Godot RML Agents

Creating RL Agents to solve games on the Godot engine

Sponsor: Ron Wright

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I. Introduction

The recent advancements of machine learning (ML) and artificial intelligence (AI) have made it an essential skill to learn in order to stay competitive in the future workforce. The goal is to introduce foundational knowledge of AI and ML into a K-12 curriculum as it currently lacks teaching students the current and most modern technologies.

This project seeks to address that gap by introducing a new competitive event in collaboration with SciOly and SkillsUSA, where students are tasked with designing and training a Reinforcement Learning Machine (RML) agent to complete a video game challenge. This will be made to provide students with an introduction to RL techniques by allowing them to build their own agents and apply theoretical concepts in a fun, practical environment.

Wahkiakum School District is pioneering this initiative as part of a K-12 curriculum strand focused on equipping students with RL skills. The project requires the creation of multiple RML agent solutions that can serve as benchmarks for student teams. These agents will be tested during a Trial Event, with the ultimate goal of refining the event for potential use at the WA State Science Olympiad (SciOly) competition. By participating, students will not only gain valuable technical skills but also become more familiar with the broader field of AI.

II. Background and Related Work

This project falls within the domain of applying RL techniques to video games, a field that has gotten a significant amount of attention due to the success of RL algorithms in various games, such as AlphaGo and OpenAI's agents for Dota 2. Games provide a great environment for RL because they offer complex and dynamic challenges, making them suitable for testing agents' adaptability and problem-solving skills.

Our work will focus on translating current RL techniques into an educational context, making it accessible for K-12 students who are just beginning to explore the field. The agents will be designed to solve simple game-specific challenges, collecting rewards and avoiding obstacles, using RL principles. Additionally, we will be creating a game for next year's competition as well.

This project does not aim to innovate new RL algorithms but rather focuses on creating a simplified, practical framework where students can learn core RL concepts. Our primary contribution will be the development of multiple RL agents that serve as purely educational tools.

Overall, here is a brief overview of the technical skills required for this project:

GD Script for Godot

- The team will need to become proficient in Godot’s programming language, GD Script, which closely resembles Python. Given the team’s experience with Python, GD Script should be relatively easy to learn and apply.

Monte Carlo Reinforcement Learning

- The team must understand how Monte Carlo methods apply to RL, particularly in the context of game environments where episodes can be fully simulated, and rewards collected over time.

Godot Game Engine

- The team will need a strong understanding of how the Godot game engine works, including handling input, managing scenes, and creating game objects. This knowledge is crucial for embedding RL agents within the game.

Integration of RL Libraries in Godot

- Familiarity with integrating RL libraries or custom RL solutions into the Godot engine is necessary.

Documentation and Curriculum Design

- Since this project involves creating educational resources, the team will need to develop clear, step-by-step documentation. This will help students understand how to implement RL solutions in their own games, making the learning process accessible and engaging.

III. Project Overview

In the last few years it has become increasingly popular to develop reinforcement machine learning algorithms to play games. Many videos on youtube show algorithms that have learned to play pacman, flappy bird, pokemon, chess, and pool along with several other games (“Code Bullet”). With the increasing interest in RML, our project is focused on helping our client teach the concepts of reinforcement machine learning to middle school students.

This project’s goal is to assist Ron Wright with a student competition that will require the students to develop reinforcement machine learning models. Students will be in groups of three and work to develop a game in godot. After they have completed the game implementation they will work to create a RML agent that can play the game. Students will also be required to submit documentation for their work. This will be graded based on the game, RML agent, and a multiple choice test on RML.

We are assisting Ron with finalizing the rules for the competition along with providing RML models to solve a simple game in godot. In the game, the player is a tank moving on a surface collecting daisies. The goal is to collect daisies for 30 seconds and then return to the starting point within 5 seconds after the initial 30. Only one daisy will be on the map at a time with its location given to the player as coordinates on the map. There are no enemies or walls in the game, however the player must avoid falling off the edge of the map. Once a player falls off the edge they are unable to get back and collect daisies.

Our first solution to this game will use the monte carlo algorithm. This will involve using a sample of simulations to develop a policy for which actions the agent should take. The agent will need to make different decisions depending on its distance from the next daisy, the direction to the daisy, its position on the board, and the time it has been playing.

Our second solution will use a different algorithm to complete the same game. The purpose for creating multiple algorithms is to provide our client with a variety of solution methods. This will allow Ron to better prepare for the competition and give him a better idea of how to grade different solutions.

In the second part of our project we will be creating games for next year’s competition. It will be important to make games that are fun to play with the right level of complexity. The games will need to be simple enough that students can create RML agents to play them while being complex enough to allow a wide variety of solutions. Support documents for these games along

with well documented code will be needed to ensure that students can spend their time learning about RML rather than struggling to understand the game.

We will develop our games using the godot game engine. The godot game engine is free to use and gives users full ownership of the games they develop using the engine (“Introduction”). This will allow us to create the games for free without worrying about how they are used in the competition.

Games completed for this second part of the project will need to be different from each other so that there is a variety to choose from. This will increase the variety of solutions and give students more ideas for the game they design and solve. Our solutions will need to be well documented to help the students build on their understanding of programming languages, game design, and reinforcement machine learning.

IV. Client and Stakeholder Identification and Preferences

Our primary client is Ron Wright. Our goal with this project is to provide Ron with some RML algorithms to solve his snake game in godot. This will be done to prepare Ron for different solutions that he might see from students when they complete this task. Our RML models will also make student solutions easier to grade by providing complete solutions for comparison.

Since we are helping Ron decide on some of the rules for this student competition, the students that will be participating are also stakeholders. We need to make sure we are giving complete and high quality solutions and rule recommendations to ensure that students are graded fairly.

In the spring, it will be even more important to recognize the students as stakeholders since we will be creating games to be used in next year's competition. For this task we will need to create bug free games that students can create RML models to solve. These games will need to have the right amount of complexity to make the competition interesting while also being simple enough for students to solve with RML. The games we create should be well designed and documented for students to learn the basics of RML.

V. Glossary

RML, reinforcement machine learning: a group of algorithms used to solve problems through repeated trial and error. Algorithms are improved based on the reward or penalty received from each move or episode.

godot: a free to use open source game engine.

VI. References

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