Artificial Intelligence Research

Artificial intelligence is completely new to me as a developer and I hope it is going to be a beneficial learning experience as I would like to explore the uses of AI further in the future. Knowing that my exposer to AI has been next to none my super visor was kind enough to suggest looking into either the Min/Max or possibly Bayesian inference.

# Maximin

The Maximin technique is a method of tree searching. It is used to either maximize or minimize the payoff of a given situation. So a very basic example would be two characters playing a game where the money used in the game determines whether a player is winning or losing. The more money the better the player is doing. When searching through the state tree the player with the most money will want to maximize this advantage by gaining more. Whereas the player with less money, will want to minimize the chances of the ‘richer player’ gaining money. This is very well explained in the paper Introduction to AI Techniques. Available at <http://web.mit.edu/sp.268/www/gamesearch.pdf>

An issue with this tree searching technique is that there is the possibility of the tree being almost infinite or simply too big to explore. This issue has been tackled in several cases using a basic heuristic that will remove any of the tree paths that exceed the given criteria.

<https://en.wikipedia.org/wiki/Minimax>

<https://www.cs.cornell.edu/courses/cs312/2002sp/lectures/rec21.htm>

<http://intelligence.worldofcomputing.net/ai-search/minimax-search.html#.VznmnvkrKUk>

Although this could be a very interesting use of an AI technique its implementations seem to be based on information that is available to the games current state. This will not be the case with the proposed game. The game in development will require the AI to assess possible outcomes to a variety of different situations opposed to maximizing its advantages over the opposition each and every turn. Maximizing its advantages is obviously a key part of the turn based strategy game play style, but the AI needs to anticipate the opposition’s actions instead of acting upon them.

# Bayesian

More specifically I have looked into the Bayes probability theorem. The Bayesian technique can be used for a number of different mathematical problems however after looking through them and seeing what they aim to achieve it was clear that the probability side was going to be the key area to research. “Bayesian probability is one [interpretation](https://en.wikipedia.org/wiki/Probability_interpretations) of the concept of [probability](https://en.wikipedia.org/wiki/Probability). In contrast to interpreting probability as [frequency](https://en.wikipedia.org/wiki/Frequentist_probability) or [propensity](https://en.wikipedia.org/wiki/Propensity_probability) of some phenomenon, Bayesian probability is a quantity that is assigned to represent a state of knowledge,[[1]](https://en.wikipedia.org/wiki/Bayesian_probability#cite_note-ghxaib-1) or a state of belief.” https://en.wikipedia.org/wiki/Bayesian\_probability. This was very interesting when I first read it as it summed up what I was picking out to be negative in the Maximin technique.

After reading through several articles I still wasn’t able to completely understand what it was attempting to achieve. From what I gathered it is where weightings are given to a range of assessed probabilities where the amount of known information in limited. So using random values or quantities as a model for any level of uncertainty and running the probabilities through these models to give an estimated value.

Knowing how to use this within the proposed game is not very clear however it could be used by the AI to guess what the player is going to do (The unknown) based on the surrounding data it has available to it, giving varying weightings to a series of different outcomes, allowing the AI to assess the possibilities.

<http://gamedev.stackexchange.com/questions/21519/complex-game-ai-for-turn-based-strategy-games>

Based on the above link a user explains the different approaches that can be used to create a seemly intelligent AI system in a turn based strategy game. The two areas that really strike me a possible solution is firstly the Operational AI system. This is where the AI assesses three main criteria, their current strength, the reinforcement of units and evaluating which fights to pick/avoid.

This is an interesting aspect that could be used within the Bayesian technique, seeing as the information available to the AI may be limited and the unknown could be given a weighted value. This will allow the AI to calculate the best areas to move, fight in based on the units around them. As well as comparing the strengths of individuals and as a whole team.

The second area is strategic AI. This is where a range of elements are evaluated and each given a score towards the intended goal. For example, deciding where to move a character, the AI will evaluate all of the given spaces, and give each open space a score based on how far it is from surrounding AI or human controlled characters and other variables. This method could be used for a number of other sections of the game however this was the first to spring to mind.

<http://stackoverflow.com/questions/3275174/algorithms-for-realtime-strategy-wargame-ai>

This was an interesting post about AI in a war game, more focused towards real time strategy game but it points out that all RTS games and be broken down into decisions which is essentially TBS. In the answer to the question the user’s stats that it is important how much information you give to the AI as this can be what ranges the difficulty. Giving the AI all of the information to the given games allows them to perform to their maximum potential, causing the game difficulty to increase, whereas if the information is restricted the AI will be making decisions based on hunches making it more likely for them to produce errors. An interesting idea to think about when creating the AI system as it might be an option to give different Ai difficulty settings. This however is a big ask before the AI system has even been put into place.

<http://gamedev.stackexchange.com/questions/72230/techniques-for-an-ai-for-a-highly-cramped-turn-based-tactics-game>

Another interesting post where the idea for a TBS AI system is broken down into several sections allowing the AI to make decisions on a series of different data opposed to very linear decisions. It breaks down the game into influence maps or conflict maps that are used to assess the ‘Cramped’ map. It then goes on to the tactical and strategic decisions. It mentions that a neural network could be applied to make the AI learn over time, feeding off the output decisions made by the human controlled characters.

http://www.checkmarkgames.com/2012/03/building-strategy-game-ai.html

The above link is a series of blog posted created by a developer called [Harvicus](https://www.blogger.com/profile/05778633676064958982). It is a multipart blog in which he/she covers the creation of the AI system they have used within a TBS game. Many of the stages have videos attached showing the results of each blog post. Each post shows a considerable amount of information about the AI system in place, including code snippets. Going through this in more detail or as a reference when developing my own AI may prove very beneficial.