General Manager Simulator
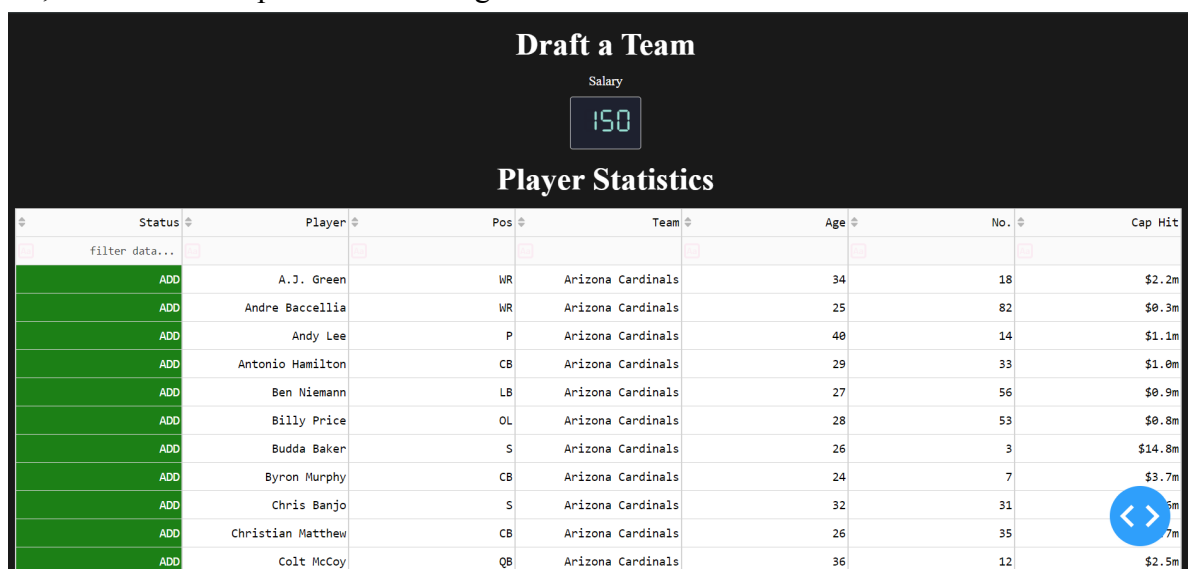
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Abstract

Managing a National Football League (NFL) team is the dream of many young athletes growing up. One of the most exciting aspects of managing a team is the ability to draft and cut players, which is one of the key responsibilities of a general manager. This General Manager Simulator creates a dashboard that allows anyone from a layperson to a seasoned football fan to create a football team of NFL players and attempt to optimize the success of their created team.

The dashboard opens to a screen with all of the active players for the 2022 season alongside their basic statistics (Figure 1). There are additional statistics displayed based on the player's position dropdown. In addition, the user is initially shown the salary cap they must abide by when creating their team. Users can add and remove players to their team, and the available salary cap will adjust accordingly. The dashboard datatable has functionality that allows for filtering of player statistics through searchable columns and dropdowns. In addition, there is a radar chart visualization that allows the user to choose two players to compare their statistics. As the user is assembling the team, players will appear in a team table along with a visualization portraying the depth of the team by position and whether players should be added or removed. Finally, the dashboard uses supervised machine learning to predict the success of the created team, if the team completed one full regular season.

Figure 1: Initial dashboard player view.

Our goal for this project was to create a simulator for football fans who are looking to discover a new perspective on the game and/or understand what a general manager values when

assembling a team. It also can help current general managers with managing their own team by looking at how their team will fare when they exchange players. It can be especially helpful when scouting free agents who have a full season in the NFL.

At the end of the project, we were able to conclude that the dashboard we created can be utilized effectively to simulate the general manager position. Throughout this project, we learned about the inner workings of a dashboard, creating visualizations with the Plotly library, and how machine learning can apply to topics in sports analytics.

Introduction

When brainstorming the project, we discovered a common interest in sports. We had several initial ideas, ranging from a node map of league trades over time, to matching players and team styles, to a general manager simulator dashboard that we eventually settled on. Football is a sport with a wide range of both data and decision making so we chose the NFL as our league to simulate.

General managers often face intense scrutiny for their decisions throughout a season, so we viewed this as an opportunity to provide casual fans with a chance to see how they would fare in a general manager's shoes.

We wanted to add unique features in our dashboard to differentiate our project from other NFL drafting applications, such as fantasy football.. Overall, we wanted our dashboard to be focused on the team data just as much as individual player data, so we could create head-to-head competition. In fantasy football, a user wants to pick excellent players, but they don't have to worry about important factors such as a salary cap. In addition, there are unique visualizations that fantasy football does not have, that provides a more appropriate illustration of what a general manager considers.

Methods

To get our data, we used the Pandas and BeautifulSoup libraries for web scraping. First, we used BeautifulSoup to get the websites for each team and each season [1, 2]. We then used a combination of Pandas and BeautifulSoup to read each table in as a DataFrame. Finally we scraped all the data from the pages into organized CSV files for team and player data.

After obtaining the data, we significantly cleaned the DataFrames by removing empty columns, condensing positions for simplicity, removing players without a salary, and changing the format of the player salaries. This helped make our data more readable when displayed on our dashboard, easier to iterate through in our functions, and more simplified for the user.

Once the data is imported, cleaned, and added to the dashboard we used a multiple regression classifier to predict the number of wins the created would achieve in a season. To get this value we aggregated player data for every team since the 2000 NFL season as well as the data of the team that has been chosen and compared them as if they were a full team.

Analysis

Some outcomes of our project we would like to highlight are our visualizations. While the main outcome of our project was the general manager simulator dashboard itself, we did have some interesting comparisons and visualizations created throughout.

Our first visualization is a radar chart made to help users make roster decisions between two players (Figure 2). The user can choose two players they want to compare by entering their IDs and pressing the submit button. This specific chart is comparing two quarterbacks currently in the NFL: Tampa Bay Buccaneers' quarterback Tom Brady is the red chart while Kansas City Chiefs' quarterback Patrick Mahomes is the blue. The radar chart itself takes five important statistics and maps where each player is for each statistic. Since both players are quarterbacks, this chart maps completion percentage, touchdown percentage, sack percentage, interception percentage, and quarterback rating for this given comparison. In this example, Tom Brady, widely regarded as the greatest quarterback of all time, is beaten by Mahomes in almost every metric. These stats could help a user choose Mahomes over Brady when creating their roster. It should be noted that if the datatable is filtered by another position, the statistics on the radar chart will change accordingly.
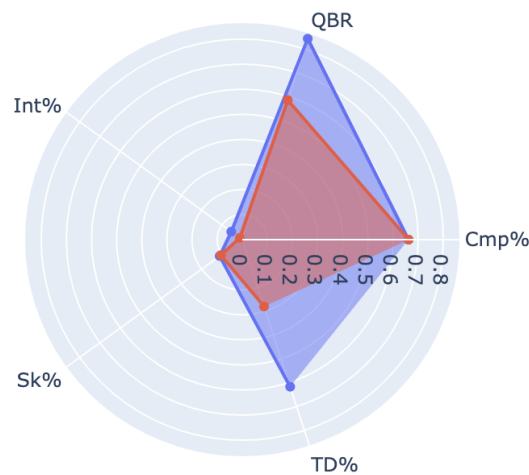

Figure 2: Radar chart comparing 2 players chosen by the user.

Another visualization we created was a replication of a football field (Figure 3). The purpose of the graph is to show the user if they have added enough players to their team per position. The color of the icon indicates the depth of the position with red showing the user has too many players of that position, cyan showing the user has an acceptable amount of players of that position, and yellow showing more players of that position are needed. This visualization has interactivity where the user can hover over each point to see the position it represents. The

visualization is laid out in the formation of a football field for those that can identify a position from its location on the field. The x's represent offensive players, which are displayed below the white line (the line of scrimmage), and the o's represent defensive players, which are displayed above the line of scrimmage. In the left bottom corner a box shows the special teams players.

Your current team! Hover over players to examine their position!

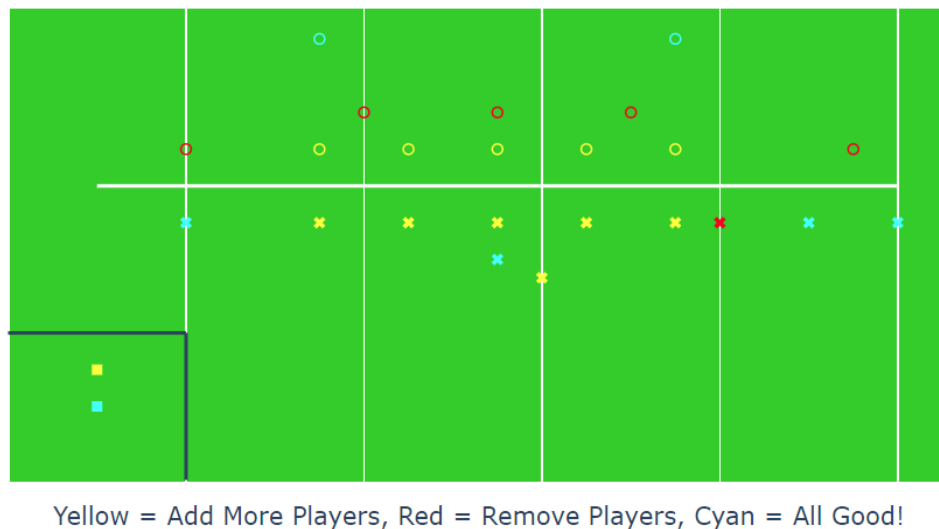Yellow = Add More Players, Red = Remove Players, Cyan = All Good!

Figure 3: Team depth visualization.

Finally, we display the machine learning aspect of our project. We used supervised machine learning with statistics from the user's team to predict how many wins the team would be projected to have over the course of a full season. To make this prediction we use Scikit-learn's multiple regression where each stat for the team has its own correlation coefficient that factors into the amount of projected wins. After the user presses the submit team button, the model runs and displays the predicted wins in a text box at the bottom of the dashboard.

Conclusions

Through the course of the project we managed to create a full general manager simulator with several points of functionality and lots of potential to grow in the future. Each aspect provides an opportunity for the user to explore a different side of the NFL, whether that be positions, salary, or stat comparisons. We focused on making the dashboard clear and concise which we believe we accomplished. From the player comparisons and multiple statistical filters to the player position visualizations, this dashboard was made for a user of any level.

Some limitations we found during our work is the data we collected was very large and difficult to sort and manage. Although we provided what factors a general manager considers when drafting, this still doesn't mean that this simulator is as realistic as we had hoped in the early stages of the project. For one thing, we cannot tell how offensive linemen will perform because we weren't provided any metrics to show their blocking skill. Additionally, team chemistry is overlooked with our project, and some players' statistics are dependent on another player's performance. For instance, it is likely that Carolina Panthers' wide receiver DJ Moore would perform better, if the Panthers had a better quarterback to throw him the ball. Since he is on a less productive offense, he is portrayed as a less productive receiver when we can't be sure if this is the case in a vacuum. This is a problem however in all team sports statistics and provides a possible field of interest for future research.

Author Contributions

Each of the members of the group contributed to all parts of the project, but had focuses in different sections. Max Rizzuto helped give the project a jump start when our main concern was compiling data. He focused on web scraping, creating many different csv files and worked to make the files organized and easy to read. After Max was done with the data, Brady Hobson took initiative to create the framework of the dashboard and lay out functions he knew we were going to need. Julian Savini worked on both of our key visualizations. The radar chart he made allowed for better comparison between players, and his team visualization allows for a user to conveniently view the depth of their team. Beckett Sanderson focused on the data cleaning and the machine learning aspects of the project with help from Max on the implementation of the multiple regression classifier. Sean Merkle also helped with the machine learning and overall team predictions. Lauren helped on specific aspects of the dashboard like the dropdowns and was the group lead on the slide presentation and final report.

Throughout the process of creating our general manager simulator, we were always available to help each other and provide ideas. Although we all had our individual focuses, we all helped a bit in each part of the project—even if it was just debugging and bouncing ideas off of each other. Oftentimes, we would sit together and code as a group, even if it was just two group members. As a whole we worked well together in the creation of our project.

References

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[3] *Dash overview*. Plotly. (n.d.). Retrieved December 6, 2022, from https://plotly.com/dash/.