DEVELOPMENT OF A 2D PLATFORMER GAME AND MACHINE LEARNING MODEL

by

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A dissertation submitted in partial fulfilment of the
requirements for the award of

BACHELOR OF SCIENCE IN COMPUTER SCIENCE

May 2025

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I declare that this dissertation is my own work and that the work of others is acknowledged and indicated by explicit references.

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May 2025

Abstract

This dissertation explores deep reinforcement learning in video games by developing a Deep Q-Network (DQN) agent capable of autonomously playing a custom 2D platformer game. The game is built using the Godot, a lightweight open-source game engine, and the model is implemented using the PyTorch deep learning framework. The model is lightweight enough to run on the CPU, but can be accelerated using a GPU. Experimental results show the DQN agent successfully learned effective strategies, achieving times comparable to human players. The agent's performance improved with training, demonstrating the potential of deep reinforcement learning in video games.

Acknowledgements

I would like to thank my supervisor Dr Daniel Gardham for being on board with my idea from our first meeting, as well as his continued guidance and support, had it not been for him I would likely have picked something much more straightforward and within my comfort zone. I would also like to thank my friends and family for encouraging me along the development of this project. Thanks also go to the Godot contributors who work tirelessly, for free, on this wonderful game engine.

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Abbreviations

AI	Artificial Intelligence
DQN	Deep Q Network
ML	Machine Learning
RL	Reinforcement Learning
DRL	Deep Reinforcement Learning
NPC	Non-Player Character
FSM	Finite State Machine

Chapter 1

Introduction

1.1 Background

In the area of video games, Artificial Intelligence (AI) has been used for many years to create non-player characters (NPCs) that can interact with players in a believable way. This is often done using finite state machines (FSMs) or behaviour trees, which allow NPCs to react to player actions in a way that seems intelligent. However, these methods can be limited in their ability to adapt to new situations, due to being based on pre-defined rules and behaviours. For example, developing an FSM for a procedurally generated game, or one with another amount of randomness involved, can be difficult or even impossible, as the FSM must be able to handle all possible situations that may arise. This is the problem I will be addressing in this project. DRL is a subfield of machine learning that combines deep learning with reinforcement learning, allowing agents to learn from their environment and improve their performance over time. In the context of video games, DRL can be used to create agents that can learn to play games by interacting with the game environment, then receiving feedback in the form of rewards or penalties. This allows the agent to learn from its mistakes and improve its performance over time, without the need for any pre-defined rules or behaviours. DRL has been successfully applied to a variety of games, including board games like Go and chess, as well as video games like Snake. However it generally has not been applied to games in a useful capacity, such as creating in-game NPCs.

1.2 Aims and Objectives

The aim of this project is to explore the use of DRL in video games by developing a DQN agent capable of autonomously playing a custom 2D platformer game, and apply it to the game in a useful way. The objectives of this project are as follows:

- Research the current state of DRL in video games, including existing methods and techniques.
- Develop a custom 2D platformer game which will serve as the environment for the DQN agent.
- Develop a DQN agent capable of playing the game.
- Train the DQN agent and evaluate its performance, comparing it to human players.
- Apply the trained DQN agent to the game in a useful way, such as creating an NPC that can interact with players.

1.3 Limitations

The scope of this project will be limited by the following limitations:

- The project will focus on a single game, rather than a variety of games.

1.4 Structure of the Report

This is the structure of the report

Chapter 2

Literature Review

2.1 Paper

this is some lit review

2.2 Paper 2

this is some more lit review