Player Emulation in Video Games using Artificial Intelligence

B.Sc. (HONS) Computing with Games Development

Supervisor: Robert Sheehy

Student Number: T00200674

Student: Ben Lenihan

Munster Technological University, Dromthacker, Tralee, Co. Kerry

# Abstract

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# Introduction

# Artificial Intelligence

## Introduction

Artificial Intelligence is a branch of computer science concerned with building programs that can perform tasks that would, under normal circumstances, require human intelligence. “It is the science and engineering of making especially intelligent computer systems.” (Mccarthy, 2004)

The idea of Artificial Intelligence can be traced back as far as the 1950’s with Alan Turing’s work “Computing Machinery and Intelligence”. In this paper Turing asks the question “Can machines think?”(Turing, 1950). He then establishes out the “Turing Test”. This is a test in which a human interrogator is supposedly able to distinguish between a machine and a human. Developments since then have already allowed Artificial Intelligence to surpass humans in some areas. In 2015 Google’s AI AlphaGo played the European Go champion Fan Hui.(Stanek, 2021)

Artificial Intelligence is utilized in many areas such as “assistants” in the form of Apple’s Siri, in games for non-player characters, self-driving cars and the AlphaGo AI that beat Fan Hui.(European Parliament, 2021)

## Machine Learning

Machine learning is a sub-branch of Artificial Intelligence focusing on the use of algorithms and data to replicate the way humans learn.

UC Berkeley describe a typical machine learning algorithm as follows:

1. **A decision process:** A recipe of calculations or other steps that takes in the data and returns a “guess” at the kind of pattern in the data your algorithm is looking to find.
2. **An error function:** A method of measuring how good the guess was by comparing it to known examples (when they are available).
3. **An updating or optimization process:** Where the algorithm looks at the miss and then updates how the decision process comes to the final decision so that the next time the miss won’t be as great.(Tamir, 2021)

# Algorithms

## Introduction

An algorithm is a set of step-by-step instructions created to solve a problem. Computers are only able to operate the way they do by the algorithms they are given. Algorithms are the starting point of any program.(BBC, 2021)

## Decision Trees

A decision tree is an algorithm used for machine learning. A decision tree starts at one point (called a node) and branches into at least two directions, each branch offering different outcomes. Decision trees consist of three types of nodes.

* Decision nodes: These represent a decision to be made by the system.
* Chance nodes: These represent a probability of what will happen.
* End nodes: Representing an outcome.

These nodes are connected by branches. These nodes and branches are reusable and can be used in any number of combinations to create more complex trees. The first node is called the “root node” this, while the final nodes, representing outcomes, are called the leaf nodes. The nodes between these are called internal nodes, these represent decisions or chances depending on the tree’s purpose. Sometimes these trees can put too much emphasis on irrelevant data. In these instances, a process named pruning can be used. In this process unnecessary data is removed.(Hillier, 2021)

Diagram

Description automatically generated

Figure 3.1. - Simple Decision Tree using chance nodes(Hillier, 2021)

## Neural Networks

A neural network is a subset of machine learning inspired by the processes of the human brain. Neural networks attempt to mimic the ways in which biological neurons signal one another. Neural networks are made up of layers of nodes, these are divided into an input layer, one or multiple hidden layers and an output layer. The nodes connect to each other and have associated weights and threshold values. If a node is above the threshold value, it activates sending data to the next layer.

Neural networks train the data to learn and improve their own accuracy overtime. Once a network has been trained to be sufficiently accurate it enables a high velocity of data classification to be done. These algorithms are often used in speech and image recognition as well as in Google’s own search algorithm.

Diagram

Description automatically generated

# Technologies

## Android Emulators

An Android emulator is a software which simulates the Android operating system for mobile devices on a desktop computer. This allows applications created for Android to be run on another system such as Windows. The emulators being examined here are:

* Bluestacks
* LDPlayer
* NoxPLayer
* MEmu Play

### Bluestacks

Bluestacks is among the most popular Android emulators, claiming more than 500 million users. It features a large library of compatible Android games and is constantly growing its library. It contains many features such as keyboard control, multi-instances, allowing multiple instances of the same application to be run at the same time, and cloud-based platform usage alongside its more traditional desktop application(Bluestacks, 2021)

### LDPlayer

LDPlayer is a popular Android emulator with more than 4 million daily users. It claims to support more than 1 million games. It supports features custom keyboard controls and multi-instance allowing the same app to be opened and used at the same time.(LDPlayer, 2021)

### NoxPlayer

NoxPlayer is a popular Android emulator. Claiming to have over 150 million users across 150 countries. It supports common features such as keyboard control mapping and multi-instances of applications.(NoxPlayer, 2021)

### MEmu Play

MEmu Play is another popular Android emulator. It reports over 100 million downloads and supports keyboard mapping and multiple instances.(Microvirt, 2021b; a)

## Evaluation of Android Emulators

These emulators are broadly similar in their abilities, making a decision between them difficult. However, benchmark tests done by Bluestacks show a number of differences in how resource intensive these emulators are compared to their peers. As these benchmark tests are done by Bluestacks themselves it is possible they are not entirely reliable. These benchmarks show Bluestacks as being the least resources intensive when compared to other common emulators.

## Programming Languages

* Python – A general-purpose object-oriented programming language (chosen)
* C# - Object-oriented language created by Microsoft

# Methodology

## Research Undertaken

## Research Question

An evaluation into the use of an artificial intelligence to replicate a human player in a mobile game.

## Proposed Project Implementation

This aim of this project is to design and build an artificial intelligence to play a mobile game, Fate/Grand Order. This will be done using a decision tree algorithm in Python and an android emulator in the form of Bluestacks. This is intended to investigate possible ways to automate aspects of games, replacing human input.

## System Design

## Prototype

|  |  |  |
| --- | --- | --- |
| Prototype | Start Date | Finish Date |
| 1 | 12/11/2021 | 12/11/2021 |

|  |  |  |
| --- | --- | --- |
| Task Number | Details | Status |
| 1 | Setup Android emulator | Complete |
| 2 | Create Fate/Grand Order profile. | Complete |

|  |  |  |
| --- | --- | --- |
| Prototype | Start Date | Finish Date |
| 2 | 12/11/2021 | //2022 |

|  |  |  |
| --- | --- | --- |
| Task Number | Details | Status |
| 1 | Setup Python Environment | Complete |
| 2 | Create representation of Fate/Grand Order’s board using python. | Complete |
| 3 | Create | Complete |
| 4 | Create representation of Fate/Grand Order’s battle system using python. | Complete |
| 5 | Create a Decision tree prototype | In progress |

# Implementation

## Sprints

### Sprint 1

|  |  |  |  |
| --- | --- | --- | --- |
| Sprint Number | Sprint Name | Start Date | Finish Date |
| 1 | Prepare Search Tree |  |  |

|  |  |  |
| --- | --- | --- |
| Task Number | Details | Status |
| 1 | Create a Card object to reference the game’s cards within the search tree. | Completed |
| 2 | Create a Node class to store information about each turn in the game. | Completed |
| 3 | Create a method to create children, Nodes showing each possible sequence of events, for the first node. | Completed |
| 4 | Create a method for making children for each subsequent child Node of the first for three turns | Completed |

|  |  |  |  |
| --- | --- | --- | --- |
| Sprint Number | Sprint Name | Start Date | Finish Date |
| 2 | Prepare Minimax algorithm |  |  |

|  |  |  |
| --- | --- | --- |
| Task Number | Details | Status |
| 1 | Create method to calculate the damage each move will do | Completed |
| 2 | Create a method which finds the move which will do the maximum damage for each move | Completed |
| 3 | Utilise these to find the optimal for each possible path for each | Completed |

# Findings & Conclusions

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