

Christian Carreras

CSC 548

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Project Narrative

The goal of this project was to make a machine-learning algorithm that was able to successfully predict the success rates of hero against another hero depending on wide variety of variables in a game called Overwatch. Success in Overwatch comes down to several factors. Factors include but are not limited to: personal skill, team member's skill, team hero composition, enemy team skill, enemy hero composition, ability to communicate and work as a team, and ability to react and change if something is not working. More likely than not, success boils down to what heroes the enemy team has picked and what heroes your team has picked. But is this really the case? Is success based on skill? Is it based on simply the hero pick? Is it based on your teammates? Is it based on all the little variables including what map you are playing on or what game mode you are playing in? Or is it a combination of everything previously stated? These are the answers I sought.

The logic of my project was to use a multi-linear, supervised-learning algorithm that would analyze the dozens of variables that come into play. After much research and failures with other algorithms such as logistic regression, decision trees, k nearest neighbor, discriminant analysis, Gaussian NB, and SVCs I finally settled on multi-linear regression being the best fit. The variables that I wanted to take into account were the hero pick, eliminations per minute, kill to death ratio, accuracy, damage per minute, damage blocked per minute, healing per minute, and critical hits per minute. All variables present were taken from both the player and the enemy player. I originally set out to have more variables including hero specific stats, objective stats, game map, game mode, etc. but I did not have time nor did I believe that it would have that big of an impact initially. All of these variables would be used by the algorithm to determine the prediction value: success rate of the player versus that specific

enemy. The dataset was mostly derived from an online database for the game but the success values were found by me and my own testing of the game. I tested in-game AI of one hero against another AI opponent to generate my success values. The variables I used for AI were national averages in order to represent an average player. I then tested every AI hero available against every combination of AI hero to build my dataset. From there I could build and test my algorithm.

The main aspects of my code are broken into functions that each have their own purpose. The first part builds the dataset if it was not previously created. If it was previously created, open it again for use. The next part encodes labels in the dataset so the machine-learning algorithm can read it properly. After that the program splits the dataset into a training dataset and a testing dataset. From there the algorithm can train followed by a test where it can predict values. It then prints the predictions and its score based on how close its prediction was to the actual value. Each part has been modularized so that it can be understood at first glance and be modified with ease if necessary.

To go into depth, first the dataset is initialized by getting its hands on the data from the data file. It first checks if the dataset exists in a pickle format. If a pickle format of the dataset does not exist, one is created for later use. The dataset is then returned either freshly generated or from a pickle file. From there the dataset is cast to an array so it can be easily manipulated and accessed. Once in array form I use a label encoder from the sklearn preprocessing library to turn the non-numerical data in my dataset to integers. I need to do this because the machine-learning algorithm cannot process non-numerical data in its analysis. The label encoder takes a pre-made list of string values to understand what to change in the dataset. Next the dataset is modified so that all instances of the heroes' names in the dataset turn into integers. The integer given is relative to the position of the hero name in the premade label-encoder list from before. Once the dataset has its labels modified, the array is then split into an X-value representing all the rows of columns zero through fifteen, i.e. the variables, and a Y-value of all the rows of the last column, i.e. the results or success rate of the row. These values are used to split the

dataset as a whole into a training dataset and a testing dataset. The training dataset will be comprised of an X_train and Y_train values. Likewise, the testing dataset will be comprised of an X_validation value and an Y_validation values. I split the dataset to be eighty percent training data and twenty percent testing data. I do this because I want to get the most out of my limited dataset. I also include a pseudo-random seed to ensure that no single test is the same as another test. Once the dataset is split into two I can start training my algorithm by the use of the fit function. After training my algorithm successfully, it can move on to the testing dataset in order to make predictions. My program will then iterate through all the predictions and make the results be easily read and understood before being printed to the screen. To do this the labels have to be reverse-encoded back to their hero names. The label encoder can easily transform the dataset back to its string name because of the reference to the pre-made list with the heroes' names. Once all the testing data is printed to the screen the score of the algorithm is also printed. The score represents how close the algorithm predicted to the actual value.

That is the entirety of the machine-learning algorithm. However, I also added several functions to analyze data. These separate functions are used to view the datasets visually through graphs. The user can view the dataset either as a box and whisker plot, a histogram (bar graph), or a scatter matrix. These graphing functions worked wonders by creating a visual representation of the dataset so one could easily spot averages, means, modes, and outliers. Although they are not part of the machine-learning algorithm I still count them as invaluable to the program as a whole.

Python libraries used were pandas for organizing and accessing my dataset, pickle for packaging and un-packaging data, os.path for accessing files in a certain directory, pandas scatter matrix, matplotlib for the visual graphing of data, sklearn for everything I needed to train, test, modify, and predict with my machine-learning algorithm, numpy used in score calculation, and datetime and random for use in pseudo-random seed generation. All of these libraries helped in some way big or small.

The results I received were at first hard to decipher since there was much discrepancy between the tests. Sometimes the prediction value could be close to the actual value while other times it could be off as far as fifteen to thirty-five percent. The variance score could be anywhere from 0.06 to 0.79 as well. I was baffled when I first saw these results. After sitting on the results for an amount of time, I believe that this outcome is due to how limited my dataset is. If I were to extend my dataset tenfold or more I am certain I would see the variance in score and prediction go down. Sadly I did not have the time to extend my dataset further so I cannot test if my hypothesis is correct. On another note, these values only represent AI versus AI, and human versus AI. It cannot truly represent human players because humans will do things AI would never do and vice versa. Regardless, the results paint a picture of how things could be and possibly a trend for some heroes. I can only surmise if these patterns would continue with actual human versus human training but that it is a project for another time.

Results

Matchup: Reaper vs McCree; Prediction: 50.85%; Actual value: 75.0%
 Matchup: Bastion vs Zenyatta; Prediction: 49.11%; Actual value: 10.0%
 Matchup: Torbjorn vs Torbjorn; Prediction: 68.17%; Actual value: 50.0%
 Matchup: Ana vs Torbjorn; Prediction: 39.47%; Actual value: 30.0%
 Matchup: Lucio vs Reaper; Prediction: 11.55%; Actual value: 30.0%
 Matchup: Zarya vs Bastion; Prediction: 66.67%; Actual value: 65.0%
 Matchup: McCree vs McCree; Prediction: 39.85%; Actual value: 50.0%
 Matchup: Zarya vs Ana; Prediction: 92.33%; Actual value: 72.72%
 Matchup: Zarya vs Soldier:76; Prediction: 73.03%; Actual value: 50.0%
 Matchup: Ana vs Mei; Prediction: 20.87%; Actual value: 30.0%
 Matchup: Mei vs Roadhog; Prediction: 48.27%; Actual value: 25.0%
 Matchup: Torbjorn vs Reaper; Prediction: 46.42%; Actual value: 40.0%
 Matchup: Soldier:76 vs McCree; Prediction: 54.34%; Actual value: 50.0%
 Matchup: Bastion vs Torbjorn; Prediction: 71.01%; Actual value: 60.0%
 Matchup: Torbjorn vs Roadhog; Prediction: 44.34%; Actual value: 18.18%
 Matchup: Zenyatta vs Mei; Prediction: 49.59%; Actual value: 30.0%
 Matchup: Torbjorn vs Zenyatta; Prediction: 46.26%; Actual value: 27.27%
 Matchup: Lucio vs Bastion; Prediction: 16.81%; Actual value: 0.0%
 Matchup: Mei vs Zenyatta; Prediction: 50.19%; Actual value: 70.0%
 Matchup: Reaper vs Torbjorn; Prediction: 60.54%; Actual value: 60.0%
 Matchup: Soldier:76 vs Roadhog; Prediction: 40.2%; Actual value: 50.0%
 Matchup: Roadhog vs McCree; Prediction: 76.73%; Actual value: 80.0%
 Matchup: Zarya vs Mei; Prediction: 64.55%; Actual value: 30.0%
 Matchup: Soldier:76 vs Soldier:76; Prediction: 53.91%; Actual value: 50.0%
 Matchup: Mei vs Ana; Prediction: 81.27%; Actual value: 70.0%

Mean squared error: 0.03
 Variance score: 0.25

Matchup: Torbjorn vs Zenyatta; Prediction: 42.82%; Actual value: 27.27%
 Matchup: McCree vs Mei; Prediction: 33.89%; Actual value: 30.0%
 Matchup: Lucio vs Reaper; Prediction: 11.62%; Actual value: 30.0%
 Matchup: Ana vs Bastion; Prediction: 16.27%; Actual value: 15.0%
 Matchup: Bastion vs Roadhog; Prediction: 41.05%; Actual value: 40.0%
 Matchup: Mei vs Torbjorn; Prediction: 72.25%; Actual value: 80.0%
 Matchup: Zenyatta vs Bastion; Prediction: 39.07%; Actual value: 90.0%
 Matchup: Lucio vs Mei; Prediction: 18.2%; Actual value: 0.0%
 Matchup: Ana vs Zarya; Prediction: 20.29%; Actual value: 27.27%
 Matchup: Soldier:76 vs Roadhog; Prediction: 39.21%; Actual value: 50.0%
 Matchup: Mei vs Roadhog; Prediction: 51.1%; Actual value: 25.0%
 Matchup: McCree vs McCree; Prediction: 43.18%; Actual value: 50.0%
 Matchup: Soldier:76 vs Zenyatta; Prediction: 42.86%; Actual value: 27.27%
 Matchup: Zenyatta vs Soldier:76; Prediction: 49.8%; Actual value: 72.72%
 Matchup: Zarya vs Zarya; Prediction: 63.96%; Actual value: 50.0%
 Matchup: Mei vs Soldier:76; Prediction: 65.35%; Actual value: 40.0%
 Matchup: Zarya vs Soldier:76; Prediction: 70.66%; Actual value: 50.0%
 Matchup: Bastion vs Reaper; Prediction: 43.95%; Actual value: 55.0%
 Matchup: Reaper vs Mei; Prediction: 48.22%; Actual value: 40.0%
 Matchup: McCree vs Soldier:76; Prediction: 38.66%; Actual value: 50.0%
 Matchup: Roadhog vs Torbjorn; Prediction: 83.09%; Actual value: 81.81%
 Matchup: Zarya vs Mei; Prediction: 65.89%; Actual value: 30.0%
 Matchup: Ana vs Ana; Prediction: 44.46%; Actual value: 50.0%
 Matchup: Lucio vs Zarya; Prediction: 16.26%; Actual value: 10.0%
 Matchup: Lucio vs Torbjorn; Prediction: 29.86%; Actual value: 40.0%

Mean squared error: 0.03
 Variance score: 0.29

Matchup: Lucio vs Torbjorn; Prediction: 35.92%; Actual value: 40.0%
 Matchup: Ana vs Torbjorn; Prediction: 39.2%; Actual value: 30.0%
 Matchup: Zarya vs Reaper; Prediction: 59.37%; Actual value: 50.0%
 Matchup: Reaper vs Ana; Prediction: 72.29%; Actual value: 61.9%
 Matchup: McCree vs Zenyatta; Prediction: 24.18%; Actual value: 41.67%
 Matchup: Roadhog vs McCree; Prediction: 85.15%; Actual value: 80.0%
 Matchup: Zarya vs Lucio; Prediction: 97.8%; Actual value: 90.0%
 Matchup: Bastion vs Zarya; Prediction: 41.78%; Actual value: 65.0%
 Matchup: Soldier:76 vs Zenyatta; Prediction: 39.82%; Actual value: 27.27%
 Matchup: Soldier:76 vs Mei; Prediction: 43.42%; Actual value: 60.0%
 Matchup: Zarya vs Zarya; Prediction: 55.88%; Actual value: 50.0%
 Matchup: Torbjorn vs McCree; Prediction: 57.6%; Actual value: 60.0%
 Matchup: Lucio vs Mei; Prediction: 16.86%; Actual value: 0.0%
 Matchup: Reaper vs Zarya; Prediction: 39.65%; Actual value: 50.0%
 Matchup: McCree vs Bastion; Prediction: 29.43%; Actual value: 45.0%
 Matchup: Lucio vs Soldier:76; Prediction: 27.6%; Actual value: 9.0%
 Matchup: Zenyatta vs Soldier:76; Prediction: 55.1%; Actual value: 72.72%
 Matchup: Zenyatta vs Lucio; Prediction: 83.15%; Actual value: 100.0%
 Matchup: Reaper vs Reaper; Prediction: 43.14%; Actual value: 50.0%
 Matchup: Reaper vs Soldier:76; Prediction: 53.51%; Actual value: 50.0%
 Matchup: Mei vs Ana; Prediction: 83.06%; Actual value: 70.0%
 Matchup: Zarya vs McCree; Prediction: 74.12%; Actual value: 66.66%
 Matchup: Zarya vs Ana; Prediction: 88.52%; Actual value: 72.72%
 Matchup: Ana vs Zenyatta; Prediction: 16.54%; Actual value: 10.0%
 Matchup: Roadhog vs Soldier:76; Prediction: 80.78%; Actual value: 50.0%

Mean squared error: 0.02
 Variance score: 0.66

Matchup: Roadhog vs McCree; Prediction: 86.28%; Actual value: 80.0%
 Matchup: Ana vs Zenyatta; Prediction: 20.76%; Actual value: 10.0%
 Matchup: Mei vs Zarya; Prediction: 44.08%; Actual value: 70.0%
 Matchup: Reaper vs Lucio; Prediction: 83.11%; Actual value: 70.0%
 Matchup: Ana vs Bastion; Prediction: 27.68%; Actual value: 15.0%
 Matchup: Reaper vs Soldier:76; Prediction: 57.23%; Actual value: 50.0%
 Matchup: Torbjorn vs Zenyatta; Prediction: 45.58%; Actual value: 27.27%
 Matchup: McCree vs McCree; Prediction: 44.91%; Actual value: 50.0%
 Matchup: Bastion vs Zarya; Prediction: 37.22%; Actual value: 65.0%
 Matchup: Torbjorn vs Roadhog; Prediction: 39.02%; Actual value: 18.18%
 Matchup: Lucio vs Lucio; Prediction: 54.18%; Actual value: 50.0%
 Matchup: Bastion vs Reaper; Prediction: 40.16%; Actual value: 55.0%
 Matchup: Roadhog vs Zenyatta; Prediction: 69.93%; Actual value: 66.66%
 Matchup: McCree vs Roadhog; Prediction: 22.01%; Actual value: 20.0%
 Matchup: Reaper vs Bastion; Prediction: 48.85%; Actual value: 45.0%
 Matchup: Soldier:76 vs Ana; Prediction: 71.62%; Actual value: 70.0%
 Matchup: Zarya vs Reaper; Prediction: 52.64%; Actual value: 50.0%
 Matchup: Reaper vs Zarya; Prediction: 39.53%; Actual value: 50.0%
 Matchup: Zarya vs Roadhog; Prediction: 45.55%; Actual value: 90.9%
 Matchup: Torbjorn vs Bastion; Prediction: 52.49%; Actual value: 40.0%
 Matchup: Roadhog vs Soldier:76; Prediction: 85.23%; Actual value: 50.0%
 Matchup: Bastion vs Ana; Prediction: 68.8%; Actual value: 85.0%
 Matchup: Soldier:76 vs Lucio; Prediction: 83.62%; Actual value: 90.9%
 Matchup: Reaper vs Roadhog; Prediction: 35.38%; Actual value: 40.0%
 Matchup: Mei vs Ana; Prediction: 75.67%; Actual value: 70.0%

Mean squared error: 0.03
 Variance score: 0.46

Matchup: Torbjorn vs Roadhog; Prediction: 38.81%; Actual value: 18.18%
 Matchup: Lucio vs Lucio; Prediction: 60.0%; Actual value: 50.0%
 Matchup: Ana vs Roadhog; Prediction: 16.89%; Actual value: 0.0%
 Matchup: Soldier:76 vs Mei; Prediction: 42.93%; Actual value: 60.0%
 Matchup: Lucio vs Zenyatta; Prediction: 15.46%; Actual value: 0.0%
 Matchup: Zarya vs Torbjorn; Prediction: 73.56%; Actual value: 72.72%
 Matchup: Zarya vs Roadhog; Prediction: 49.57%; Actual value: 90.9%
 Matchup: Zarya vs Zenyatta; Prediction: 53.76%; Actual value: 70.0%
 Matchup: Reaper vs Reaper; Prediction: 41.13%; Actual value: 40.0%
 Matchup: Zenyatta vs McCree; Prediction: 62.01%; Actual value: 50.0%
 Matchup: Zarya vs Soldier:76; Prediction: 67.81%; Actual value: 50.0%
 Matchup: Bastion vs Zenyatta; Prediction: 48.02%; Actual value: 10.0%
 Matchup: Roadhog vs Torbjorn; Prediction: 90.8%; Actual value: 81.81%
 Matchup: Reaper vs Reaper; Prediction: 40.21%; Actual value: 50.0%
 Matchup: Roadhog vs Lucio; Prediction: 115.56%; Actual value: 100.0%
 Matchup: Soldier:76 vs Soldier:76; Prediction: 56.65%; Actual value: 50.0%
 Matchup: Reaper vs Ana; Prediction: 69.42%; Actual value: 61.9%
 Matchup: McCree vs Bastion; Prediction: 28.5%; Actual value: 45.0%
 Matchup: Roadhog vs Soldier:76; Prediction: 85.06%; Actual value: 50.0%
 Matchup: Torbjorn vs Lucio; Prediction: 87.55%; Actual value: 60.0%
 Matchup: Torbjorn vs Soldier:76; Prediction: 57.05%; Actual value: 72.72%
 Matchup: Roadhog vs Mei; Prediction: 71.34%; Actual value: 75.0%
 Matchup: McCree vs Zarya; Prediction: 26.61%; Actual value: 33.33%
 Matchup: Zenyatta vs Mei; Prediction: 46.05%; Actual value: 30.0%
 Matchup: Lucio vs Roadhog; Prediction: 11.26%; Actual value: 0.0%

Mean squared error: 0.03
 Variance score: 0.53

Matchup: Reaper vs McCree; Prediction: 54.99%; Actual value: 75.0%
 Matchup: Torbjorn vs Zenyatta; Prediction: 39.83%; Actual value: 27.27%
 Matchup: Roadhog vs Zenyatta; Prediction: 63.4%; Actual value: 66.66%
 Matchup: Zarya vs Lucio; Prediction: 97.86%; Actual value: 90.0%
 Matchup: Soldier:76 vs Bastion; Prediction: 33.56%; Actual value: 65.0%
 Matchup: Torbjorn vs Soldier:76; Prediction: 51.15%; Actual value: 72.72%
 Matchup: Ana vs Lucio; Prediction: 56.95%; Actual value: 75.0%
 Matchup: Zarya vs Reaper; Prediction: 61.01%; Actual value: 50.0%
 Matchup: Soldier:76 vs Roadhog; Prediction: 32.88%; Actual value: 50.0%
 Matchup: Bastion vs Soldier:76; Prediction: 58.03%; Actual value: 35.0%
 Matchup: Zenyatta vs Bastion; Prediction: 36.3%; Actual value: 90.0%
 Matchup: Ana vs Soldier:76; Prediction: 27.64%; Actual value: 30.0%
 Matchup: Soldier:76 vs Lucio; Prediction: 77.59%; Actual value: 90.9%
 Matchup: Bastion vs Bastion; Prediction: 43.31%; Actual value: 50.0%
 Matchup: Zarya vs Bastion; Prediction: 53.83%; Actual value: 65.0%
 Matchup: Roadhog vs Lucio; Prediction: 104.03%; Actual value: 100.0%
 Matchup: Bastion vs Roadhog; Prediction: 42.62%; Actual value: 40.0%
 Matchup: Zenyatta vs Reaper; Prediction: 43.48%; Actual value: 45.45%
 Matchup: Roadhog vs Zarya; Prediction: 63.67%; Actual value: 90.9%
 Matchup: Zenyatta vs Roadhog; Prediction: 35.62%; Actual value: 33.33%
 Matchup: Reaper vs Soldier:76; Prediction: 50.72%; Actual value: 50.0%
 Matchup: Soldier:76 vs Soldier:76; Prediction: 48.28%; Actual value: 50.0%
 Matchup: Zarya vs Ana; Prediction: 88.92%; Actual value: 72.72%
 Matchup: McCree vs Ana; Prediction: 61.14%; Actual value: 55.0%
 Matchup: Roadhog vs Torbjorn; Prediction: 85.17%; Actual value: 81.81%

Mean squared error: 0.03
 Variance score: 0.30

Matchup: Torbjorn vs Ana; Prediction: 71.2%; Actual value: 70.0%
 Matchup: Reaper vs Zenyatta; Prediction: 33.96%; Actual value: 54.54%
 Matchup: Torbjorn vs Bastion; Prediction: 45.49%; Actual value: 40.0%
 Matchup: Bastion vs McCree; Prediction: 63.4%; Actual value: 55.0%
 Matchup: Ana vs Soldier:76; Prediction: 27.15%; Actual value: 30.0%
 Matchup: Soldier:76 vs Lucio; Prediction: 78.33%; Actual value: 90.9%
 Matchup: Zarya vs Ana; Prediction: 90.09%; Actual value: 72.72%
 Matchup: Zarya vs Torbjorn; Prediction: 79.38%; Actual value: 72.72%
 Matchup: Soldier:76 vs Torbjorn; Prediction: 59.55%; Actual value: 72.72%
 Matchup: Lucio vs Mei; Prediction: 19.14%; Actual value: 0.0%
 Matchup: McCree vs Zenyatta; Prediction: 21.45%; Actual value: 41.67%
 Matchup: McCree vs Zarya; Prediction: 26.25%; Actual value: 33.33%
 Matchup: Lucio vs McCree; Prediction: 34.51%; Actual value: 20.0%
 Matchup: McCree vs Ana; Prediction: 57.84%; Actual value: 55.0%
 Matchup: Soldier:76 vs Soldier:76; Prediction: 49.37%; Actual value: 50.0%
 Matchup: Bastion vs Roadhog; Prediction: 42.02%; Actual value: 40.0%
 Matchup: Bastion vs Lucio; Prediction: 83.74%; Actual value: 100.0%
 Matchup: Lucio vs Roadhog; Prediction: 13.14%; Actual value: 0.0%
 Matchup: Zarya vs Reaper; Prediction: 60.9%; Actual value: 50.0%
 Matchup: Ana vs Reaper; Prediction: 18.86%; Actual value: 38.1%
 Matchup: Bastion vs Torbjorn; Prediction: 64.96%; Actual value: 60.0%
 Matchup: Roadhog vs Zarya; Prediction: 62.23%; Actual value: 90.9%
 Matchup: Soldier:76 vs Ana; Prediction: 70.26%; Actual value: 70.0%
 Matchup: Mei vs Bastion; Prediction: 54.73%; Actual value: 40.0%
 Matchup: Soldier:76 vs Bastion; Prediction: 44.55%; Actual value: 65.0%

Mean squared error: 0.02
 Variance score: 0.70

Matchup: McCree vs McCree; Prediction: 46.55%; Actual value: 50.0%
 Matchup: Soldier:76 vs Mei; Prediction: 43.8%; Actual value: 60.0%
 Matchup: Reaper vs Zenyatta; Prediction: 35.18%; Actual value: 54.54%
 Matchup: Ana vs Reaper; Prediction: 16.68%; Actual value: 38.1%
 Matchup: Ana vs Roadhog; Prediction: 15.68%; Actual value: 0.0%
 Matchup: Reaper vs Roadhog; Prediction: 36.23%; Actual value: 40.0%
 Matchup: Zenyatta vs Zenyatta; Prediction: 38.87%; Actual value: 50.0%
 Matchup: Ana vs Zenyatta; Prediction: 14.64%; Actual value: 10.0%
 Matchup: Torbjorn vs Zarya; Prediction: 45.63%; Actual value: 27.27%
 Matchup: Torbjorn vs McCree; Prediction: 60.91%; Actual value: 60.0%
 Matchup: Mei vs Reaper; Prediction: 45.65%; Actual value: 60.0%
 Matchup: Lucio vs Torbjorn; Prediction: 36.01%; Actual value: 40.0%
 Matchup: Mei vs Lucio; Prediction: 87.44%; Actual value: 100.0%
 Matchup: Roadhog vs Zenyatta; Prediction: 60.46%; Actual value: 66.66%
 Matchup: Zenyatta vs Ana; Prediction: 68.27%; Actual value: 90.0%
 Matchup: Bastion vs Bastion; Prediction: 50.21%; Actual value: 50.0%
 Matchup: Roadhog vs McCree; Prediction: 81.53%; Actual value: 80.0%
 Matchup: Lucio vs McCree; Prediction: 31.77%; Actual value: 20.0%
 Matchup: Reaper vs Zarya; Prediction: 40.97%; Actual value: 50.0%
 Matchup: Reaper vs Soldier:76; Prediction: 51.46%; Actual value: 50.0%
 Matchup: Torbjorn vs Torbjorn; Prediction: 65.14%; Actual value: 50.0%
 Matchup: Roadhog vs Ana; Prediction: 89.86%; Actual value: 100.0%
 Matchup: Reaper vs Mei; Prediction: 39.83%; Actual value: 40.0%
 Matchup: Soldier:76 vs Zenyatta; Prediction: 39.15%; Actual value: 27.27%
 Matchup: Lucio vs Soldier:76; Prediction: 26.99%; Actual value: 9.0%

Mean squared error: 0.02
 Variance score: 0.77

Matchup: McCree vs Mei; Prediction: 34.48%; Actual value: 30.0%
 Matchup: McCree vs McCree; Prediction: 45.49%; Actual value: 50.0%
 Matchup: Zarya vs Roadhog; Prediction: 42.12%; Actual value: 90.9%
 Matchup: Ana vs Soldier:76; Prediction: 30.27%; Actual value: 30.0%
 Matchup: Torbjorn vs Roadhog; Prediction: 34.78%; Actual value: 18.18%
 Matchup: Torbjorn vs Ana; Prediction: 72.38%; Actual value: 70.0%
 Matchup: Roadhog vs Torbjorn; Prediction: 85.95%; Actual value: 81.81%
 Matchup: Zarya vs Zenyatta; Prediction: 41.44%; Actual value: 70.0%
 Matchup: Bastion vs Bastion; Prediction: 39.85%; Actual value: 50.0%
 Matchup: Torbjorn vs Zenyatta; Prediction: 34.1%; Actual value: 27.27%
 Matchup: Reaper vs Torbjorn; Prediction: 62.44%; Actual value: 60.0%
 Matchup: Reaper vs Zenyatta; Prediction: 35.23%; Actual value: 54.54%
 Matchup: Reaper vs Bastion; Prediction: 37.56%; Actual value: 45.0%
 Matchup: Soldier:76 vs Torbjorn; Prediction: 61.27%; Actual value: 72.72%
 Matchup: Lucio vs Ana; Prediction: 45.82%; Actual value: 25.0%
 Matchup: McCree vs Bastion; Prediction: 23.69%; Actual value: 45.0%
 Matchup: Zenyatta vs Lucio; Prediction: 81.05%; Actual value: 100.0%
 Matchup: Reaper vs Lucio; Prediction: 85.05%; Actual value: 70.0%
 Matchup: Zenyatta vs Torbjorn; Prediction: 58.44%; Actual value: 72.72%
 Matchup: Soldier:76 vs Bastion; Prediction: 36.39%; Actual value: 65.0%
 Matchup: Reaper vs Mei; Prediction: 48.35%; Actual value: 40.0%
 Matchup: Lucio vs Mei; Prediction: 20.66%; Actual value: 0.0%
 Matchup: Mei vs Zenyatta; Prediction: 37.36%; Actual value: 70.0%
 Matchup: Mei vs Zarya; Prediction: 45.13%; Actual value: 70.0%
 Matchup: Zenyatta vs Bastion; Prediction: 33.55%; Actual value: 90.0%

Mean squared error: 0.05
 Variance score: 0.19

Matchup: Ana vs Lucio; Prediction: 48.04%; Actual value: 75.0%
 Matchup: Zenyatta vs Mei; Prediction: 37.36%; Actual value: 30.0%
 Matchup: Zarya vs McCree; Prediction: 73.86%; Actual value: 66.66%
 Matchup: Mei vs Roadhog; Prediction: 54.01%; Actual value: 25.0%
 Matchup: Soldier:76 vs Roadhog; Prediction: 47.43%; Actual value: 50.0%
 Matchup: Ana vs Reaper; Prediction: 11.17%; Actual value: 38.1%
 Matchup: Roadhog vs Lucio; Prediction: 102.05%; Actual value: 100.0%
 Matchup: Bastion vs Ana; Prediction: 70.26%; Actual value: 85.0%
 Matchup: Torbjorn vs Reaper; Prediction: 38.83%; Actual value: 40.0%
 Matchup: Torbjorn vs Soldier:76; Prediction: 47.5%; Actual value: 72.72%
 Matchup: Torbjorn vs Roadhog; Prediction: 40.6%; Actual value: 18.18%
 Matchup: McCree vs Zenyatta; Prediction: 28.93%; Actual value: 41.67%
 Matchup: Soldier:76 vs Zenyatta; Prediction: 46.13%; Actual value: 27.27%
 Matchup: Zenyatta vs Bastion; Prediction: 34.82%; Actual value: 90.0%
 Matchup: Lucio vs Zenyatta; Prediction: 13.91%; Actual value: 0.0%
 Matchup: Soldier:76 vs Torbjorn; Prediction: 65.84%; Actual value: 72.72%
 Matchup: Zenyatta vs Zarya; Prediction: 38.13%; Actual value: 30.0%
 Matchup: Zenyatta vs Ana; Prediction: 60.77%; Actual value: 90.0%
 Matchup: Zarya vs Zarya; Prediction: 59.86%; Actual value: 50.0%
 Matchup: Zenyatta vs Soldier:76; Prediction: 42.94%; Actual value: 72.72%
 Matchup: Soldier:76 vs McCree; Prediction: 63.53%; Actual value: 50.0%
 Matchup: Zenyatta vs Lucio; Prediction: 71.15%; Actual value: 100.0%
 Matchup: Ana vs Zarya; Prediction: 15.02%; Actual value: 27.27%
 Matchup: Ana vs McCree; Prediction: 29.03%; Actual value: 45.0%
 Matchup: Lucio vs Soldier:76; Prediction: 22.1%; Actual value: 9.0%

Mean squared error: 0.04
 Variance score: 0.44

Matchup: McCree vs Roadhog; Prediction: 27.01%; Actual value: 20.0%
 Matchup: Torbjorn vs Torbjorn; Prediction: 66.41%; Actual value: 50.0%
 Matchup: Reaper vs Bastion; Prediction: 45.9%; Actual value: 45.0%
 Matchup: Ana vs Mei; Prediction: 19.04%; Actual value: 30.0%
 Matchup: Mei vs Roadhog; Prediction: 50.14%; Actual value: 25.0%
 Matchup: McCree vs Torbjorn; Prediction: 49.09%; Actual value: 40.0%
 Matchup: Reaper vs Reaper; Prediction: 40.15%; Actual value: 50.0%
 Matchup: Bastion vs Zarya; Prediction: 45.04%; Actual value: 65.0%
 Matchup: Roadhog vs McCree; Prediction: 81.74%; Actual value: 80.0%
 Matchup: Bastion vs Soldier:76; Prediction: 56.53%; Actual value: 35.0%
 Matchup: McCree vs Lucio; Prediction: 66.48%; Actual value: 80.0%
 Matchup: McCree vs Reaper; Prediction: 27.03%; Actual value: 25.0%
 Matchup: Torbjorn vs Ana; Prediction: 70.44%; Actual value: 70.0%
 Matchup: Zarya vs Lucio; Prediction: 96.83%; Actual value: 90.0%
 Matchup: McCree vs Mei; Prediction: 26.51%; Actual value: 30.0%
 Matchup: McCree vs Zenyatta; Prediction: 22.9%; Actual value: 41.67%
 Matchup: Bastion vs Torbjorn; Prediction: 66.49%; Actual value: 60.0%
 Matchup: Torbjorn vs Zenyatta; Prediction: 40.21%; Actual value: 27.27%
 Matchup: Roadhog vs Ana; Prediction: 91.27%; Actual value: 100.0%
 Matchup: Roadhog vs Zenyatta; Prediction: 61.05%; Actual value: 66.66%
 Matchup: Zenyatta vs Zarya; Prediction: 45.37%; Actual value: 30.0%
 Matchup: Soldier:76 vs McCree; Prediction: 60.34%; Actual value: 50.0%
 Matchup: Bastion vs Ana; Prediction: 70.52%; Actual value: 85.0%
 Matchup: Lucio vs Bastion; Prediction: 21.03%; Actual value: 0.0%
 Matchup: Ana vs Roadhog; Prediction: 19.54%; Actual value: 0.0%

Mean squared error: 0.02
 Variance score: 0.75

Matchup: Ana vs Zenyatta; Prediction: 18.52%; Actual value: 10.0%
 Matchup: Torbjorn vs Roadhog; Prediction: 40.24%; Actual value: 18.18%
 Matchup: Ana vs Bastion; Prediction: 17.99%; Actual value: 15.0%
 Matchup: Roadhog vs Zarya; Prediction: 62.97%; Actual value: 90.9%
 Matchup: Reaper vs McCree; Prediction: 55.44%; Actual value: 75.0%
 Matchup: McCree vs Mei; Prediction: 30.73%; Actual value: 30.0%
 Matchup: Roadhog vs Bastion; Prediction: 62.59%; Actual value: 60.0%
 Matchup: Bastion vs Zenyatta; Prediction: 49.94%; Actual value: 10.0%
 Matchup: Zarya vs Ana; Prediction: 85.75%; Actual value: 72.72%
 Matchup: Zenyatta vs Zenyatta; Prediction: 35.6%; Actual value: 50.0%
 Matchup: Mei vs McCree; Prediction: 66.66%; Actual value: 70.0%
 Matchup: Roadhog vs McCree; Prediction: 76.41%; Actual value: 80.0%
 Matchup: Zenyatta vs Soldier:76; Prediction: 45.08%; Actual value: 72.72%
 Matchup: Ana vs Lucio; Prediction: 58.02%; Actual value: 75.0%
 Matchup: Zarya vs Zarya; Prediction: 56.24%; Actual value: 50.0%
 Matchup: Lucio vs Ana; Prediction: 43.34%; Actual value: 25.0%
 Matchup: Zenyatta vs Reaper; Prediction: 35.39%; Actual value: 45.45%
 Matchup: McCree vs Soldier:76; Prediction: 39.34%; Actual value: 50.0%
 Matchup: Zenyatta vs Bastion; Prediction: 35.07%; Actual value: 90.0%
 Matchup: Mei vs Soldier:76; Prediction: 62.84%; Actual value: 40.0%
 Matchup: Torbjorn vs Bastion; Prediction: 42.02%; Actual value: 40.0%
 Matchup: Zenyatta vs Ana; Prediction: 64.95%; Actual value: 90.0%
 Matchup: Zarya vs Torbjorn; Prediction: 75.77%; Actual value: 72.72%
 Matchup: Lucio vs Zarya; Prediction: 13.83%; Actual value: 10.0%
 Matchup: Reaper vs Lucio; Prediction: 81.64%; Actual value: 70.0%

Mean squared error: 0.04
 Variance score: 0.45

Matchup: Torbjorn vs Zarya; Prediction: 52.2%; Actual value: 27.27%
 Matchup: Bastion vs Mei; Prediction: 48.75%; Actual value: 60.0%
 Matchup: Lucio vs Reaper; Prediction: 9.67%; Actual value: 30.0%
 Matchup: Soldier:76 vs Zarya; Prediction: 46.97%; Actual value: 50.0%
 Matchup: Soldier:76 vs Torbjorn; Prediction: 62.68%; Actual value: 72.72%
 Matchup: Zarya vs Mei; Prediction: 64.43%; Actual value: 30.0%
 Matchup: Torbjorn vs Bastion; Prediction: 53.29%; Actual value: 40.0%
 Matchup: Lucio vs Mei; Prediction: 17.85%; Actual value: 0.0%
 Matchup: Torbjorn vs McCree; Prediction: 63.77%; Actual value: 60.0%
 Matchup: Reaper vs Reaper; Prediction: 36.44%; Actual value: 50.0%
 Matchup: Soldier:76 vs Ana; Prediction: 70.2%; Actual value: 70.0%
 Matchup: Mei vs McCree; Prediction: 65.57%; Actual value: 70.0%
 Matchup: Mei vs Roadhog; Prediction: 46.76%; Actual value: 25.0%
 Matchup: Torbjorn vs Lucio; Prediction: 89.16%; Actual value: 60.0%
 Matchup: Bastion vs Torbjorn; Prediction: 64.23%; Actual value: 60.0%
 Matchup: McCree vs Torbjorn; Prediction: 50.84%; Actual value: 40.0%
 Matchup: Zenyatta vs McCree; Prediction: 63.12%; Actual value: 50.0%
 Matchup: Zenyatta vs Zarya; Prediction: 51.55%; Actual value: 30.0%
 Matchup: Roadhog vs Ana; Prediction: 92.67%; Actual value: 100.0%
 Matchup: Torbjorn vs Torbjorn; Prediction: 67.91%; Actual value: 50.0%
 Matchup: McCree vs Reaper; Prediction: 27.19%; Actual value: 25.0%
 Matchup: McCree vs Mei; Prediction: 35.37%; Actual value: 30.0%
 Matchup: Mei vs Mei; Prediction: 54.23%; Actual value: 50.0%
 Matchup: Lucio vs Bastion; Prediction: 18.7%; Actual value: 0.0%
 Matchup: Ana vs Soldier:76; Prediction: 30.33%; Actual value: 30.0%

Mean squared error: 0.02

Variance score: 0.51

Matchup: Torbjorn vs Zarya; Prediction: 44.79%; Actual value: 27.27%
 Matchup: Mei vs Soldier:76; Prediction: 60.62%; Actual value: 40.0%
 Matchup: Ana vs McCree; Prediction: 32.66%; Actual value: 45.0%
 Matchup: Torbjorn vs Reaper; Prediction: 41.64%; Actual value: 40.0%
 Matchup: Zarya vs Ana; Prediction: 85.9%; Actual value: 72.72%
 Matchup: Roadhog vs Ana; Prediction: 91.99%; Actual value: 100.0%
 Matchup: Bastion vs Ana; Prediction: 71.85%; Actual value: 85.0%
 Matchup: McCree vs Soldier:76; Prediction: 38.11%; Actual value: 50.0%
 Matchup: Lucio vs Zarya; Prediction: 17.14%; Actual value: 10.0%
 Matchup: Lucio vs Bastion; Prediction: 17.56%; Actual value: 0.0%
 Matchup: Ana vs Lucio; Prediction: 56.91%; Actual value: 75.0%
 Matchup: McCree vs Zarya; Prediction: 28.86%; Actual value: 33.33%
 Matchup: McCree vs Bastion; Prediction: 29.27%; Actual value: 45.0%
 Matchup: McCree vs Roadhog; Prediction: 23.92%; Actual value: 20.0%
 Matchup: Bastion vs McCree; Prediction: 59.77%; Actual value: 55.0%
 Matchup: Zarya vs Torbjorn; Prediction: 80.44%; Actual value: 72.72%
 Matchup: Roadhog vs Lucio; Prediction: 104.17%; Actual value: 100.0%
 Matchup: Reaper vs Reaper; Prediction: 39.55%; Actual value: 50.0%
 Matchup: Mei vs Reaper; Prediction: 48.22%; Actual value: 60.0%
 Matchup: Roadhog vs Zenyatta; Prediction: 61.96%; Actual value: 66.66%
 Matchup: Soldier:76 vs Bastion; Prediction: 44.27%; Actual value: 65.0%
 Matchup: Zenyatta vs Roadhog; Prediction: 42.36%; Actual value: 33.33%
 Matchup: Ana vs Torbjorn; Prediction: 39.27%; Actual value: 30.0%
 Matchup: Roadhog vs Mei; Prediction: 66.32%; Actual value: 75.0%
 Matchup: Torbjorn vs Ana; Prediction: 69.99%; Actual value: 70.0%

Mean squared error: 0.01

Variance score: 0.79

Matchup: Soldier:76 vs Roadhog; Prediction: 35.98%; Actual value: 50.0%
 Matchup: Bastion vs Zarya; Prediction: 47.89%; Actual value: 65.0%
 Matchup: Ana vs Torbjorn; Prediction: 38.55%; Actual value: 30.0%
 Matchup: Torbjorn vs Lucio; Prediction: 86.25%; Actual value: 60.0%
 Matchup: McCree vs Reaper; Prediction: 24.69%; Actual value: 25.0%
 Matchup: Bastion vs Soldier:76; Prediction: 60.96%; Actual value: 35.0%
 Matchup: Ana vs Roadhog; Prediction: 13.23%; Actual value: 0.0%
 Matchup: Roadhog vs Roadhog; Prediction: 65.44%; Actual value: 50.0%
 Matchup: McCree vs Bastion; Prediction: 30.05%; Actual value: 45.0%
 Matchup: Bastion vs Zenyatta; Prediction: 51.12%; Actual value: 10.0%
 Matchup: Mei vs Ana; Prediction: 80.91%; Actual value: 70.0%
 Matchup: Soldier:76 vs Zenyatta; Prediction: 43.61%; Actual value: 27.27%
 Matchup: Zarya vs Ana; Prediction: 88.94%; Actual value: 72.72%
 Matchup: Soldier:76 vs Ana; Prediction: 71.7%; Actual value: 70.0%
 Matchup: Mei vs Bastion; Prediction: 52.43%; Actual value: 40.0%
 Matchup: Soldier:76 vs Bastion; Prediction: 43.21%; Actual value: 65.0%
 Matchup: Lucio vs Ana; Prediction: 43.62%; Actual value: 25.0%
 Matchup: Soldier:76 vs Reaper; Prediction: 37.85%; Actual value: 50.0%
 Matchup: Torbjorn vs Reaper; Prediction: 39.65%; Actual value: 40.0%
 Matchup: Lucio vs Reaper; Prediction: 9.77%; Actual value: 30.0%
 Matchup: Bastion vs Mei; Prediction: 47.61%; Actual value: 60.0%
 Matchup: Ana vs Reaper; Prediction: 15.1%; Actual value: 38.1%
 Matchup: Lucio vs McCree; Prediction: 27.52%; Actual value: 20.0%
 Matchup: Ana vs McCree; Prediction: 32.86%; Actual value: 45.0%
 Matchup: Roadhog vs Soldier:76; Prediction: 82.91%; Actual value: 50.0%

Mean squared error: 0.03

Variance score: 0.06

Matchup: McCree vs Reaper; Prediction: 32.63%; Actual value: 25.0%
 Matchup: Reaper vs Zenyatta; Prediction: 34.54%; Actual value: 54.54%
 Matchup: Zarya vs Zenyatta; Prediction: 47.16%; Actual value: 70.0%
 Matchup: Roadhog vs Reaper; Prediction: 69.3%; Actual value: 60.0%
 Matchup: Lucio vs Mei; Prediction: 19.1%; Actual value: 0.0%
 Matchup: Soldier:76 vs Lucio; Prediction: 80.38%; Actual value: 90.9%
 Matchup: Ana vs Reaper; Prediction: 20.41%; Actual value: 38.1%
 Matchup: Reaper vs Ana; Prediction: 70.08%; Actual value: 61.9%
 Matchup: Bastion vs Mei; Prediction: 49.78%; Actual value: 60.0%
 Matchup: Torbjorn vs Ana; Prediction: 70.68%; Actual value: 70.0%
 Matchup: Bastion vs McCree; Prediction: 61.93%; Actual value: 55.0%
 Matchup: Soldier:76 vs Bastion; Prediction: 37.69%; Actual value: 65.0%
 Matchup: Reaper vs Torbjorn; Prediction: 60.51%; Actual value: 60.0%
 Matchup: Mei vs Bastion; Prediction: 45.78%; Actual value: 40.0%
 Matchup: Zenyatta vs Bastion; Prediction: 37.88%; Actual value: 90.0%
 Matchup: Reaper vs Roadhog; Prediction: 30.28%; Actual value: 40.0%
 Matchup: Roadhog vs Ana; Prediction: 97.26%; Actual value: 100.0%
 Matchup: Mei vs Zarya; Prediction: 48.3%; Actual value: 70.0%
 Matchup: Roadhog vs Lucio; Prediction: 108.46%; Actual value: 100.0%
 Matchup: Zenyatta vs Torbjorn; Prediction: 59.79%; Actual value: 72.72%
 Matchup: Soldier:76 vs Roadhog; Prediction: 29.38%; Actual value: 50.0%
 Matchup: Bastion vs Ana; Prediction: 74.06%; Actual value: 85.0%
 Matchup: Torbjorn vs Torbjorn; Prediction: 61.11%; Actual value: 50.0%
 Matchup: Zarya vs Roadhog; Prediction: 42.9%; Actual value: 90.9%
 Matchup: Zarya vs Mei; Prediction: 58.41%; Actual value: 30.0%

Mean squared error: 0.04

Variance score: 0.29