Utilising Co-operative AI in Hearthstone to improve the new player experience

Project Proposal

DES501

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Abstract

CONTEXT >In multiplayer video games there exists a barrier of entry for new players that increases with time and content – this is the problem of the 'new player experience' when competing with older players with more knowledge and resources. Once specific genre that this can be observed in is the Collectable Card Game (CCG), with resources directly tied to the amount of cards within a player's collection. Hearthstone is a popular Online CCG that has been dealing with this issue in various ways.

AIM>A solution to this problem is the substitution of the mentor with an AI, wherein it would suggest what move to make to the player and explain its reasoning why.

METHOD> The inbuilt AI present in the open-source Hearthstone simulator *Spellsource* will be placed on the user's side and a tool will be created that relates its numerical decision tree to in-game implications and converts that into human-readable decisions. This will lead into testing the tool on inexperienced players and comparing respective win-rates pre and post usage.

RESULTS>This is with the expectation that players will learn of more abstract concepts within the game and be able to apply that reasoning themselves in regular gameplay without the tool.

CONCLUSION>Further investigation into dynamic sentence creation in opposition to pre-created phrases would increase the longevity and effectiveness of the tool. Potential for investigation into this method of teaching in other genres of game and its effectiveness there. Further polish and optimisation of the tool could lend itself to becoming a feature in the Hearthstone game proper.

Keywords: Hearthstone, AI, tool, decision tree, expert system.

Introduction

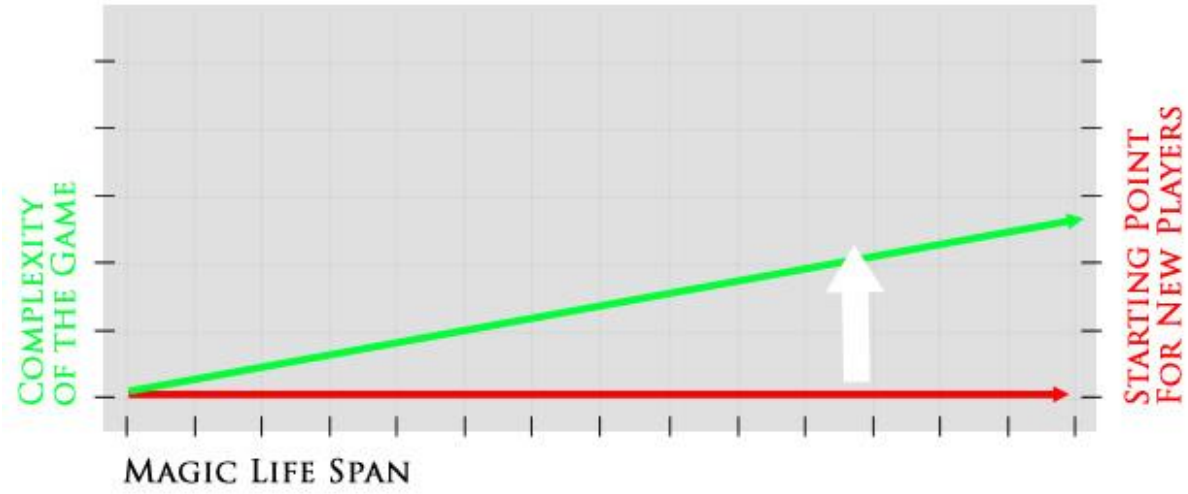

Figure 1 A variant of the new player experience problem present in another card game, Magic the gathering. (Rosewater M., 2011)

Any card game (physical or digital) that relies on updates to content to maintain interest of its players will inevitably approach the problem of the 'New Player Experience'. This problem is a compound of many different factors that have been covered in different methods; the specific problem trying to be solved in this instance is that of consistent player teaching as more cards are added. This specific facet of the problem– as has been viewed in other card games such as *Magic the Gathering* (Figure 1) – has been viewed as a part of the genre as much as a problem to be solved. With some CCG's being created digitally however, more tools and avenues to tackle this issue open up.

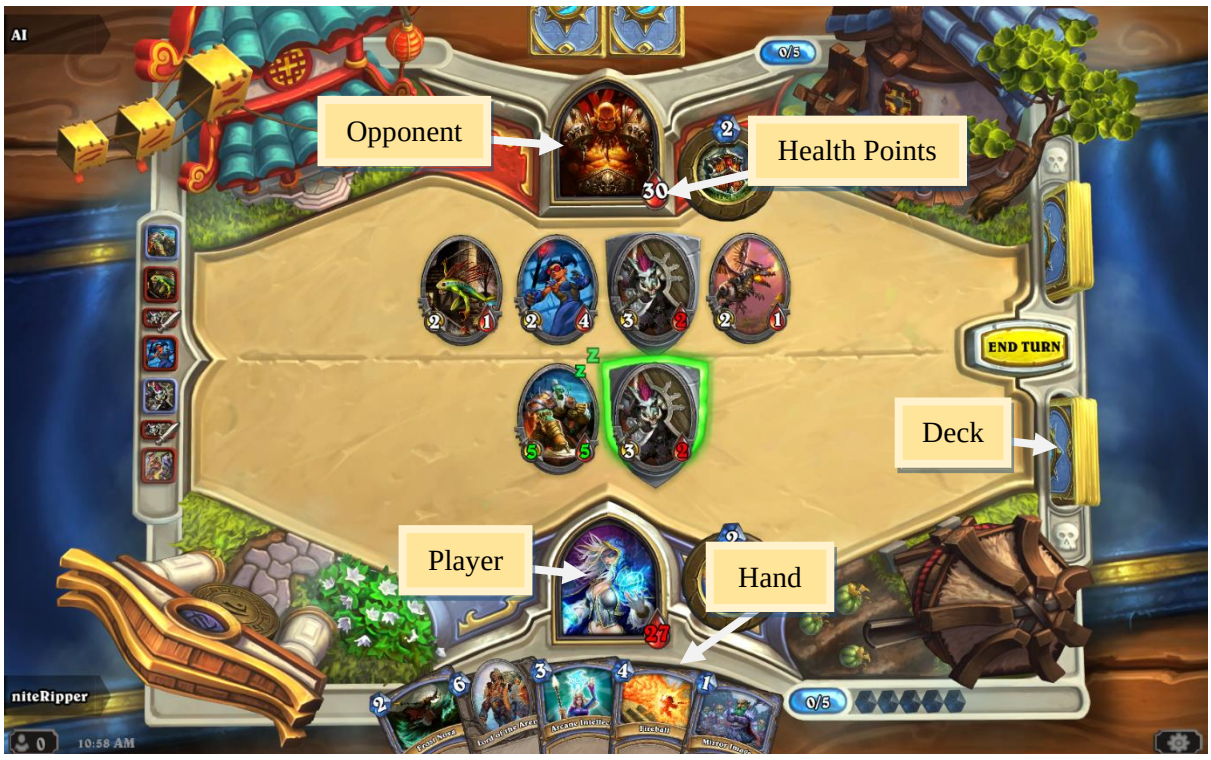

Figure 2 Labelled diagram of a typical game of Hearthstone

Hearthstone is an Online Collectable Card Game (CCG) that faces this particular problem more and more as time goes on since its release in 2014. The goal of this game is to reduce the opponents player's 'Health Points' to zero using strategies involving combinations of cards available to the player in their hand. Players can create decks containing 30 of these cards, each with unique abilities and rules, and then challenge other players to matches in the hope of victory for in-game rewards and enjoyable game experiences.

When beginning the game for the first time a new player is led through a tutorial that explains all of the basic interactions and values present within the game before they are then given a few basic cards with which to build decks with and a small checklist of defeating some Artificial Intelligence opponents. Once that is done the player can explore the game proper and fight other players in one of the various game-modes. To give Hearthstone's system for matching players some credit, new players are predominantly matched against other new players in a 'playpen' style until certain conditions are met (Blizzard Entertainment 2015), however these tutorials and new player zones teach basic controls but not critical thinking, gameplay strategy or deck-building considerations. One notable constant in regards to these values is Hearthstone's AI – which maintains the same intermediate level of strategy and combinatorial thinking regardless of time and amount of content produced.

With this in mind it seems obvious to utilise that source of strategy and rules to improve player's skill and knowledge. Utilising this as a mentor of sorts also bridges one of the greatest differences between a physical CCG and an Online CCG. Wherein physical games usually have social friend circles and communities that pull people in and connect with them on a case-by-case basis, Online games lack such individual connections and opt for a singular tutorial or teaching method and hope for each players perseverance. In a perfect world, every player would have another player that knows how to teach them and how to explain the game to them.

Due to the nature of player skill being an internal and individual problem, any exact statistics are nearly impossible. It can be inferred through different anecdotal and circumstantial sources though, that this problem is widespread. Whether it is as blatant as new players finding the game unenjoyable and leaving (DrLoaky 2018) or the creation of guides for specifically fresh players. Guides from new players (pong_ethan 2018), from hearthstone professionals ((Disguised Toast) Wang 2018) or from the company itself (Blizzard Entertainment 2018) shows that there is a demand for external teaching materials, indicating that there is not enough done to teach players in the games as it exists now.

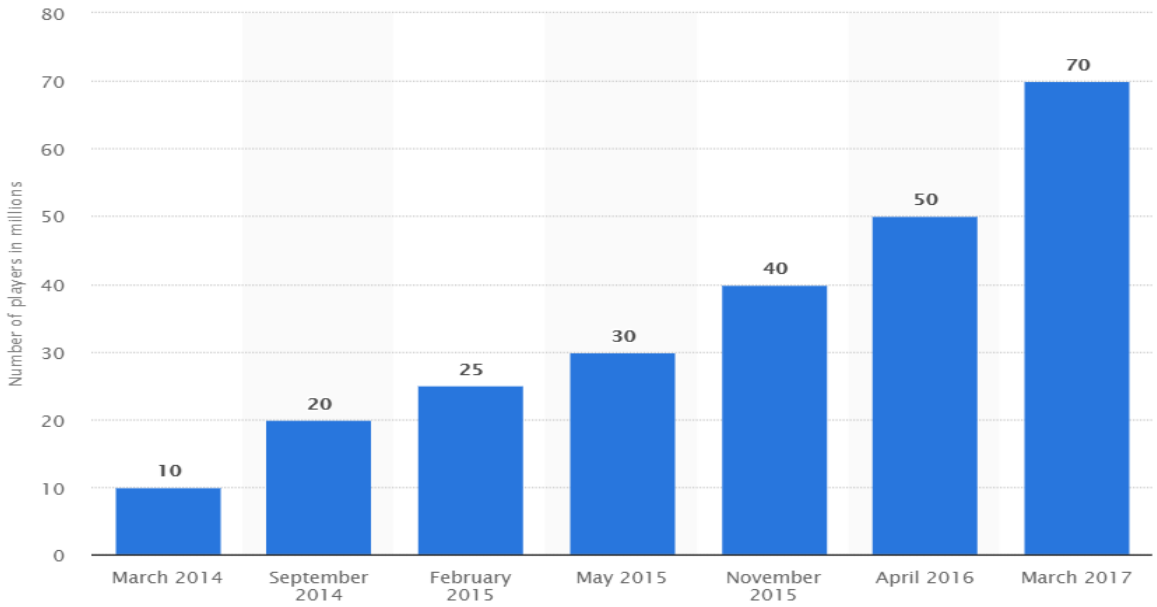

Figure 3: Active player statistics for hearthstone, based on released information

The social aspect of stores and real life friend circles cannot also be relied upon as a source of continued spread of the product. While the number of players has increased consistently since release (Figure 3), no game has survived solely by attracting new players to replace old ones. There needs to be a level of dynamic future proofing when considering an increasing game size in relation to player retention, lest the developers front-load any new player with information that could do more to push them away from the game than continue with it (Eppler & Mengis 2002).

Literature Review

"The biggest reason tutorials seem haphazard … is because often the tutorial is left as one of the last things to be completed in the development cycle" (Extra Credits 2012). This statement can apply to any video game, regardless of genre as this entails more of the design methodology and production schedule over anything else. A few major examples of tutorial design that gained a negative reception include the 1-2 hour long sequence at the start of *The Legend of Zelda: Twilight Princess* (Nintendo EAD 2006), the excessive amount of reading required to progress in *Endless Space* (Amplitude Studios 2012) or the complete lack of any tutorial and reliance on third-party explanations in *Crusader Kings II* (Paradox Development Studio 2012). While examples of bad tutorials can be found easily due to the nature of incompetence or deadlines, good tutorials are much harder to pinpoint as great examples teach the player subconsciously and remain as unobtrusive as possible. One good example lies in *The Witcher 3: The Wild Hunt* (CD Projekt Red 2015), where the tutorial is presented as the main character teaching another character – however the player can choose to skip it without missing any content, it is just presented as another narrative option. While many of the lessons that can be learned from good tutorials are universal, there are more specific challenges present in content changing multiplayer games (i.e., CCG's).

Hearthstone is a popular online collectable card game (Blizzard Entertainment 2017)) that consistently updates its cards while acquiring new players. The tutorial currently packaged with Hearthstone lies within the good category of tutorials as it involves teaching mechanics through narrative. However this game is not a linear experience and it also has the aim of appealing to people who do not usually play video games – with these considerations the tutorial unfortunately fails. As

more content is added and long-term players increase their skills and knowledge, new players must be taught critical thinking and abstract play if they want to stand a chance at victory against older players and also if the company making the game wants to retain them for longer.

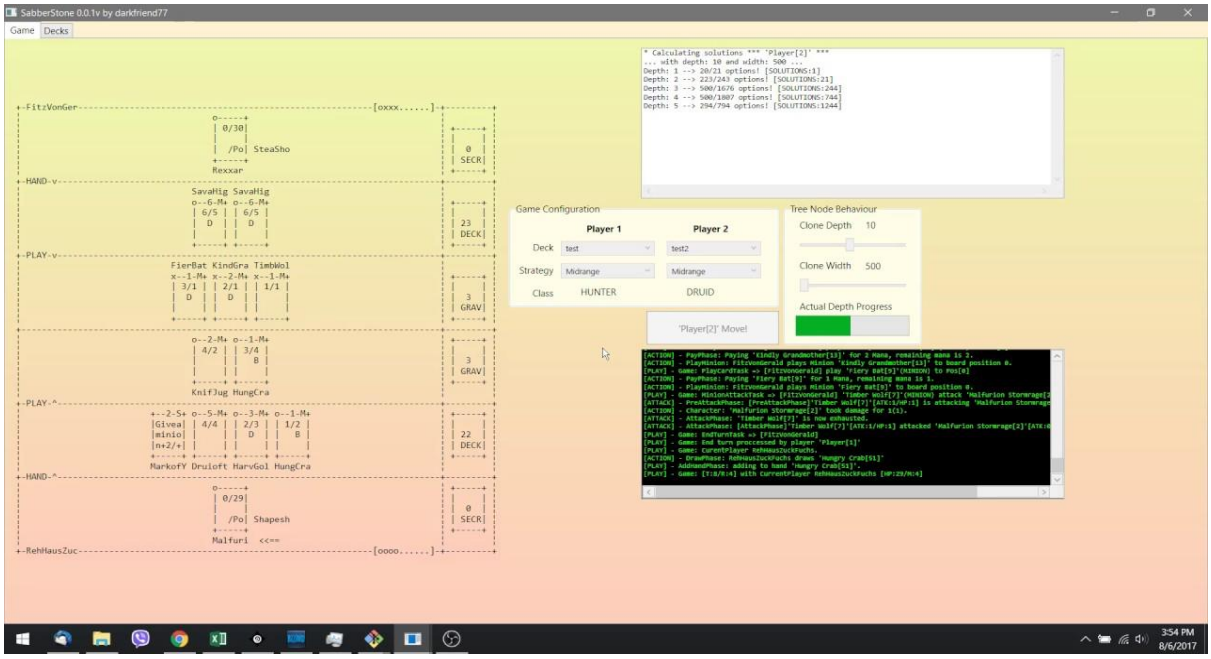

Figure 4 User interface of Sabberstone

Figure 5 User interface for Metastone

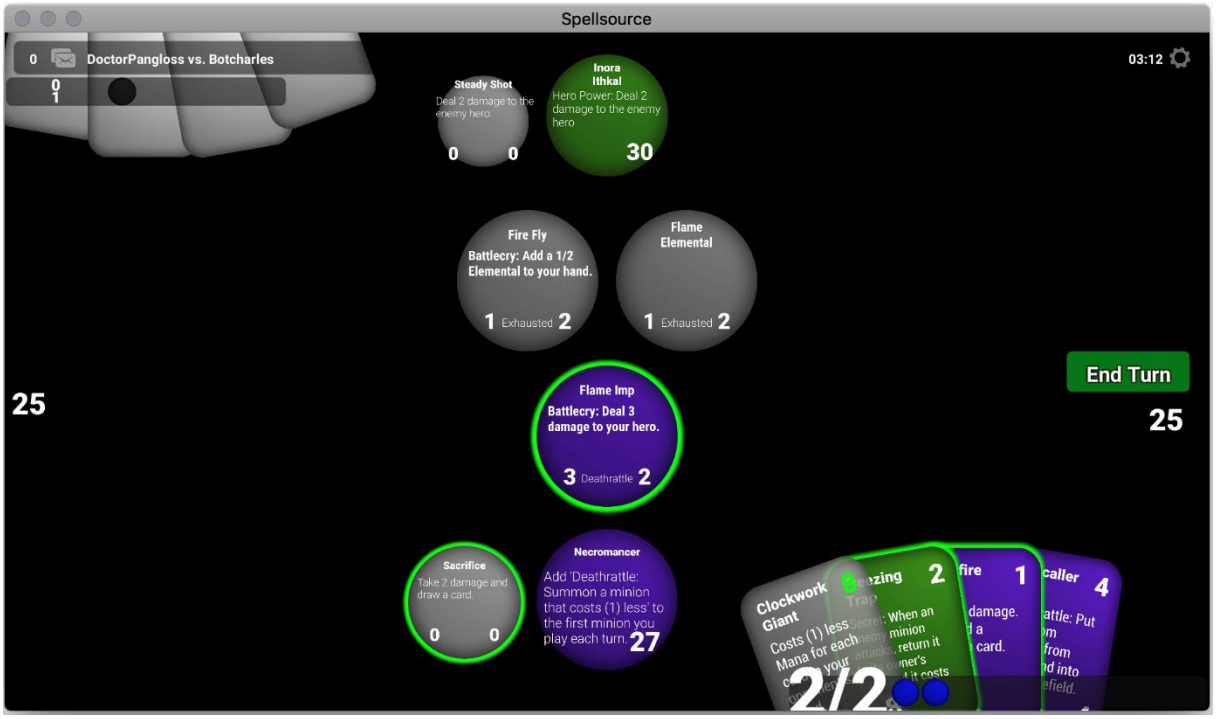

Figure 6 User interface of Spellstone

Since this project is based around displaying data from a re-used artificial intelligence based within hearthstone, sourcing a simulator of the game seemed like the next logical step. The three most popular simulators were identified based on download number and community size as Sabberstone (Sabberstone Community), MetaStone (Demilich 2018) and Spellsource (doctorpangloss, demilich1 2018). Each of these simulators were ranked against each other on the criteria of: Visual similarity to Hearthstone, The amount of community support, and the adaptability of an included AI. Using the data in Figure 7 it was decided that 'Spellsource' was the best choice for the tool, as the bonus of both AI and Community was greater than the visual fidelity of the simulator.

Simulator	User Interface	Community Support	AI Availability
Sabberstone	3rd	2nd	3rd
MetaStone	1st	3rd	2nd
Spellsource	2nd	1st	1st

Figure 7 Ratings of each simulator based on priority criteria

As a large component of this tool is the AI aspect, it is worth dissecting the inner logic behind it before we adapt it. The technique for decision making is the *Monte Carlo Tree Search*, which analyses the most beneficial moves and expands to investigate all possibilities. Prior to making any decisions it scores every entity and activity each entity can perform as a resource, so it can be used later to score. It goes through 4 stages (as shown in Figure 8):

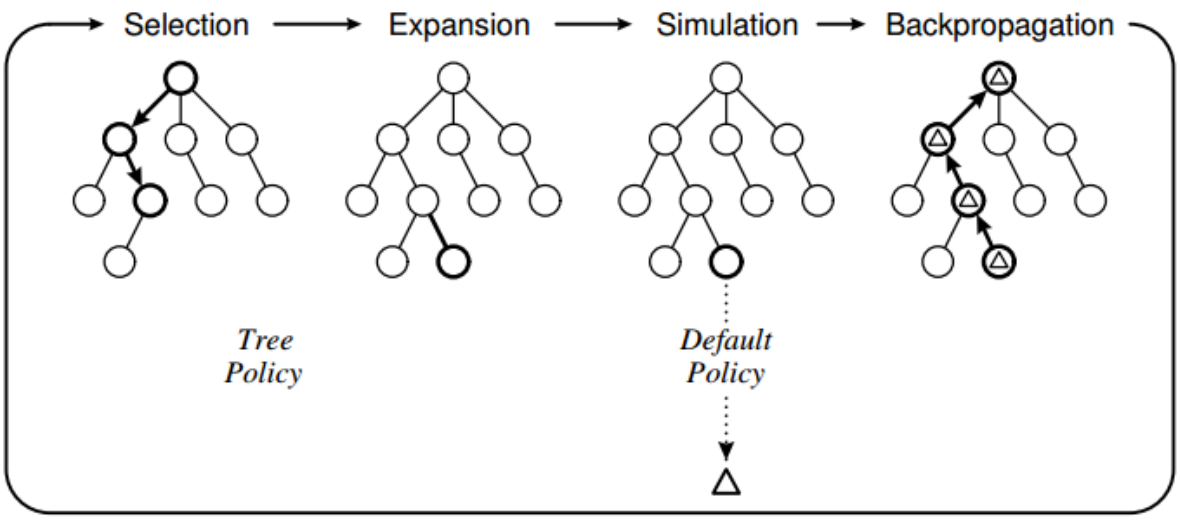

Figure 8 Monte Carlo Tree Search stages

- Selection: Using known scores, evaluate the possible moves and countermoves, altering the value of each option as choices go on.
- Expansion: When at the end of known pre-calculated scores, generate new options based on what can be done.
- Simulation: Calculate the possible future values of all of options the new state can access, and give the state its own value based on those options it can access.
- Backpropagation: Adjust all of the related values to the new value and re-do the stages.

The source code for the AI present in hearthstone is undisclosed, however during a Post-mortem review of the AI several facets of how it worked were revealed, including that it was "Designed to imitate an Intermediate player" (Schwab 2014). 'Intermediate player' refers to a player who attempts to gain a favourable position on their turn using what they have available. This is in contrast to the 'Beginner player', who is learning mechanics of the game and basic interactions; and the 'Advanced player', who is concerned with what the opponent may be doing/what cards they have in their deck as part of a grander strategy. The Monte Carlo Search Tree technique mirrors that Intermediate mind-set due to its focus on optimising play and localisation to a single turn computation scope.

With this in mind, when we adapt the AI onto the player's side we remove the functionality to act on decisions, instead leaving that to the player. Once the player has made a decision the AI will function as normal as though it had made the decision, recalculating options and starting the whole process again until no options remain.

Methodology

Spellsource is structured in a modular fashion so the AI's are completely separate from the game – which helps us when we are applying it to the player's side. In order to allow different AI's to be tested Spellsource is structured so that individual AI's request data from the main game state (be it cards they own, cards in play or positional data). The AI also acts on decisions by requesting specific pre-defined actions and targets from the main game. With this in mind, converting the AI to work on the player's side is just a matter of handing it different data, and refusing its request actions. Difficulty

comes from having two AI's running concurrently, adding functionality to the AI so that it highlights cards, and gives in-depth information at the correct times.

Two projects are required in order to operate Spellsource: the server project, where the AI and game state are housed, and the client project, which contains the user interface and sends actions to the server. The AI will send messages to the client when informing the tool, which will update its explanation and effects based on that knowledge.

At the most basic level the AI will transfer its preferred choice to the user with its explanation being a display of the choice's score, similar to Google's AlphaGo Teach (Hassabis, Suleyman et al. 2017) where the best move determined by the software is displayed as percentage of win-rate. With further development however it is planned to back-trace the decisions made by AI and explain any scoring modifiers that affect an individual entity so that players may align their thinking with the AI.

Hearthstone has a few pre-existing options for UI design of the tool, seen in the figures below.

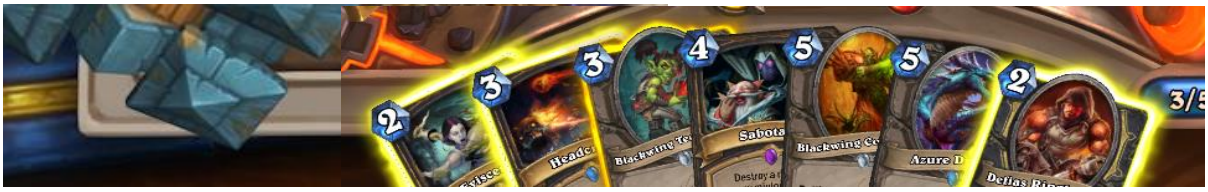

Figure 11 Cards highlighted to show secondary effects active along with empty space in left tray

Figure 12 Pop-up text featured in Hearthstone Tavern Brawl #136: The Championship

Figure 10 Character in-game pop-up

Figure 9 Proposed final design of tool

Each of the different designs has their own pros and cons. Figure 12 proposes using a system of colouring card auras to denote what card should be played and the small space in the bottom left corner for explanations of choice. The design in figure 10 offers full space for long explanations provided by the decision system; however it also takes up a large portion of the screen and is visually uninteresting. While more visual this option lends itself to more confusion by new players if not properly explained and also would require more design around itself for any new features. Figure 11 offers the most visually appealing option although size of explanations would have to be adjusted appropriately. With taking each of these strengths and weaknesses into account, Figure 9 was proposed; which contains the visually appealing avatar with a unique card glow for the best rated decision.

When the tool has been implemented, a set of inexperienced players will go through 3 stages of testing with their win-rates and a few questions recorded. They will be given the simulator to play 3 matches against the AI without the tool, repeated with the tool, and finally again without to tool to test any immediate improvements. This is with the hope that there is a noticeable slight increase in player proficiency.

Conclusion

Through the expected positive results we can infer that using an artificial intelligence modelled on the one available to Hearthstone can help supplement a new players learning experience and have them playing at the level comparable to an intermediate player, although the sample size and moderate game literacy of participants introduce bias to this conclusion. Improvements to the project include a greater testing distribution to eliminate bias, testing against human opponents, and general polish through user interface. This could be further developed and adapted to other genres of games to investigate those teaching methods there, as well as developed within Hearthstone proper.

Table of Figures

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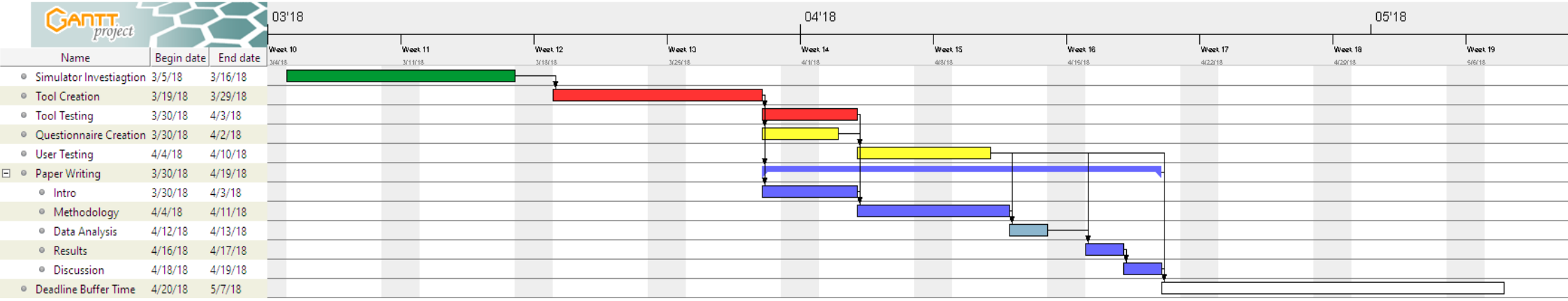

Figure 13 Gantt Chart of Projected task in tool development