Project Proposal

G53IDS

Project Title: Applying Evolutionary Algorithms to Pokémon Team Building

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1 Background and Motivation

Video games are an ever growing field of interest for many people. Like many games people play competitively against each other and in some cases their are tournaments on an international scale with whole teams set up to win the large prize pools[3][2]. This field has become to be known as eSports.

Game playing is an obvious application of AI techniques as you can objectively score wins and losses. Initially this has been seen with traditional board games like Chess[1] and Go[6]. During The International 2017 for DotA 2 this all changed as the worlds of AI and eSports came together in a 1v1 show match[8]. Elon Musk, backer of this initiative, said that this is 'Vastly more complex than traditional board games like chess & Go'[8].Typically in these set ups their is no decisions to be made prior to the game itself, in fact to limit the DotA 2 AI they limited it to a preselected character to play with.

Many strategy games have decision making before the game is played. Collectable Card Games (CCGs) have the choice of which cards to put in your limited deck or in Pokémon you have to choose which members of your team to use and how you have trained them. This element of the games is refereed to as deck/team building as the player has to build up what they bring to the game from an empty deck or team. Some players are very good at playing the game but not very good at choosing which deck/team to bring resulting in a practice called 'netdecking', being called so as the player will take someone else's deck/team from the internet instead of coming up with their own.

Pokémon has a tricky team building process that is rather hard for new players to comprehend. In the build up to the annual Pokémon World Championships, many players will go through the tedious process of team building to make sure they have the right strategies and counters in place to bring to the matches ahead[5]. This requires expert knowledge such as type match ups and speed tiers along side several rules of thumb. Once a general strategy is in place the players must perform several calculations to optimise the statistics of their team, optimising offensive stats to faint certain threats or optimising defensive stats to allow the team to survive after certain moves are used against them.

An attempt at automating the deck building process via evolutionary algorithms have been made in Hearthstone, a popular CCG[4]. The results where comparable of a well designed human deck which a talent player could then go and take to win tournaments. Another evolutionary algorithm was created to optimise build orders in StarCraft 2, a real time strategy game. The solution that the AI came up with was quicker than the best known strategy at the time and went on to be used in competitive play[7]

Pokémon team building is a similar problem to the other deck building problems stated. These where solved to an respectable standard by evolutionary algorithms and as such it seems worthwhile to try and apply this method to the problem.

2 Aims and Objectives

This project aims to implement a evolutionary algorithm that will team build for Pokémon. The output of such will be a team of Pokémon, including all of the vital statistics and moves. This would be dependant of the format. These results will be then compared to human designed solutions to conclude if the evolutionary algorithm is any better than a expert.

The objectives of this project are:

1. Research evolutionary algorithm methods used to approach similar problems. Looking in detail about issues such as representation, evaluation and validity of the chromosomes. This information will be used to help direct how best to approach the problem and design the system.
2. Design an effective and efficient way to model and represent the problem in the evolutionary algorithm while still maintaining relevant data to the problem. This will also be used to form the output so will need to be readily be able to translate into a readable format for the user to understand.

3. Develop a Genetic and Memetic algorithm to tackle the problem from scratch, including conventional and unique methods for the various stages in the algorithms. Making sure that all of the elements of the code base are created in a fashion that allows for reusability and adaptation. For example both the Genetic and Memetic algorithm should share the methods like objective evaluation and selection.

4. Compare and analyse the results of each evolutionary algorithm (with a variety of settings) with each other and human designed solutions. Solutions for comparison will come from readily available teams from top players and analysis will be taken by evaluating the solutions. If solutions are viable enough they can be input into the game and used in some real world settings such as battling with other players, rather than being graded by a score.

3 Work Plan

To help outline the project flow and I have created a gantt chart (found in the appendix) and the following descriptions of each portion.

Documentation

Project Proposal Write the project proposal and ethics form for approval of supervisor, due 13$^{\text{th}}$ October.

Revised Project Proposal Any revisions to the project proposal that need to be made after supervisor feedback, due 23$^{\text{rd}}$ October

Interim Report Write the interim report summarising the work so far, due 8$^{\text{th}}$ December.

Structure Sections Decide and begin to structure the sections and the arguments within them for the final dissertation.

Dissertation Write the final dissertation, due 24$^{\text{th}}$ April.

Research

Evolutionary Algorithms Research into the various Evolutionary Algorithms, like Genetic Algorithms, Memetic Algorithms & Multimeme Memetic Algorithms.

Review languages for EAs Primarily seeing if python has suitable features required to make the development of evolutionary algorithms easier or whether Java would be better suited.

Representation Look into various representation methods that could be applied to the problem.

Advanced EA Methods Research the variety of more advanced methods for elements in evolutionary algorithms like selection and cross over.

Memetic Algorithms Study how memetic algorithms differ from genetic algorithms and why they are advantageous.

Development

Create GA Structure Set up the basic main loop and the relevant interfaces.

Representation Code the structure that the model will be represented by to be used as chromosomes in the Evolutionary Algorithm.

Data import Build methods to import the data that is needed at various points in the running of the algorithm.

Validation Method Build a method that will check that a chromosome is valid, for use after other methods so that invalid solutions aren't created.

Basic Methods for GA Create trivial methods for each stage of the Genetic Algorithm to allow for test runs.

Bug Fixing 1 A period of time to allow for bug fixing and general code clean up to happen on the initial part of the project.

Advanced Methods for GA Create more advanced methods for the GA that may perform better.

Memetic Algorithms Code the structure of the memetic algorithm main loop and allow it to access the various methods created for the genetic algorithm. This could include creating more methods if research suggests that would be helpful.

Bug Fixing 2 Another period for bug fixing, during this period all of the features should be locked in place.

Miscellaneous

Install Software Install and configure the relevant software and libraries that are required for the project.

Run Basic Methods Run the basic methods created with varying parameters to see some initial results

Other Commitments

Welcome Week First week of the year, time set aside to allow for settling in as well as running various welcome events.

Christmas Holiday Time off after Autumn term, Although not completely set aside allows for some time to relax.

Autumn Exams Potentially could have exams for the entire 2 weeks so is set aside to allow for revision and the exams themselves.

Easter Holiday Time off after Spring term, As no teaching is happening will give more time to concentrate on coursework and dissertation.

4 Appendix

References

[1] Murray Campbell, A Joseph Hoane, and Feng-hsiung Hsu. Deep blue. *Artificial intelligence*, 134(1-2):57–83, 2002.

[2] Esports Earnings. Highest overall team earnings. `https://www.esportsearnings.com/teams`, October 2017.

[3] Esports Earnings. Largest overall prize pools in esports. `https://www.esportsearnings.com/tournaments`, October 2017.

[4] Pablo García-Sánchez, Alberto Tonda, Giovanni Squillero, Antonio Mora, and Juan J Merelo. Evolutionary deckbuilding in hearthstone. In *Computational Intelligence and Games (CIG), 2016 IEEE Conference on*, pages 1–8. IEEE, 2016.

[5] Griffin McElroy. Becoming the very best: The pokemon world championships. `https://www.polygon.com/2013/7/20/4539528/becoming-the-very-best-the-pokemon-world-championships`, July 2013.

[6] David Silver, Aja Huang, Chris J Maddison, Arthur Guez, Laurent Sifre, George Van Den Driessche, Julian Schrittwieser, Ioannis Antonoglou, Veda Panneershelvam, Marc Lanctot, et al. Mastering the game of go with deep neural networks and tree search. *Nature*, 529(7587):484–489, 2016.

[7] Quintin Smith. Algorithms discover build order from hell. `https://www.rockpapershotgun.com/2010/11/02/genetic-algorithms-find-build-order-from-hell/`, November 2010.

[8] T.C. Sottek. The worlds best dota 2 players just got destroyed by a killer ai from elon musks startup. `https://www.theverge.com/2017/8/11/16137388/dota-2-dendi-open-ai-elon-musk`, August 2017.

Work Plan

Label
Week
25-Sep
02-Oct
09-Oct
16-Oct
23-Oct
30-Oct
06-Nov
13-Nov
20-Nov
27-Nov
04-Dec
11-Dec
18-Dec
25-Dec
01-Jan
08-Jan
15-Jan
22-Jan
29-Jan
05-Feb
12-Feb
19-Feb
26-Feb
05-Mar
12-Mar
19-Mar
26-Mar
02-Apr
09-Apr
16-Apr
23-Apr
30-Apr
Documentation
Project Proposal
Revised Project Proposal
Interim Report
Structure Sections
Dissertation
Research
Evolutionary Algorithms
Review languages for EAs
Representation
Advanced EA methods
Memetic Algorithms
Development
Create GA Structure
Representation
Data import
Validation Method
Basic Methods for GA
Bug Fixing 1
Advanced Methods for GA
Memetic Algorithms
Bug Fixing 2
Misc
Install software
Run Basic Methods
Other Commitments
Welcome Week
Christmas Holiday
Autumn Exams
Easter Holiday
Start of Term
13th October
Project Proposal
23rd October
Revised Project
Proposal
8th December
Interim Report
24th April
Dissertation Hand In
TBA
Demo