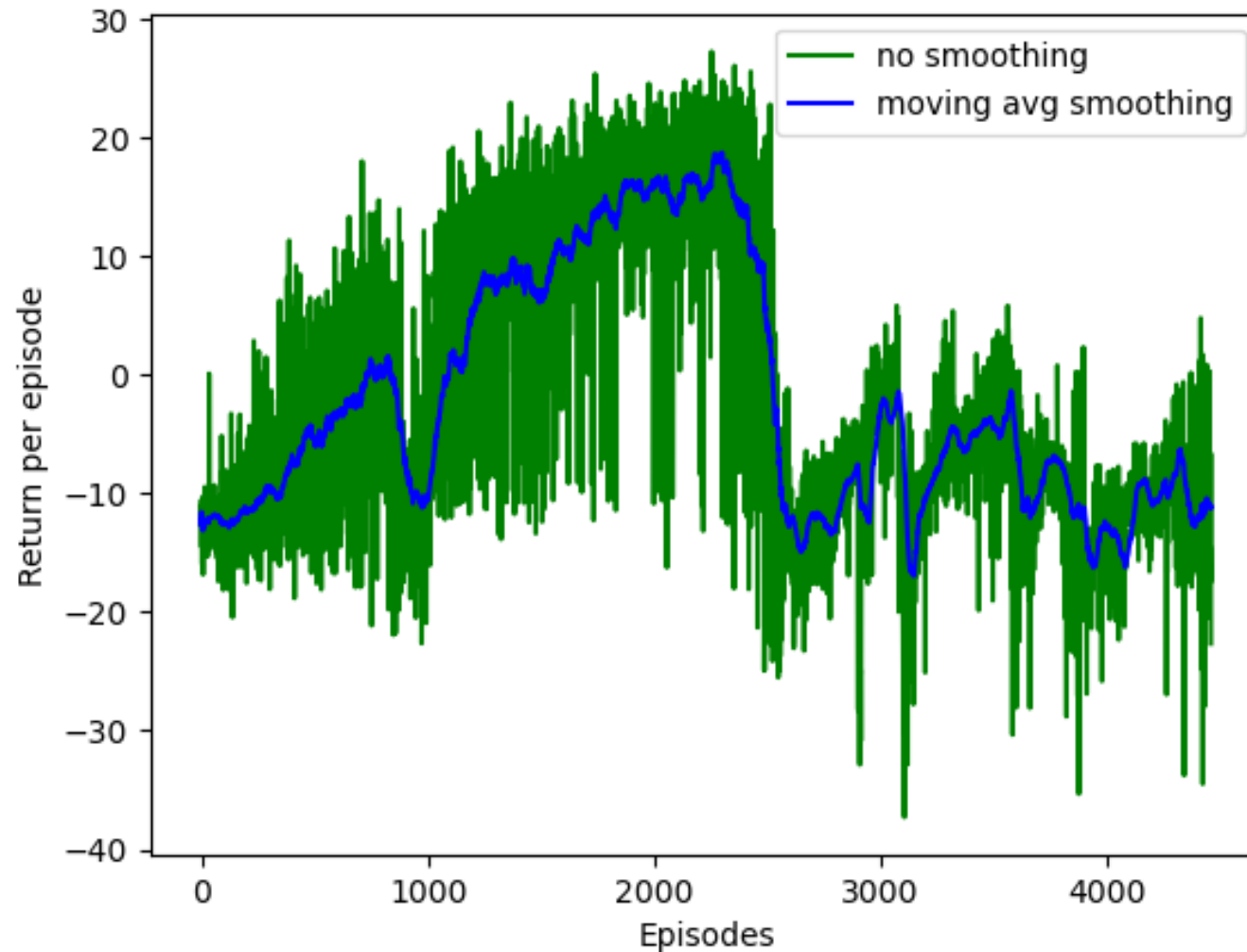
Steps
taken
=44

Results

Deep Q-learning

State Space, $S \rightarrow (X, Y, \theta)$

Gamma = 0.99, Eps = 1 \rightarrow 0.01



Path Ahead

- Improving Deep Q-learning performance
- Extend the algorithm to more complex environment
- Implement other deep RL algorithms

Video -

https://drive.google.com/drive/folders/1-4UmNG38PIJ5w7TckJuNP7aKNrLOasnz?usp=drive_link

Code - <https://github.com/k-rahul1/Reinforcement-Learning>

