Adaptive AI for games using DRL algorithms with PyTorch

R244 Mini Project

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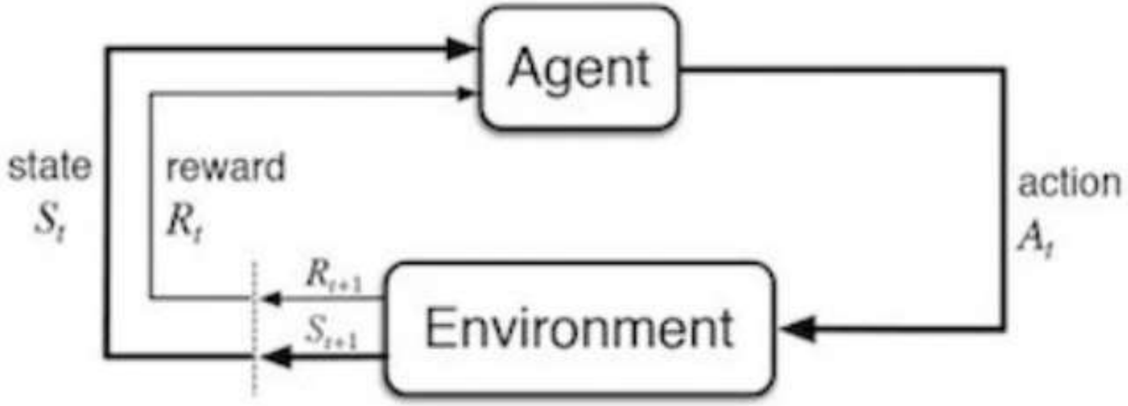
Proposal

1. **Objective**: Develop an adaptive AI for gaming using DRL algorithms in PyTorch.
2. **Foundation**: Build upon the "DRL-PyTorch" open-source project for algorithm implementation.
3. **AI Agent Design**: Create AI agents that can learn complex strategies and adapt to diverse gaming environments.
4. **Techniques**: Implement and evaluate DRL techniques such as DQN, PPO, and A3C.
5. **Game-Specific Application**: Apply these algorithms to a targeted game genre, like strategy games or platformers.
6. **Learning Approach**: Emphasize minimal supervision learning for dynamic adaptation to game changes.
7. **Project Impact**: Showcase the potential of DRL in crafting sophisticated, adaptive game AI beyond current capabilities.

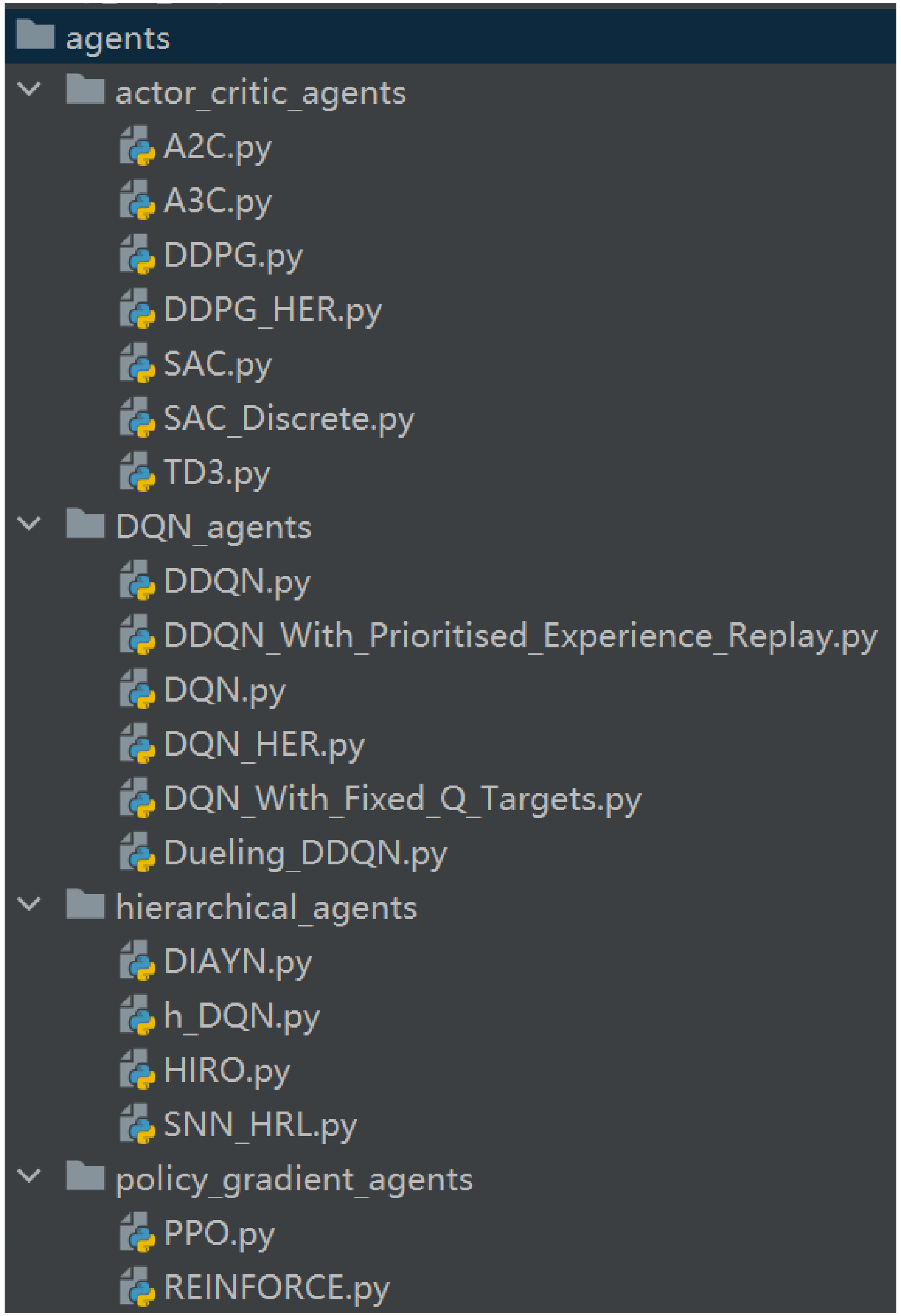
Background



PyTorch

Algorithms Implemented

1. *Deep Q Learning (DQN)* (Mnih et al. 2013)
2. *DQN with Fixed Q Targets* (Mnih et al. 2013)
3. *Double DQN (DDQN)* (Hado van Hasselt et al. 2015)
4. *DDQN with Prioritised Experience Replay* (Schaul et al. 2016)
5. *Dueling DDQN* (Wang et al. 2016)
6. *REINFORCE* (Williams et al. 1992)
7. *Deep Deterministic Policy Gradients (DDPG)* (Lillicrap et al. 2016)
8. *Twin Delayed Deep Deterministic Policy Gradients (TD3)* (Fujimoto et al. 2018)
9. *Soft Actor-Critic (SAC)* (Haarnoja et al. 2018)
10. *Soft Actor-Critic for Discrete Actions (SAC-Discrete)* (Christodoulou 2019)
11. *Asynchronous Advantage Actor Critic (A3C)* (Mnih et al. 2016)
12. *Syncrhonous Advantage Actor Critic (A2C)*
13. *Proximal Policy Optimisation (PPO)* (Schulman et al. 2017)
14. *DQN with Hindsight Experience Replay (DQN-HER)* (Andrychowicz et al. 2018)
15. *DDPG with Hindsight Experience Replay (DDPG-HER)* (Andrychowicz et al. 2018)
16. *Hierarchical-DQN (h-DQN)* (Kulkarni et al. 2016)
17. *Stochastic NNs for Hierarchical Reinforcement Learning (SNN-HRL)* (Florensa et al. 2017)
18. *Diversity Is All You Need (DIAYN)* (Eyensbach et al. 2018)

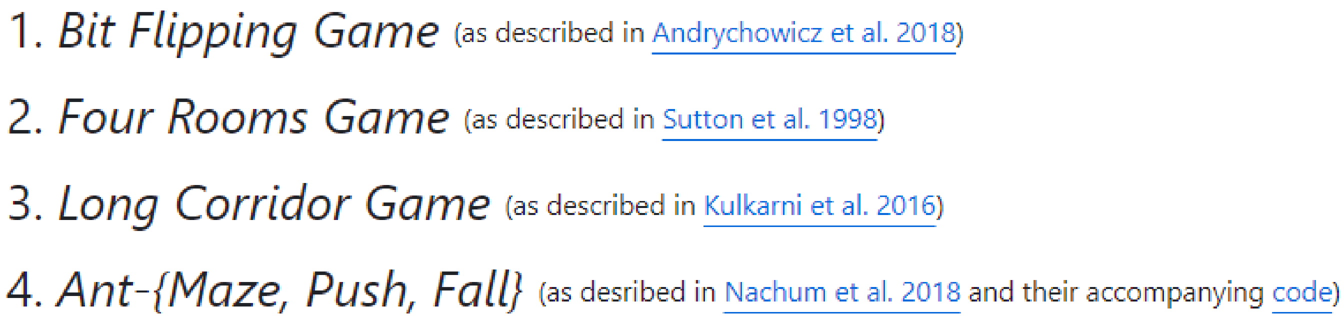


```
agents
  actor_critic_agents
      A2C.py
      A3C.py
      DDPG.py
      DDPG_HER.py
      SAC.py
      SAC_Discrete.py
      TD3.py
  DQN_agents
      DDQN.py
      DDQN_With_Prioritised_Experience_Replay.py
      DQN.py
      DQN_HER.py
      DQN_With_Fixed_Q_Targets.py
      Dueling_DDQN.py
  hierarchical_agents
      DIAYN.py
      h_DQN.py
      HIRO.py
      SNN_HRL.py
  policy_gradient_agents
      PPO.py
      REINFORCE.py
```

More Algorithms that Could Be Implemented

1. **MT-Opt**: A Google multi-task RL system enhancing automated data collection and training efficiency in robotics.
2. **RGB-stacking**: DeepMind's benchmark for vision-based robotic manipulation, training robots to stack objects using RL.
3. **SaLinA**: A Facebook (Meta) extension to PyTorch for simplifying sequential decision processes, suitable for large-scale RL applications.
4. **TextWorld Commonsense**: An IBM environment for infusing RL agents with commonsense knowledge, improving decision-making in text-based games.
5. **Reversibility-Aware RL**: A Google methodology adding reversibility estimation to self-supervised RL, improving agent performance in tasks like puzzle solving.
6. **Adaptive RL Agents**: DeepMind's approach for training game-playing agents capable of adapting to new conditions without human intervention.
7. **Evolving Reinforcement Learning Algorithms**: Google's application of AutoML optimization techniques to evolve RL algorithms, enhancing the interpretability and generalization.

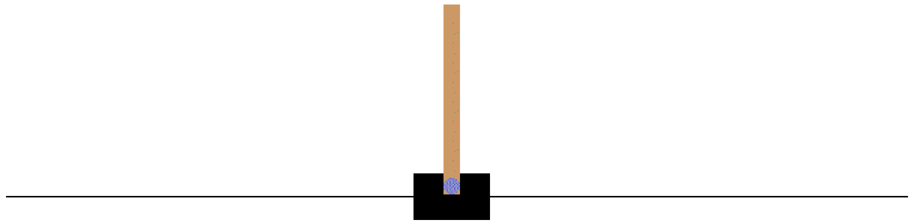
Environments Implemented



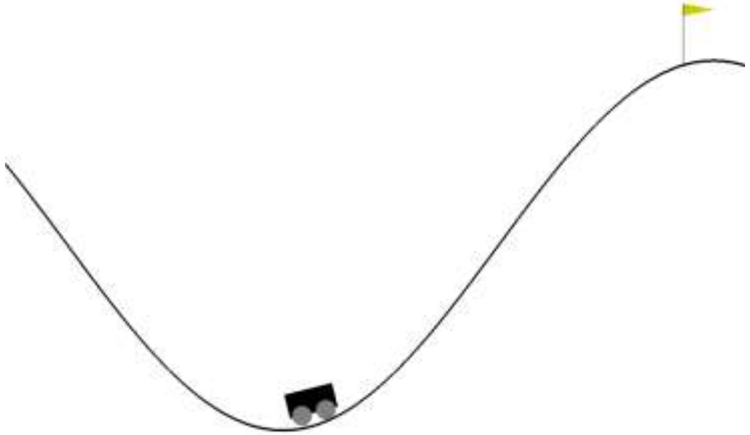
1. *Bit Flipping Game* (as described in Andrychowicz et al. 2018)
2. *Four Rooms Game* (as described in Sutton et al. 1998)
3. *Long Corridor Game* (as described in Kulkarni et al. 2016)
4. *Ant-{Maze, Push, Fall}* (as desribed in Nachum et al. 2018 and their accompanying code)

Etc.

Case studies

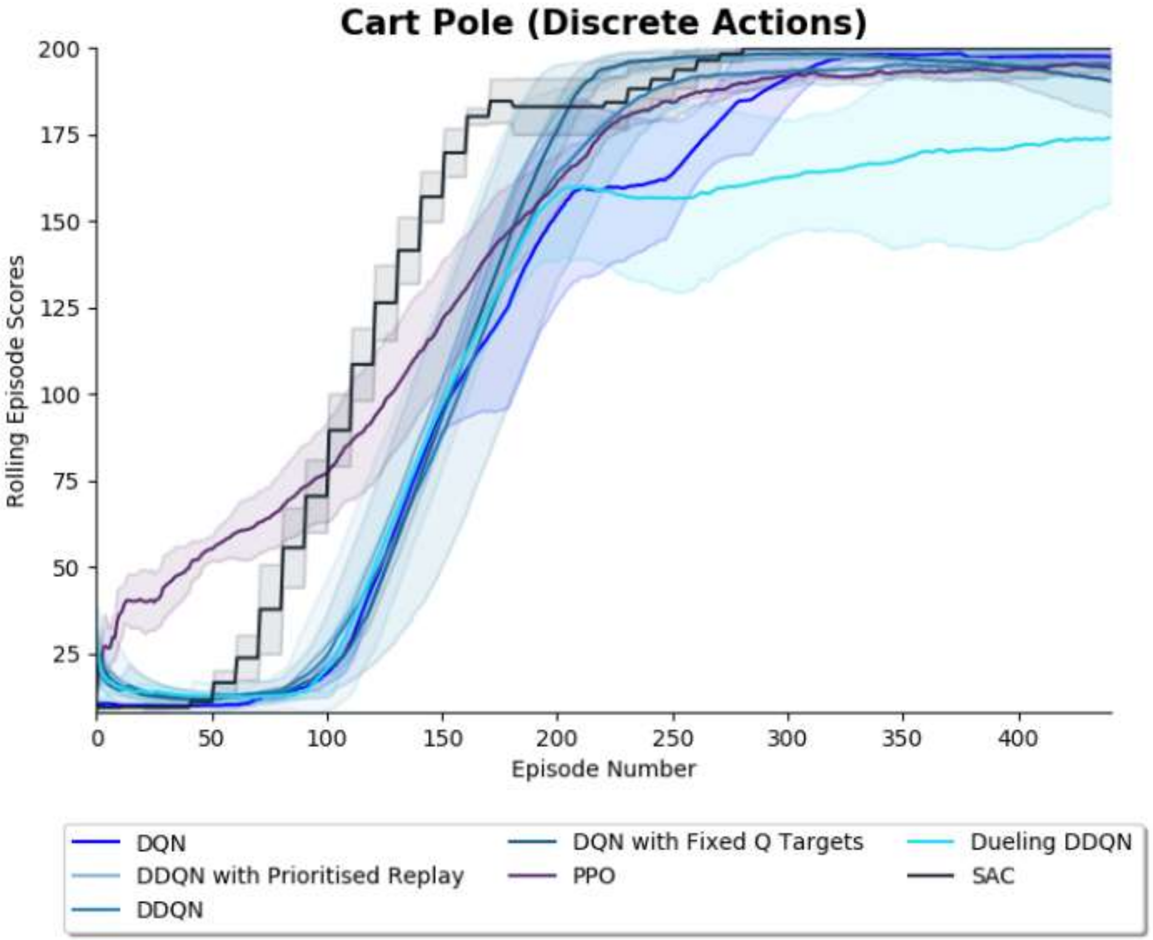


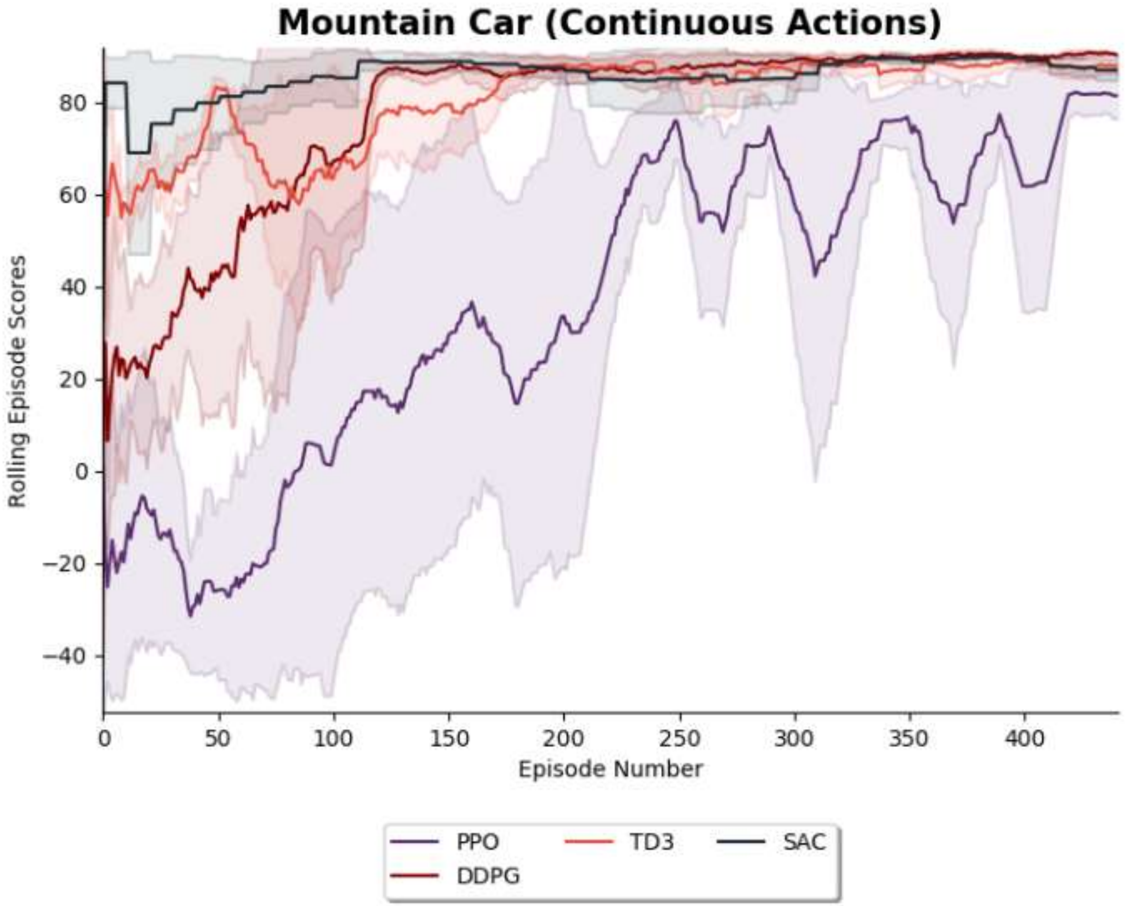
Cart Pole



Mountain Car

Case studies





What I have done and been doing

1. Environment Setup

2. Literature Review

3. Preliminary Experiments

Next Plans

1. **Trying optimising and implementing new DRL agents**

2. **Algorithm and Environment Customisation**

3. **Complex Environment Testing**

4. **Comprehensive evaluation**

5. **Comparative Analysis**