Analysis of the Battleship Game

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1 Introduction

This article will try and analyse the game of battleship. Our goal is to come up with a strategy for optimal (or close to optimal) play, inspired by an article by Anthony Rochford's analysis.[1]. However, I try to formalise these ideas in my own way as well as extend this to a deep learning context to make his approach problem more computationally feasible for real time play.

2 Rules of The Game

3 Modelling the Game

First we must note two things. Our goal is to win. We do so by hitting all 17 boat tiles in the least number of moves. Let T_s be the number of moves/time it takes for us to do so with strategy s. We can therefore quantify the performance of our strategy using $E[T_s]$. This might not be the entire picture because winning is dependent on the performance of the other player as well. For example lets say player 1 has strategy s_1 and player 2 has strategy s_2, and $E[T_{s_1}] = E[T_{s_2}]$. Then, s_1 might be a better strategy than s_2 if $var[T_{s_1}] > var[T_{s_2}]$. However, this is simply intuition and has to be proven and/or tested.

Lets simply focus on finding s which minimises $E[T_s]$ for now.

Lets now come to the question of modelling the opponents board. Since there are 100 tiles. Now let X^i be the true value of the i^{th} tile. where $X^i = 1$ if that tile has a ship and $X^i = 0$ if it doesn't.

We will try to determine these probabilities to incorporate them in our strategy. Note we make no i.i.d assumptions for X^i. Since, for example, if we know tile i has a ship, then we can conclude that adjacent tiles are more likely to be ships as well. Now, clearly $X^i \sim Ber(\theta_i)$.

References

[1] https://austinrochford.com/posts/2021-09-02-battleship-bayes.html

[2] http://thevirtuosi.blogspot.com/2011/10/linear-theory-of-battleship.html