**Investigating AI approaches and how they challenge resolutions: State AI vs Machine Learning**

This document will explain the aims and objectives of the project, my motivation behind choosing this topic and what problems I aim to solve. It will also summarise the work I will undertake to achieve the objectives.

**Motivation and Rational**

The context

The problem

The rationale

**Aims and Objectives**

The overall aim of the project is to investigate how different AI approaches can change the outcome of a hardpoint game and examine the learned behaviour of the AI units over time. This will be done by studying the wins/losses of a State AI team against an AI team that is being taught using deep reinforcement learning and imitation learning. Further aims of the project will be to explore the behaviours generated by the machine taught AI and how it compares to different “human” gameplay styles. For example, answering the questions: are the agents aggressive in their attacks, or more defensive? Do they “camp”?

Objectives

1. Explore and research different AI approaches and how they are implemented, focusing on Unity
2. Gain familiarity and competency in using Unity to generate self-playing games using AI Agents and machine learning
3. Understand the limitations and risks of bias algorithms in machine learning and how these could affect the outcome of the study
4. Develop a prototype that can host AI units and run a Hardpoint game which can be watched and observed. The prototype should focus on simplicity for its interface to ensure it is easily viewable and understandable
5. Develop a State AI agent that can successfully complete a game of Hardpoint with no human interaction
6. Develop and train an AI agent using deep reinforcement learning and imitation learning to complete a game of Hardpoint
7. Gather and evaluate the outcome of a Hardpoint game when the two AI agents are played against each other multiple times
8. Gather, evaluate, and discuss the behavioural patterns developed by the two AI agent types over time by observing and recording the changes

**Background**

|  |  |
| --- | --- |
| **Resource** | **Info** |
|  | Description  Reason |
|  | Description  Reason |

**Work Plan**

This project will last for 3.5 months, with the first 3 months dedicated to developing the project. The remaining time will be for solidifying and writing up my findings.

I have developed a Gantt chart to help plan and organise the progress to be made throughout this project. The chart highlights the key tasks that need to be completed in a weekly format. It shows when a task should be started and finished with the darker colours representing main tasks to be done and the lighter colours representing background tasks that should be constantly occurring over a long period of time. For example, the research into similar topics and the tools/skills needed should continue even whilst implementation is happening.

Timeline

Description automatically generatedWhilst it is not fully clear from the diagram, I will be using the Agile Development methodology during the implementation stages as there are clear cut objectives to achieve during this time, but they don’t have to be dependant on each other – making this strategy favourable over the Waterfall methodology.

The chart shows that I will start with a research phase. I will research into the different types of AI approaches and other studies/articles that have done similar topics to further my understand for this project. Also during this stage, I will be continually improving my skills needed for the implementation stages. I will be using online resources surrounding the Unity Physics Engine and the Unity Machine Learning Agents to become more knowledgeable about how to use them to ensure I can provide the best quality outcome of this study. As seen by the chart, research will begin early, but it will continue throughout the project. This will help to achieve objectives 1,2 and 3 by the end of the project.

The implementation and testing stage work alongside each other and will be the most intense part of the project. Due to this project using the Agile Development methodology it is expected that testing will occurring throughout the implementation stages and in more depth at the end of each sprint which is 2 weeks long. During Sprint1, I will cover objectives 4 and 5 by building the initial map level and implementing the State AI within Unity. By the end of the sprint, the State AI agents should be able to play the game without any human interaction. Sprint2 will partially cover objective 6 as training the AI will take time – with Sprint3 completing this objective. An additional part of the testing would be to record the development of the machine learned AI as this is part of objectives 7 and 8. This will occur continuously and will monitor the behaviour of the AI from the very beginning.

I have also included on the Gantt chart the other deliverables that that will occur during this project. This is to remind myself that they are to do as well as also ensure I know to take them and the time they will take into consideration when working. These include items such as the poster and dissertation.

Risks and Contingencies

This project will be using the Agile Development methodology for the implementation with each sprint introducing the next AI type. Sprint1 and Sprint2 are two weeks long but there comes the risk that work will not be completed within the sprint for a range of possible reasons, and this will cause a knock-on effect in the upcoming sprints.

In addition, the most significant risk for this project, is that the sprints I have planned extend into and through April which is the holidays. Whilst I plan to continue the implementation during this time, home life and other responsibilities expected of me may interfere with this and may result in delays. To help manage this, Sprint3 is significantly bigger than Sprint1 and Sprint2 but with the same amount of work planned for this stage. This will help to accommodate for any interference during the sprint as well as allowing for work not completed in previous sprints to be now completed before the deadlines.

**References**