Solving a skill labyrinth using Reinforcement Learning with Unity ML-Agents and Curriculum Learning

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Self-optimizing Systems
Winter Term 2022/23
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Abstract. This project report examines curriculum learning in Unity ML-Agents using a 3D skill labyrinth as an example. The task involves tilting the board on two axes to guide a marble through a labyrinth, filled with walls and holes, through which the agent must steer the marble in order to follow the correct path and reach the end. The agent's performance was evaluated using two different approaches: standard reinforcement learning and curriculum learning. Curriculum learning involves starting the agent with simpler sub-tasks, and gradually increasing the difficulty over time. The paper covers the technical details of the project, including setup of the environment, tuning of parameters, reward engineering and performance analysis of the trained agent.

Keywords: Reinforcement Learning · Curriculum Learning · Unity ML-Agents

1 Introduction

Machine learning (ML) is a subset of Artificial Intelligence (AI) that focuses on the development of algorithms and statistical models that allow computers to learn from data and make predictions or judgments without being explicitly programmed. Reinforcement Learning is a type of Machine Learning that focuses on teaching agents to make decisions in a given environment by maximizing a reward signal. It is a method for an agent to learn how to behave in a given situation by executing specific actions and watching the rewards that the environment provides.
ML and RL are widely used in a range of applications, such as robotics, autonomous vehicles, finance, healthcare and games. This report explores Reinforcement Learning in the latter one, by creating a complex and agility focused labyrinth environment, that an agent has to successfully solve. With the help of Unity's ML-Agents [2] a model is trained using the standard Reinforcement Learning and Curriculum Learning [3] approach. The goal of this project was to explore the process of an agent learning a fine motor task. The following chapter

will explain the setup of the board game in real life and as a game in the Unity engine [1] to lay the grounds for the third chapter, where the reinforcement learning aspects of this project are described. The focus is on the environment and training setup, as well as the reward engineering. In chapter four the used metrics are discussed and the results presented, in order to give a qualified statement in chapter five about the performances and show where the process can be improved.

2   Game Implementation

2.1   Game board

Fig. 1. The wooden game board, with the path to follow.

References

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