Practical Applications of AI and Machine learning in different areas within the Game Development Industry and multiple implementation approaches.

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Abstract—This paper draws a rough sketch of what the gaming industry represents in the current world and how AI and Machine Learning became almost core to it. It explains some areas in video games where AI is implemented and the different approaches used in order to maximize "human like" behaviour when required and how AI can be used to improve performance in pathfinding for the game agents.

Index Terms—AI, Machine Learning, Gaming, Game Design, Pathfinding, Agents, RTS, AI Behaviour.

1 Introduction

We have come a long way since first video games were created back in the 1950's. The first of which was 'Tennis for Two', introduced on October 18, 1958, at Brookhaven National Laboratory, An electronic tennis game that would become the father of modern video games[1]. But what is essentially a video game? As defined by [2] video game [noun] "A game played by electronically manipulating images produced by a computer program on a monitor or other display". Born in laboratories the first video games were developed by scientists putting the computational frames on Universities to the test.

On the other hand Artificial Intelligence as a concept was born earlier culturally in the form of robots on films and comic books. Alan Turing a British Mathematician started to tread the path by suggesting that just like human process information to make decisions, machines could equally do it. However, it was not until the 1950's that computational capabilities were powerful enough, not only to perform operations but also store to commands, to do some actual practical research. AI as such was conceived as such in a famous conference presented at the Dartmouth Summer Research Project on Artificial Intelligence (DSRPAI) hosted by John McCarthy and Marvin Minsky in 1956[3].

As technology progressed very much in accordance to Moore's law, the increase in computational power allowed both fields, AI and Video Games to develop even further from the expected. As video games have grown both in scope and depth, AI has become an entwined part of it. Not only to create bots capable of defeating humans in games such as Chess or Go, but also to create better gaming experiences and more realistic behaviours in NPC's (Non-playable Characters) in video games, and more enjoyable challenges in an ever growing industry. According to a newzoo article[4] about the gaming Industry revenue in 2017, it is expected that 2.2 billion gamers worldwide will generate $108.9 billion in this year's exercise, which represents a significant increase from previous years.

In this paper, we pretend to introduce some of the most common uses for AI that predominate in video games, and provide a definition as well as to explain some approaches to implement them. We will also provide an insight of how machine learning has improved both capabilities and performance of some of the proposed models and algorithms and how can they be tuned to increase outputs.

1.1 Pathfinding

Pathfinding is a technique or a process carried by a software running in a computer from which the shortest path or route between two points is extrapolated. Pathfinding is, not only important in video games, but also in other areas such as delivery, transport services and intelligent storage among others. Pathfinding algorithms are usually heavily based on the Dijkstra's algorithm[5] which implies what follows: Let the node starting be X. Let the distance of node Y be the distance from X to Y. Dijkstra's algorithm will assign some initial distance values and will try iteratively to improve them step by step.

However there are other approaches using different techniques.

1.1.1 Using Potential Fields

In 1985, Ossama Khatib discussed a new concept in regards a real-time obstacle avoidance for manipulators and mobile Robots. He named it Artificial Potential Fields[6]. In 2008, Johan Hagelback et al.[7] used it to create a Multi-agent Potential Field-based Bot for Real-Time Strategy Games(RTS) in which objects in the map where assigned charges (like

magnetic chargers positive or negative) and such charges were used as forces to attract the agents to specific destination or to repel such agents to avoid collisions or to delimit the terrain.

They proposed two-different scenarios using Open real-time strategy (ORTS) engine to deploy the bot. In the first scenario the task of the bot was to recollect as many resource as possible in a limited amount of time. To do so Johan Hagelback et al. had 20 agents (workers) using a finite state machine (FSM) to define their behaviour and assigned the charges to the agents, to the resource gathering point, the base were resources had to be delivered and "sheep" moving around the map to provide moving obstacles. Even though the results shown that the bot was prone to disconnect from the game in some occasions, it beat bots developed in previous years improving the average of resources gathered.

For the second scenario, using ORTS, the scenario was a tank game, where two player had a number of tanks and bases and the goal of the game was to destroy both enemy bases and tanks. After outlining the rules for the game agents, they assigned the charges accordingly and programmed the bot to avoid situating tanks in the middle of enemy clusters. The results of such scenario, tested against other bots, were of a 98% of victory rate over their opponents.

1.2 Machine Learning

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1.3 Defining Behaviour

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1.4 Performance

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1.5 The future of AI in Games

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2 Conclusion

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