Autonomous Learning with the Snake Game Using Reinforcement Learning

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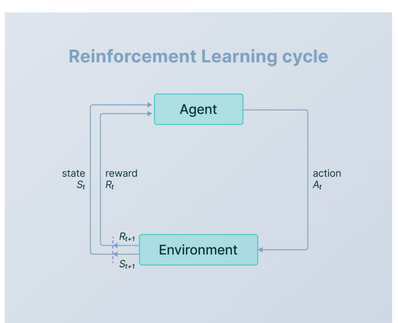
Abstract

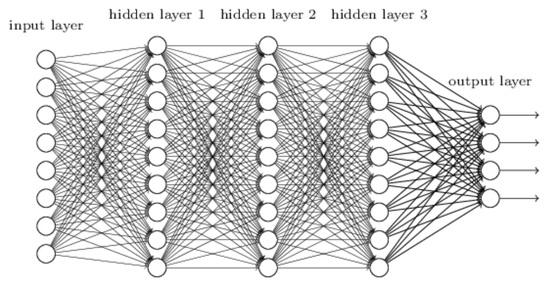
This project delves into the realm of Reinforcement Learning (RL) by applying it to the training of a machine learning model tasked with autonomously mastering the classic Snake Game. The primary aim is to develop an intelligent agent capable of learning effective game strategies and independently adapting to escalating levels of complexity, devoid of human intervention. Using RL principles, particularly Q-Learning and Deep Q-Networks, the project showcases how the agent learns from its environment by iteratively experiencing actions, rewards and penalties to optimize its gameplay performance.

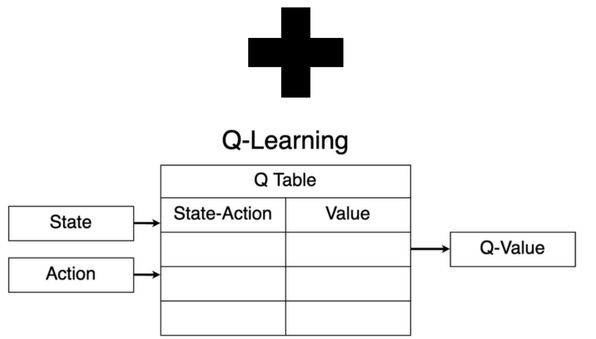
Method

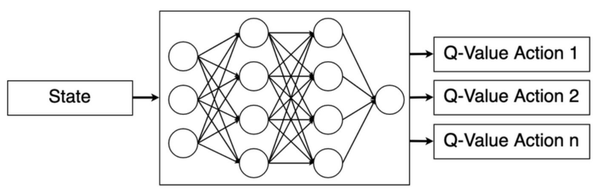
The training procedure used was an implementation of the “Q-Network” model named as the “Linear_QNet” class. This is trained using a Q-Learning algorithm with experience replay.

The “QTrainer” class within the code, facilitates the training process by managing the optimizer, loss function, and parameter updates.



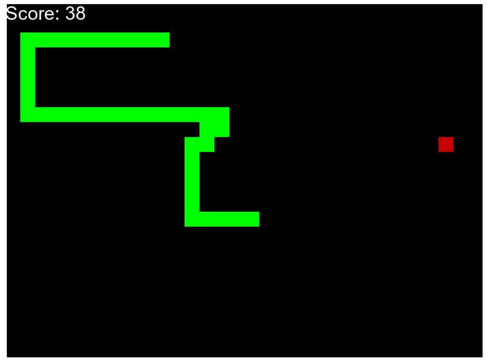


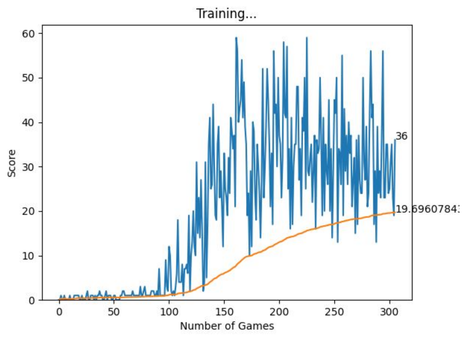


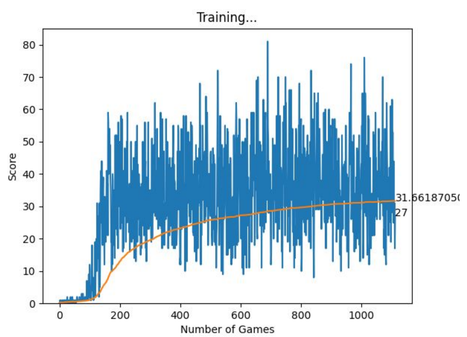


The training process consists of iteratively playing multiple episodes of the game, during which the AI agent learns to improve its performance. Through each step of the loop, the agent observes the current state of the game, selects an action based on its learned policy, performs the action, and receives a reward from the environment. The agents experiences are then stored for in memory for training.

Results







Conclusions

- This research sheds light on the intersection of reinforcement learning and classic gaming.
- Through this study, the aim is to showcase the potential of RL algorithms by putting it in complex environments such as games.
- Acknowledging the groundwork laid by previous studies, and outlining this approach, sets the stage for a detailed exploration of our findings and methodologies.

Future Direction

- Explore the integration of multi-agent reinforcement learning techniques to enable collaborative or competitive interactions between AI agents in the environment.
- Adopt an evolutionary algorithm, such as genetic algorithms or evolutionary strategies, to evolve neural network architectures or hyperparameters for improved performance in training AI agents.

Acknowledgements

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References

Playing the Snake Game with Reinforcement Learning. Yuhang, Pan & Yiqi, Song & Qianli, Ma & Bowen, Gu & Junyi, Dong & Zijun, Tang. (2023). Cambridge Explorations in Arts and Sciences. 1. 10.61603/ceas.v1i1.13.

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