Detailed Project Proposal

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Defining your Project

1.1 Project title

Help: a brief statement about what you are actually going to do.

Augmenting Deck Building AI using Deep Neural Networks and Genetic Algorithms for Hearthstone: Heroes of Warcraft

1.2 Background

Help: Provide the background to your project. This section should highlight the main topics in the area you are going to research. Essentially what is the project about, what has been done before and why is this project important? ~500 words

Hearthstone is a card game, more specifically a digital card game where two players face off wielding each a deck of their own making. Decks consist of no more, no less than 30 cards. Players then take it in turns to play their cards, the objective being to reduce the other players health to 0. Each turn a player draws a card and gains a “Mana Crystal” up to a maximum of 10 (crystals are refreshed every turn), these crystals are expended to cast a card from the player's hand. Before a match each player chooses to embody a class (such as Mage, Warrior, Rogue, Druid, etc…), each class has specific cards only they can add into their deck, these are adequately named “Class Cards”, these are accompanied by “Neutral Cards” that any class can use. Each card in the game has a “mana” cost which shows how many mana crystals are needed to cast that card. They also have a card type, rarity and an effect. Players have a “Collection”, where the cards they own are stored, to get new cards players must buy card packs with gold, the in-game currency of Hearthstone. Gold is earned slowly through quests, winning and events, it can however be sped up through the purchase of gold with real life currency.

The aim of this project is to develop an artificial intelligence for this game that builds a deck for a player based on the class they have chosen and the cards they own. It’s main objective is to assist players in building a reliable deck if they don’t have an idea of what to construct, to find reliable cards to fill incomplete decks and to help players that don’t spend money on the game (free-to-play players) to not get flushed out by the people who do. One of the biggest problems with the game is the fact that new players have a hard time getting

into the game and winning since they are up against people who own all the cards when they in fact have not. This division is accentuated my the length of time it takes to accumulate gold, a pack of 5 cards is worth 100 gold and a player gets 1 quest per day to a maximum of 3 awarding between 50 – 150 gold. So it may take weeks to accumulate a handful of random cards (including duplicates).

Currently there is an AI implemented that assists in deck completion via suggesting cards to add, however it is quite simple and does not update when there are new cards added to the game. There is also a similar creation related to another game called “Magic: The Gathering” however that game has a very different rule set and is split across digital and physical platforms to play.

To sum up it’s goal is to make the game more accessible to new players and better for the current ones.

1.3 Motivation

Help: To whom is this project important? A project must address a question/problem that generates a small piece of new knowledge/solution. This new knowledge/solution must be important to a named group or to a specific client (such as a company, an academic audience, policy makers, people with disabilities) to make it worthwhile carrying out. This is the ***motivation*** for your project. In this section you should address who will benefit from your findings and how they will benefit. ~300 words

> **Example** 1: If you intend to demonstrate that a mobile application that automates class registers at RGU will be more efficient than paper-based registers - the group who would be interested in knowing/applying these findings would be both academic and administrative staff at RGU and they would benefit by time saved and a reduction in their administrative workload.
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> **Example** 2: You are demonstrating that a particular 3D model design increases realism in 3D environments. The group that would be interested would be games designers or developers of 3D virtual environment applications. The would benefit from producing more realistic environments that could increase sales of their products.
>
> **Example** 3: You have designed a new network topology for IrishOil plc’s new Aberdeen headquarters. The interested group would clearly be IrishOil. They would benefit from easier maintenance and improved security of their computer network.

This project will be at the benefit of players to Hearthstone, this AI will allow them to improve at the game and be more creative in their deckbuilding rather than relying on community submissions. The player base of Hearthstone splits into 2 categories, the free-to-play players and the pay-to-play players. The former do not spend money thus they might missing cards for a deck they want to make, the latter also have that problem but to a lesser extent. It also depends on how frequently a player plays the game, some players just want to play casually when commuting from time to time whereas others play everyday, most of the day which also accentuates this disparity

between players. The AI seeks to help reduce this disparity between players, allowing for a better experience for all parties.

All people are different in the world, they look different, dress different and they choose to spend their time differently. Some may dedicate their life to mastering the violin whereas another just wants to play a single song. In Hearthstone: Heroes of Warcraft this is no different, players choose how much time and money they want to spend in the game, each investing the amount they deem right. This creates a spectrum spanning from casual players who play infrequently and hardcore players who play everyday. Usually diversity is good, but the way that Hearthstone have marketed their game values and rewards returning players, hardcore players, and award very little for those who seek an ephemeral pleasure after a hard day. My project goal is to rupture this disparity or at least reduce the severity of it, of course people who already own every card in their collection will get little benefit, but the players who seek casual play could gain greatly from this project as it will improve their deck quality and thus their enjoyment. I could also argue that it would assist Blizzard, the developers of Heartstone as it would increase the chances that the casual players play longer than they usually would. Why? Because it’s human nature, when we win, our brain creates dopamine, when we lose frustration appears, and no one wants to play a game that frustrates them. So this AI would increase the chances of winning and thus allowing users to play longer without tiring of the game. To conclude this project will benefit mostly new players, returning players and the company, it also has its place for even the most dedicated of players.

1.4 Aim & Objectives

Help: Outline what are the main things your project is going to do and what steps or milestones will be used to achieve this aim. The Aim is unlikely to change throughout your project; however, the objectives are likely to adapt to your ongoing research and development. In particular it is highly likely that you may wish to split objectives into sub-objectives as work progresses. A good clear set of objectives give you something to evaluate your final project against.

Example : For the timetable app outlined above
Aim: To create a functioning attendance application that efficiently automates the taking of class registers.
Objective 1: study existing register system in place at RGU and identify weaknesses
Objective 2: research existing automation technology's and identify and evaluate those that may be appropriate to taking in class registers
Objective 3: Implement chosen technologies to create prototype application
Objective 4: Conduct user trials to evaluate capabilities of prototype application
Objective 5: Create a refined application incorporating feedback from user trials

Aim: To create a functioning AI that builds reliable decks for players in Hearthstone: Heroes of Warcraft

Objective 1: Study similar iterations of my project from other games

Objective 2: Research various AI algorithms and identify those that would be appropriate to creating a deck

Objective 3: Implement chosen algorithms and technologies to create a proof of concept

Objective 4: Conduct trials via a Hearthstone game simulator to optimize the algorithms

1.5 Key Techniques

Help: Perform some initial research into the area and outline what techniques you my research in further detail here. The techniques you cover here should include references to the papers where you have sourced the information. The techniques mentioned here are very likely to become the section headers in your literature review.

Genetic Algorithms – Goodman-Wilson, D., 2018. Machine Learning Magic. Hackernoon: Don Goodman-Wilson. Available from: https://hackernoon.com/machine-learning-magic-64a6a7f864d4

Supervised Learning - Janikow C.Z. (1993) A Knowledge-Intensive Genetic Algorithm for Supervised Learning. In: Grefenstette J.J. (eds) Genetic Algorithms for Machine Learning. Springer, Boston, MA. https://doi.org/10.1007/978-1-4615-2740-

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Unsupervised Learning - Banković Z., Bojanić S., Nieto O., Badii A. (2008) Unsupervised Genetic Algorithm Deployed for Intrusion Detection. In: Corchado E., Abraham A., Pedrycz W. (eds) Hybrid Artificial Intelligence Systems. HAIS 2008. Lecture Notes in Computer Science, vol 5271. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-540-87656-4_17

Deep Neural Networks - Ward, H. et al., 2020. AI solutions for drafting in Magic: the Gathering.

1.6 Legal, Social, Ethical, Professional and Security issues

Help: Here you should discuss any legal, social, profession and security issues that you believe may occur during the course of your project. It is not acceptable to write none in this box, all projects, regardless of focus will have to address issues in one, or more, of these categories. This is an extremely important part of your honours project to which there is no correct answer, this section must be fully discussed with your Honours Supervisor.

Example 1 : In the class register example above – there would be a Legal and Security issue with the gathering and storage of student data. There may be a social constraint as you may be relying on a user to have access to a specific technology. There will need to be consideration of user accessibility.

Example 2 : A 3D model design may have ethical considerations in its evaluation. What if your model made users feel nauseous. Social constrains may again be access to technology or accessibility issues.

Example 3 : You network design need to adhere to specific company policies. You would need to consider the possibility that your design could be wrong, compromising the company's security.

There could be an Legal and Security issue with the gathering and storage of data from either play-testers or websites for the training of the AI. There could be a Security issue with the collecting of data from the AI.

There may be a social constraint as you need to play Hearthstone to use it

My AI would need to adhere to Blizzards company policies.

1.7 Project Plan

Help: This is the project plan as to how you will go about achieving the objectives of the project.

Example: In the class register example above the research plan may involve:
Collecting and analysing paper-based registers in a given class on five occasions.
Identifying the error rate average on these occasions
Researching existing automation techniques
Designing and implementing a mobile application that automatically records attendance in class.
Deploying the application in the class on five occasions.

Identifying the error rate average of the mobile application on these occasions. Comparison of data and summary of findings.

Research existing AI techniques and fitness methods Designing and implementing each AI deck building technique that records the win rate of the produced deck Deploy the AI on two separate Experiments with a different pool of cards Visualize collected data into graphs, tables and statistics Comparison of performance and summary of findings.

1.8 Ethics Form

You must include in your signed ethics form in this submission or you will not be able to continue the project.