Using Plotly's Dash to Visualize NBA Shot Data

CS 519 Scientific Visualization - Fall 2021

Matthew Mechtly
mechtly2@illinois.edu

Ryan Kruse
rjkruse2@illinois.edu

Aaron Bromagem
aaronb3@illinois.edu

Abstract

SportVU, a leading provider of optical player tracking technology, released its National Basketball Association (NBA) data to the public for the 2015-16 season. Our group used this data to create informative visualizations on how NBA teams shoot and score. Using Ploty's Dash framework, three interactive visualizations were created [1]. The target audiences for our visualizations are NBA front office and coaching staffs, for the purpose of game planning.

1 Introduction

Since 2013, the NBA has been using player tracking systems throughout their games. The first systems – built by SportVU – were a set of cameras installed in the stadium catwalks above the court. Their aim was to track the ball and all players on court. Numerous times each second, these cameras collect data points on ball and player coordinates, shot types and how many points were scored (or missed) based on those shots. Players are located within a two-dimensional coordinate system [2]. For the 2015-16 season, the NBA and SportVU made this data publicly available, inviting researchers to pore through the dense tracking data.

In our work, we used detailed shot data, found on GitHub [3]. In order to create our visualizations, we chose to use the open-source platform Dash (a Plotly framework). Below you'll find explanations for three sample advance scouting / game planning tools that we built within our Dash application.

Our application is being hosted with limited resources at http://mmechtly.pythonanywhere.com [1]. Additionally, it can be installed locally by cloning the github repo here: https://github.com/matthewmechtly/CS519_Vis_Ballers

2 Shot Selection Scatterplot

The first visualization we created was a shot selection scatterplot. Using this visualization, the user can easily see where different players from different teams chose to shoot the ball. Additional filtering is available by specific quarter. If the user wants to see all quarters concurrently, the "All" selection accomplishes this.. When using this visualization, the user should first select the team(s) whose players they desire to select. If no team is selected, then all NBA players can be searched through. Once teams are selected, the user simply selects the players of interest to see where their shots occurred during the particular quarter. If no players are selected, Dash will send the user an error, indicating that at least one player must be selected to view shots. As many players as desired may be selected. To facilitate the distinguishing of different players, a color map is applied. This allows different players (from the same or different teams) to be represented by differing colors.

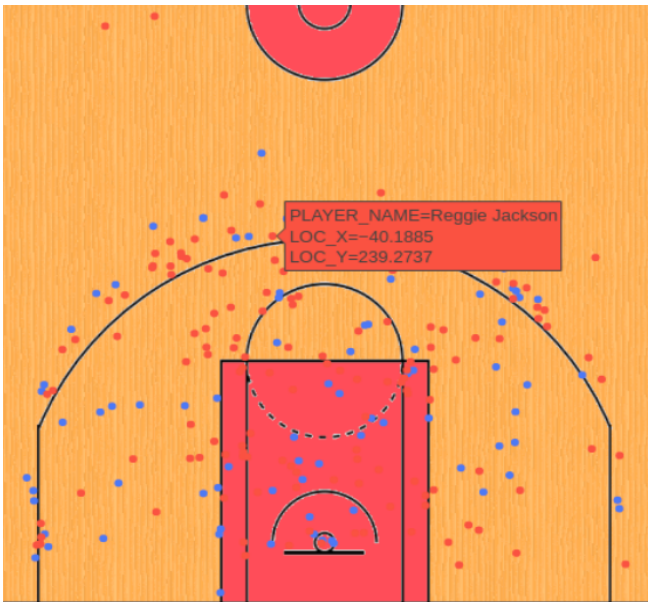

Figure 1: Scatter plot of shot data for given players overlaid on half-court image

2.1 Technique

To transpose these shots onto an image of a basketball court and visualize was relatively simple. Simply put, the only thing that needed to be created was a scatterplot using the X and Y locations of the ball at the time of the shot. This was created after adjusting the locations of the ball so that the point directly under the basket was at (0,0).

3 Shots Made/Missed Heatmaps

For this next step, we wanted to create an easy way to see where a team makes or misses most of their shots.

To accomplish this goal, we decided to use a heatmap, (i.e. a contour plot) as shown in Figure 2.

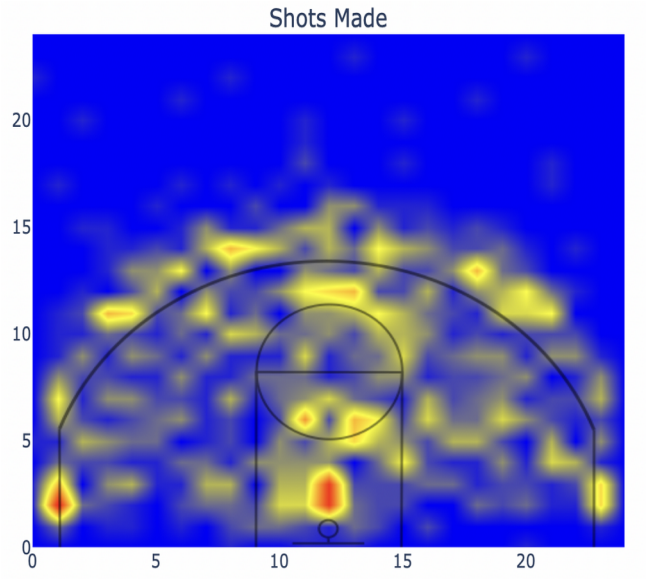

Figure 2: Heatmap of shots made by a team over the 2015-16 season

As you can see in this sample, this particular team makes the highest ratio of their shots beneath the hoop (as expected) and also from the right-side of the three point line (the left side of this image). Seeing this graphic would provide an opposing team some instant strategy.

3.1 Technique

In order to build this visualization we first needed to create a matrix of the court. What you see above is a half-court divided into a 25x25 grid.

We then take all the shots and aggregate them based on their location relative to a particular grid cell. Once our matrix is built, we can use Plotly's contour functions to build our heatmap [4].

4 Shot Accuracy Scatterpolar

Finally, we thought it would be useful to visualize a player's different shot type skills in one visualization. Plotly's `scatterpolar` class from their `graph_objects` library allowed us to accomplish this [5]. The NBA shot data contains fifty-three different shot types, which would be much too cumbersome to display. However, they fit roughly into six distinct categories: bank, dunk, fadeaway, hook, jump, and layup. Figure 3 shows scatterpolars of two different players. The coverage of the shaded portions quickly allows one to compare shooting percentages for different shot types.

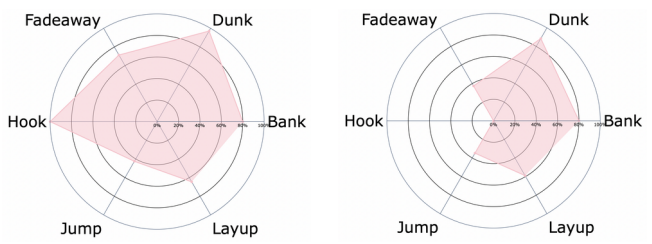

Figure 3: Scatterpolars of shot percentages for two players during the '15-16 season

4.1 Technique

We configured the radial coordinates of each scatterpolar to be the six shot types mentioned previously. Theta – the extent that a given shot category is shaded – is the shot's success percentage, ranging from 0-100%. We then filled in the area between these coordinates to provide a visual representation of a player's shooting skill. The interface on the Dash application deployed allows the user to look at the scatterpolar for any player from the 2015-16 season.

5 Conclusion

Winning in basketball obviously requires scoring the most points. Shot selection is important to scoring, since it significantly influences the success rate of the shot. Two aspects of shot selection that influence the success rate are the location of the shot and the type of shot. Using the aforementioned SportVU data, our trio of visualizations allow managers to evaluate teams as a whole as well as individual players, based on their location-specific shot selections as well as their shot types. Looking to the future, statistical models could be used to predict the probability of success for a given shot, based on the location, shot type, and other factors available. These could be utilized to help optimize game strategy.

References

[1] "Basketball SportVU Visualization," [Online]. Available: http://mmechtly.pythonanywhere.com

[2] "SportVU," Accessed on: Dec. 12, 2021. [Online]. Available: https://en.wikipedia.org/wiki/SportVU

[3] Seward, Neil, (2018) NBA Movement Data (Version 1) [Source code]. https://github.com/sealneaward/nba-movement-data

[4] "*Plotly Graphing Libraries: Contour Plots in Python*," Accessed on: Nov. 26, 2021. [Online]. Available: https://plotly.com/python/contour-plots/

[5] "*Python Figure Reference: scatterpolar Traces*," Accessed on: Nov. 30, 2021. [Online]. Available: https://plotly.com/python/reference/scatterpolar/