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**Robot War: Testing Robot905’s Effectiveness**

**Part 1):** **Robots Tested**

1. **Robot905 🡪 The one I want to fight with**

-Colour: Magenta

-Stats: Attack = 5, Defense = 4, Speed = 1

This robot has a fairly balanced stat line, except it heavily lacks in terms of speed. It generally favours health over distance (2x modifier in favour of health) This robot utilises an extended opponent data to determine the win rates of opponents it is facing, and attempts to limit the number of rounds it allocates to an opponent which has a high win rate against my robot.

1. **TestFighterAggresive**

-Colour: Red

-Stats: Attack = 6, Defense = 2, Speed = 2

This robot has the highest attack and aims at attacking opponents with lower health, caring less about their distance. (3x modifier in favour of health). It attempts to kill all other robots with it’s high attack, and simply goes for the targets with the lowest health in order to kill and obtain the health bonus of killing a target. (+10 health)

1. **TestFighterBalanced**

-Colour: Green

-Stats: Attack = 4, Defense = 3, Speed = 3

This robot has balanced stats and has an equal preference for health and distance. It still attempts to kill other robots and goes for the best target (takes into consideration health and distance equally).

1. **TestFighterDefensive**

-Colour: Blue

-Stats: Attack = 1, Defense = 6, Speed = 2

This robot has the highest defense allocated and tries to attack targets with the lowest amount of rounds possible (1) to avoid attacking and rolling only 1 dice. It attempts to mainly defend against other robot’s attacks and use its high defense stat to win rounds against attackers.

1. **TestFighterRunner**

-Colour: Yellow

-Stats: Attack = 1, Defense = 5, Speed = 4

This robot tries to avoid other robots and simply runs up and down the screen. It tries to mess up the other robots to get them to try and chase it, and in theory it tries to wear them down with energy. It does not attack other robots as it will generally lose, as it has a low stat distribution for attack.

**Part 2): Explanation of Robot905’s Algorithm**

Algorithm:

My robot’s algorithm works by first, sorting through the list of opposing robots by their priority. Priority in my algorithm, is the health of the opponent robot added with the distance away it is from my robot. In my robot’s case, when its health is at 100 (either the beginning of a round, or when it is very healthy), it prioritizes attacking a closer target over health. However, generally, (when my robot is not at 100 health), it prioritizes attacking a target with lower health, over a closer target, (has a modifier of 2x in favour of health) as a target with lower health is closer to death and the 10 additional health points gained through killing this low health target.

Next, my robot attempts to find the “bestTarget” through iterating through this sorted array, and looks for the target with the lowest “score”. The target with the lowest score’s ID is stored, and my robot then tries to move to this target’s avenue and street. It moves accordingly towards this target with consideration to its number of moves per turn, which is determined using its current energy and SPEED. My robot makes sure to not move more steps than it is allowed, to avoid the energy penalties regarding movement. While doing this, my robot continually checks to see if its current avenue and street is equal to its target’s avenue and street. When these values are equal, my robot will be at this target’s street at the end of its turn, and thus it will attempt to decide on the number of rounds it wishes to fight.

For determining the number of rounds, I utilised an extended opponent data to make a more advanced algorithm. Essentially, my robot keeps track of the total number of rounds it has fought an opponent, and when this total number of rounds is greater than 30 (or else the sample is too small), it can determine the win rate facing this opponent. Before these 30 games, my robot only attempts to fight a robot with half the amount of rounds it normally would fight, to “test” out the opposing robot’s strength. Thus, after these 30 rounds, it will decide whether it is favoured or not, and if it is, it will fight that opponent in the future with its maximum number of rounds. Additionally, if my robot is below 20 energy, it will attempt to use its maximum number of rounds it can fight with, in an attempt to win the round, and gain energy back through bonuses. Wins, losses and ties with an opponents are stored in the extended Robot905OppData.

**Part 3): Statistics**

-My BattleArena has 5 robots. One copy of each robot.

-For this graph, 3 games were played in total. The result of the round wins and round losses were used to find the resultant win rate for each robot, the total # of penalties and kills was also recorded.

-The overall effectiveness of a robot was determined through the numbers of rounds it won/ number of rounds it loss- the robot’s win rate.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Robot | Rounds Won | | | | Rounds Lost | | | Win Rate | Uncertaintyof Rounds Won | Total # of Penalties | # Of Kills |
| Robot905 | 225 | | 178 | 380 | 105 | 194 | 101 | 1.9575% | 101 | 8 | 6 |
| Aggressive | 358 | 260 | | 300 | 180 | 250 | 112 | 1.6937% |  | 2 | 5 |
| Balanced | 110 | 177 | | 93 | 200 | 216 | 132 | 0.5839% |  | 0 | 1 |
| Defensive | 55 | 171 | | 109 | 320 | 161 | 155 | 0.5267% |  | 5 | 0 |
| Runner | 1 | 8 | | 5 | 2 | 21 | 65 | 0.1591% |  | 96 | 0 |

Sample Calculation for the Rounds Won in the Robot905.

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**Part 4): Analysis of Results**

From my results of fighting 5 different robots in an arena, it can be seen that my robot, utilising the Robot905OppData to calculate winPercentage against a certain robot, and the aggressive robot that did not utilise this additional opponent data, had the highest win rates, whilst the more defensive ones, the Balanced and the Defensive Robots, had the lower win rates.

Robot905 had the highest win-rate, this could be because of the stat allocation of the robot, as I purposely kept the speed of the robot very low (1 point allocated to speed) to allow the Attack and Defense stats to be as high as possible. Because of this, it appears that the robot was able to fight much more effectively with other robots, as it could defend much better than the Aggressive robot. The algorithm for calculating the win rate between the opponents might have been another factor that led to this robot doing significantly better then the rest, as it would allocate less rounds to fighting robots that it would do poorly against (the defensive one, presumably) and more rounds to the aggressive robot with lower points in health.

The Aggressive robot that utilises a simpler algorithm also did fairly well. It maintained high amounts of rounds won, but also had many rounds lost- most likely when it had to defend. The robot used a basic algorithm which prioritized health 3x over distance, and attempted to simply kill the lowest healthed target.

Both the balanced and the defensive robots did mediocre within my tests. The balanced robot might not have done too well as it did not have a priority regarding health and distance (valued them the same), but also due to the fact that the robot was neither great at attacking, nor defending. Regarding the defensive robot, it seemed to only to be able to win rounds off of the balanced robot, as it is the only one who has an attack lower than 5. If there were more robots with lower attack values in this test, the defensive robot might have done better.

Lastly, the runner robot, did not win too many rounds. It appears that it’s strategy of not attacking did not work, as it would eventually succumb to the penalties of not attacking. The idea behind the robot was to cause problems for the other robots so that they would chase it, but it appears that they simply ignored the robot as it was always a far enough distance away. This robot was mainly to test for the case of another player creating a similar type of robot, and testing to see how mine would fair against it.

Ultimately, it appears that through my tests, the robots that had a higher attack and prioritized health over distance, did better than those with lower attack (and those which prioritized distance). This may be because the game seems to provide more benefits to attackers that win a fight, than defenders- such as the 20 energy bonus when an opponent is killed, as the most successful robots (Robot905 and the AggressiveRobot), have the greatest amounts of kills. Robots that have a lower speed, and can fight better, I theorize and which show in my results, are better than robots with higher speed and which fights worse. However, when examining the uncertainty of the “rounds won” within this 3 round test, it appears that the uncertainty was fairly high, (around apart from the “Runner” robot. This could be due to the nature of the game and the way rounds are won (through dice rolls), and that the game has high variance. More tests would be necessary to see whether or not this uncertainty value decreases and if my results are an accurate representation of the effectiveness of each robot.