What contributes to winning in League of Legends?

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***Abstract*—Video game industry has progressively become more ingrained within real-world discourse as a pillar of entertainment and culture. MOBAs (Multiplayer Online Battle Arena) as a genre popularized a multitude of games with millions of players worldwide. The most popular MOBA game is Riot Games entry into the genre, League of Legends. The goal is to research the effects of how in-game statistics during the first ten minutes of a League of Legends match affects the overall outcome of the game. These results from the game can emulate real world datasets and problems, and the tactics used to analyze win conditions in League of Legends can be applied to great effect in real life scenarios.**

I. INTRODUCTION

League of Legends is one of the most popular online video games in the world, pulling in millions of players with its free to play model and its simple gameplay relative to other entries in the MOBA (Massive Online Battle Arena) genre. The premise for the gameplay in League of Legends revolves around a 5 versus 5 game between two opposing teams, the blue and red team. Throughout the course of a match, these two teams take objectives from each other to win. The win condition for a match revolves around a structure in the heart of both bases known as the nexus. The team that destroys the opposing team's nexus wins (e.g., blue team wins if they destroy the red team's nexus).

We plan to research the effects of how in-game statistics during the first ten minutes of a League of Legends match affects the overall outcome of a game. Although researching video game outcomes can be seen as miniscule relative to other issues, video games emulate real-world problems. Since problem solving has become a crucial tool in the modern world, coupled with the fact that video games have formed an alternate lens to observe data - one can claim that video games are creating the world's next problem solvers. Throughout our research, we will be looking at a dataset of in-game statistics and features which will reveal the contribution each one gives with respect to the overall outcome of a game. In addition, we will employ the use of various bar plots and scatter plots to help visualize the data. By researching win conditions in League of Legends, we believe that the tactics that are used to observe video game data can also be applied to great effect in real world scenarios.

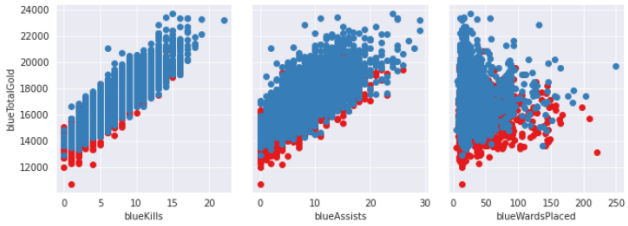
II. APPROACH

We analyze the dataset to find how various win conditions aggregate into a victory or defeat. The analysis is completed through Python, using the Pandas and NumPy libraries to visualize and analyze the dataset.

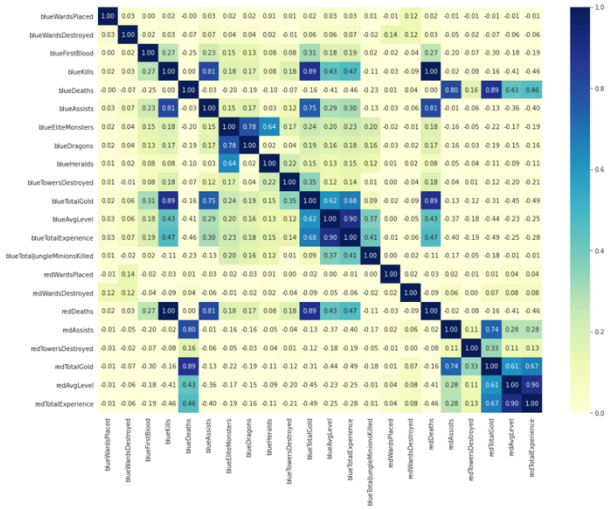
We use datasets from Kaggle that collect information about high rank League of Legends games from Riot's API. Taking matches from higher ranked players is indicative of a higher skill level and command of the game's mechanics. We examined the various factors that contribute to a match's win condition and built models and graphs to determine the interaction between all the factors stored within the dataset.

III. DATA

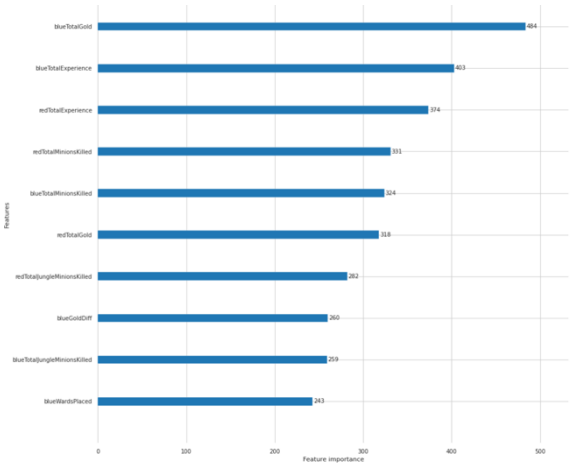
The data set consists of a multitude of features, including but not limited to: team gold, team kills, team assists, wards placed, towers destroyed, monsters killed, and experience points earned. These are all complex aspects of League of Legends that interact with each other alongside the win condition of destroying the opposing team's nexus. With respect to our data, it becomes important to note how a lot of the data is extracted from the first ten minutes of each game. In addition, this means there is a chance that this data has the potential to significantly change throughout the course of every individual game which can last up to an hour. This is especially important because this can be highly affected by how our data comes from extremely high skill-based matchmaking. Some of the more noticable parameters for the game features were blueKills to blueTeamGold, blueAssists to blueTeamGold, and blueWardsPlaced to blueTeamGold. We decided to look at these parameters on scatterplots as they greatly affect the outcome of the game.



With this in mind, we did measure the correlations of much of the parameters discussed which is shown in the following chart where you can see correlation coefficients for every parameter that appears to affect game outcome.



Once again, there is only some noticable parameters which stand out from the rest. As seen, the total gold collected is the most important in many cases and you'll notice it was a parameter on each of the scatterplots shown earlier. The following important parameters are usually kills and experience level. Kills greatly impacts gold advantges per game and experience can easily determine the strength of the team during the game.

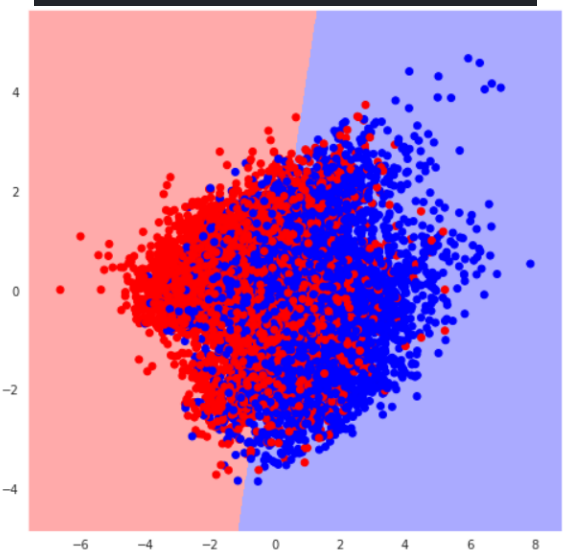


blueGoldDiff	10.0
blueExperienceDiff	9.5
blueGoldPerMin	8.0
blueTotalGold	8.0
blueTotalExperience	8.0
blueAvgLevel	7.0
blueKills	6.5
blueAssists	5.5
blueTotalMinionsKilled	4.5
blueCSPerMin	4.5
blueEliteMonsters	4.5
blueDragons	4.0
blueFirstBlood	4.0
blueTotalJungleMinionsKilled	2.5
blueTowersDestroyed	2.5
blueHeralds	2.0
blueWardsDestroyed	1.0
blueWardsPlaced	0.0

IV. EVALUATION

We can observe from the dataset that there are several factors which contribute to the outcome of a game. We decided to use multiple classifiers to help us with our model selection. From basic inspection of the below chart, we can see many models are of similar accuracy with logistic regression being the highest. The models we decided to test with are: Naive Bayes, Decision Trees, Random Forests, Logistic Regression, and K-Nearest Neighbors.

	Accuracy Score
Naive Bayes	0.717611
DT	0.692814
Random Forest	0.728239
Logistic Regression	0.730263
K_nearest Neighbors	0.717105



Although the model above looks a bit messy, one can clearly see the decision boundary fitted in the background. We'd say our training data is fairly precise and accurate considering we are only looking at a partial portion of every single game played for this data.

V. CONCLUSION

The results demonstrate that winning in League of Legends is based on gold advantage which is greatly affected by farming monsters and killing the enemy team. Despite us finding the numbers showing us what gives advantage, one may argue how communication is an important social factor to the outcome of a game as we all know communication is a necessary skill for the top players who play the game. We can observe that the model (III. Data) shows how these features are of the utmost importance when deciding the outcome of the game. This can be extrapolated from the visuals we created in a Python Notebook on JupyterLab. Due to the data and the evaluation processes, we can conclude that a general team advantage of gold and experience contributes to winning League of Legends matches.

VI. RELATED WORK

There are a multitude of machine learning projects intended to understand what contributes to winning in League of Legends, and moreover, all kinds of competitive video games. Modeling the interaction between players and video games is a microcosm of similar analytics that can be applied in real life, and the application/connection between them only gets closer as technology progresses and becomes embedded into world affairs.

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