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Sinking Ships: A Battleship AI

Battleship is one of many classic board games turned digital. The 2-player game is played on a 10x10 grid where both players are agents that must hide and attack. Each player must hide 5 ships of differing lengths on the board while also guessing where the opponent hid theirs. The first to “sink” all of the opponent’s ships is the winner. Therefore this game requires dual strategy: it needs to effectively handle placement and attacks. For our project, we will aim to create a digital application of the Battleship game with an AI opponent that will successfully handle both challenges and win a majority of the time.

To accomplish this, we will primarily work with Python to create the backbone of the game. We will also use the open-source Pygame module, in order to construct a UI with visual effects into a functional, desktop game application. To build an intelligent AI, we have to break the problem into subproblems and consider different cases. The strategy for ship attacking will change as the agent acquires more information about the environment (previous hits and misses). Furthermore, the cases have to be considered when the AI is taking its initial guess, when a hit has been made, when there is a cluster of hits/misses, etc. By contrast, the ship placement will require experimentation and research to find a method that allows for the most percentage of wins. Our implementation will incorporate different AI algorithms and techniques.

This relates to several concepts we’ve already learned in class and will learn in the future. Primarily, this project is a game application. It will involve AI concepts like case-based reasoning, heuristic functions, search algorithms and decision making. Specifically, we have found research that suggests the use of “Monte Carlo Methods” (heuristic tree search methods) as effective in the game of Battleship [1]. There is also research that suggests the possibility of using reinforcement learning. This method can be applied to our own project as well, where there will be positive and negative rewards associated with each move the agent takes. As the AI progresses, it will learn from previous moves in order to more effectively make the next. In particular, we've researched the Q-Learning algorithm. Researcher Ladislav Clementis of the Slovak University of Technology discusses how the Q-Learning algorithm can be used in a Battleship AI by using "the learning rate β and the discount factor γ to parameterize reward propagation across a state space" [2].

We are planning on dividing up the responsibility as evenly as possible. We will both do research that will help us construct the Battleship AI game. Denysse will do research on placement strategies and Kat will do research on attacking strategies. We will also both research algorithms that will be helpful in creating a functional and efficient game strategy and then combine this information with knowledge from lectures and other outside resources. We will both be contributing code to a collaborative Git/Github page along with notes for the other person to be able continue to build on the code. We will also be working together to incorporate Pygame into the visual and audio development of the game.

We are planning to run the game and record the results of the game in order to demo how the game works. We will allow it to play an entire round to show how the agents interact with each other and how well they are able to play the game. We will include that in the 2 minute video, along with our code and our notes to each other to showcase our thought process throughout creating the game. We will be measuring success in how quickly and efficiently the AI is able to win the game. We will also be measuring success in whether the AI is winning a majority of the time. We plan on running a series of tests and recording the percentage of AI wins.

References

1. BRIDON, J. G., CORRELL, Z. A., DUBLER, C. R., and GOTSCH, Z. K. 2019. An Artificially Intelligent Battleship Player Utilizing Adaptive Firing and Placement Strategies. The Pennsylvania State University, State College, PA, 1-7.
2. CLEMENTIS, L. 2013. Supervised and Reinforcement Learning in Neural Network Based Approach to the Battleship Game Strategy. In Zelinka, I., Chen, G., Rössler, O. E., Snasel, V., and Abraham, A. ed. *Nostradamus 2013: Prediction, Modeling and Analysis of Complex Systems.* Springer International Publishing, Switzerland, 191-200.