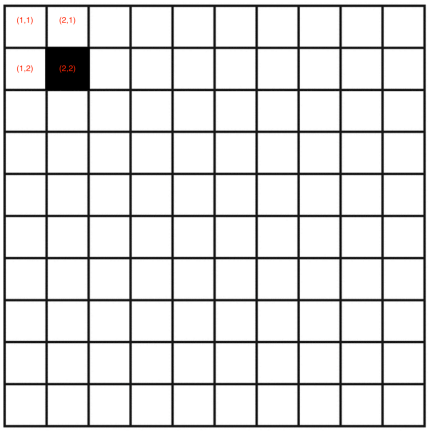
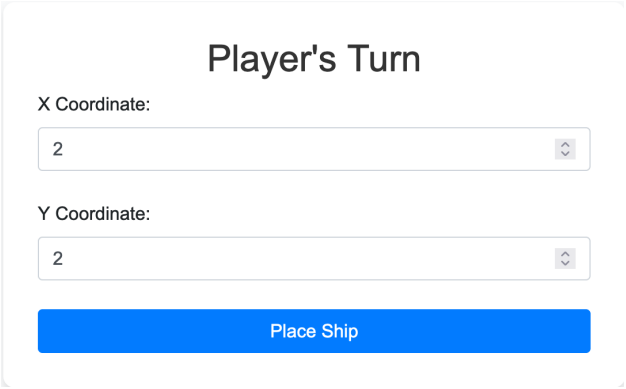
The battleship strategy.

Instruction

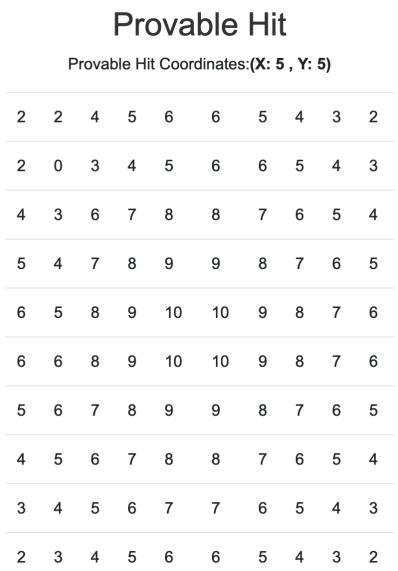
This website has a purpose of assisting you to play battleship, whenever you take a hit at your opponent's ship, enter the coordinates of your shot on the website. For example, if you take a shot at this location:



Enter:



Before you take a shot, consider using the possible hit function of the website, the strategy works best starting with a ship length of 5, after you entered the targeted ship length in the possible hit input box, the website/program would return you the location of highest probability of hitting an opponent's ship.



Introduction:

Battleship is a strategy guessing game, which player guess the position of an opponent's ship. The two players will take turns, with each player guessing the position of their opponent. After one placed a guess, the result would be known, either a hit or a miss. If the result is a hit, the player would get another chance to hit.

The game of battleship take place on a 10*10 grid, at the start of the game, each player have a chance to place their ships. Each player should have:

1. Carrier(5 space)
2. Battleship(4 space)
3. Cruiser(3 space)
4. Submarine(3 space)
5. Destroyer(2 space)

You can only place the ship horizontally or vertically. The game ends when any player's all 5 ship sinks.

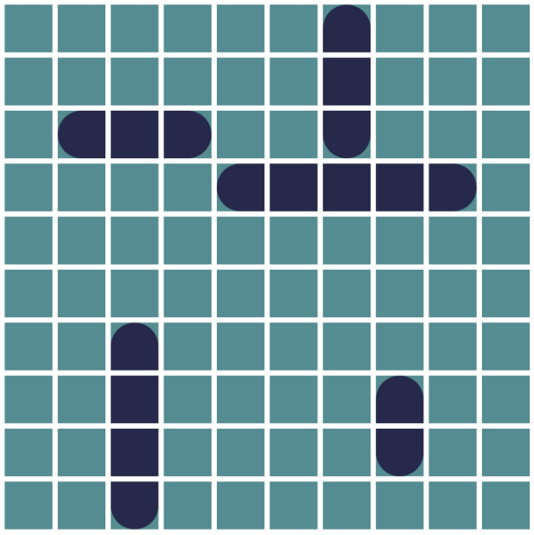


Figure 1: An example of arrangement of ships

Although seems random, the game of battleship has strategy and patterns. I collected 1000 rounds of battleship games and concluded that on average, there are 49.4 moves per game, with the most move at 97 and the least at 17 moves..

I concluded the least frequent hit location in the first 39 action, shown in this picture:

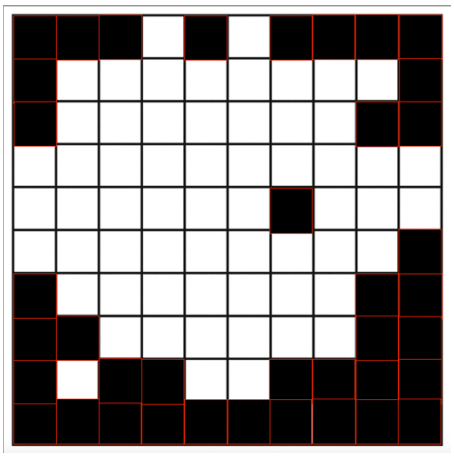


Figure 2: Least hit position

Theoretically, with ships placed at these location, the probability of getting hit would be the lowest.

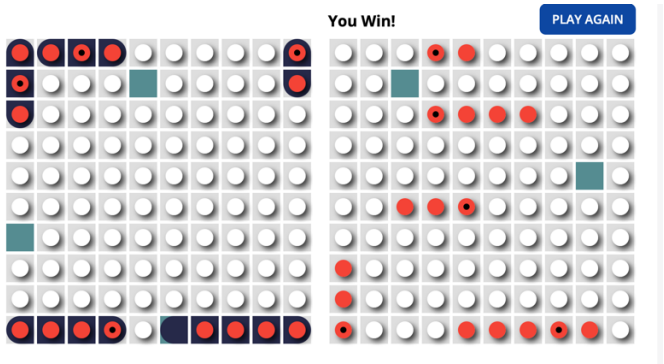


Figure 3: Example with winning with defensive strategy

To test the strategy, I played 52 games and win 33 games. The p-value as calculated:

$$\sum_{n=33}^{52} \binom{52}{n} \cdot (0.5)^{52} = 0.0351971105$$

Is lower than 0.05.

Attacking

For the attacking strategy, I coded a code that calculates the probability of a targeted ship length, it sums up all the possible location a ship can be at and returns the location with highest probability. Sometimes, there will be multiple locations with the same probability, in this case, the algorithm will return the first position found.

```
[2, 3, 4, 4, 6, 6, 5, 4, 3, 2]
[3, 4, 5, 4, 7, 7, 6, 5, 4, 3]
[4, 5, 6, 4, 8, 8, 7, 6, 5, 4]
[4, 4, 4, 0, 5, 6, 6, 6, 6, 5]
[6, 7, 8, 5, 10, 10, 9, 8, 7, 6]
[6, 7, 8, 6, 10, 10, 9, 8, 7, 6]
[5, 6, 7, 6, 9, 9, 8, 7, 6, 5]
[4, 5, 6, 6, 8, 8, 7, 6, 5, 4]
[3, 4, 5, 6, 7, 7, 6, 5, 4, 3]
[2, 3, 4, 5, 6, 6, 5, 4, 3, 2]
x:5
y:5
```

Figure 4: 4 positions with the same probability, the algorithm returns (5,5), which is the first found

The Algorithm is fairly simple, it calculates all possible arrangement of the opponent's ship, and find the location that contains the most "ships".

Getting help:

For the completion of this strategy, I asked a computer engineer on the process of building a website, since my code was originally written in python, I've encountered some problems

putting it on websites.

Battleship assistance: https://batleship.onrender.com/

Internal value of my project

For my project, there are a lot of coding and math involved. I emailed one of the company that runs the game battleship to ask for their data, and I write a code to extract the least frequent hit position in battleship. The code was written in python, the hardest part was to transfer the mongodb file to a .json string, I asked chatgpt and it shows me the way to do it. After my strategy is done, I used my strategy to play 52 games and win 33 games, I used a binomial model to calculate the p-value.

External value of my project

The external value for my project is fairly straightforward, the project itself is a code that helps the user to play battleship. So the targeted audience is people who want to win the game battleship, according to my test, this model/strategy has an extremely high percentage win rate of 63%.

Word cited

The computer engineer that I asked for help: yingdanong765@gmail.com
For calculating the p-value: www.desmos.com
Data from: https://papergames.io/en/
Tests on: http://en.battleship-game.org/