Visualization of NBA Game Performance in 2018-2019 Season[⋆]

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Abstract. NBA, one of the men's Professional Basketball League, consisting of 30 teams from North America [7], brings together some of the best players in the world. There are masses of data from thousands of matches in a year. The significance of data visualization is thus embodied when showing numerous and chaos information to the sponsors, coaches, and audiences. Next.js, along with MongoDB were utilized to build the core of the website. With the use of D3 library, six interactive charts are built for showing NBA game performance in 2018-2019 season.

Keywords: Data Visualization · NBA · D3.

1 Introduction

As one of well-known games, NBA games bring up many excellent basketball players and exciting game moments. It is attractive for sponsors, coaches, and audiences to have access to data visualization so that they can catch integrated information at a glance instead of searching scattered information cluelessly. After collecting and aggregating data from numerous raw information, our visualization consisting six types of charts can help them recognize and understand NBA game performance in 2018-2019 season thoroughly and intuitively.
In our system, each page combines various charts forms, visualizing methods, and interactive tools such as drop-down menu, tooltip and check box, button to show multi-dimensional data, which is better than existing graphs[3,4,8,5].
In section 2 we will discuss related visualization work, in section 3 we will describe the dataset and pre-processing, in section 4 we will show the design process of pages and charts, in section 5 we will explain how the system is built and highlight main features of our work, and finally conclude with 6).

[⋆] Instructed by Dr.Luciano Nocera.

2   Related Work

2.1   Other's works in same topic

1) Shooting map: In Previous works [8], we have seen charts showing field goal percentage in separated area or hit and miss in a certain period of time. Most of them are plotted for a single team or player without desired filters. Most of them use either color or icons to distinguish hit and miss.
2) Donut Chart: In most donut charts made for basketball data visualization, data are presented in a single dimension. Donut charts[3] are always used to show the contribution of players in point or win share distribution. There are much more to explore in multi-dimension donut chart design.
3) Bar Chart: In previous bar charts, stats of a specific category are often compared between teams throughout the league. Color of the bar is not well used in most cases and filter and sort function is not applied. Also, animation can be used to show the position change of teams in different counting area.
4) Map: Most of the maps[5] for NBA are static map of North America showing geographical info of the teams. They are inaccurate in coordination and can tell few things about the teams. With the help of mapbox and interaction design, maps can be more rhetoric.

2.2   Relevant works in other areas

1) Heatmap: Heatmap[4] is frequently used when analyst want to show the court coverage of a soccer player in a certain match. This type of visualization can't be well applied to the basketball court since it's relatively too small. Still it's inspiring regarding to the works of shooting map.
2) Radar chart: This type of chart is often used in sports to represent strength and weakness of a player. Radar chart was among the candidates when we decide the design of our project.

2.3   Originality

Thanks to prior works mentioned above, we are inspired and came up with some improvement. Usually shot charts is created for certain players, our shot charts are for each game with a filter to hide made or/and missed shots for a team. Addition to simple donut chart showing 1-D players' scoring data within team, we enlarged dimension utilizing the hue to compare scoring data between two teams and saturation of the color to represent efficiency data of a player. Normally a tree structure is a way of describing a hierarchy. Here we combined the bubble clouds to a circle packing layout to show which team a player belongs to and which region a team belongs to. Squeezing 30 teams' performance data in one bar chart is meaningful but less readable. Thus we give users options to switch to the mode with only top or bottom 10 teams in one aspect of performance, and users can order them ascendingly or descending by value or alphabetically by team name with transition animation. Rather than a static choropleth map,

users can interact with the map by filtering to include or exclude domestic players. When clicking a country, the information card beside the map is not only show the country's data but also all players' profile. For Mapbox map, we almost align with previous works but using primary color of a team to fill the marker and show teams logo along with arenas information.

3 Data

The topic of dataset is about NBA game performance in 2018-2019 season. The volume of scraped raw dataset is above one hundred thousand. After aggregating using python, we have structured data. The E-R diagram for detailed data scope are shown blow.
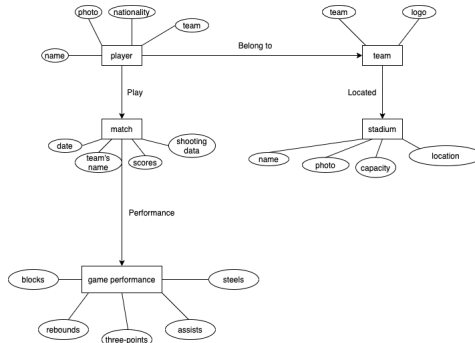

Fig. 1. NBA data E-R diagram

For most of the charts, we used data.nba.net as data source. The API is explained in nba.js [6]. We scraped the data using the requests package and pre-processed the data in Python scripts.
For the shooting map, we used dataset from data.world [2]. A MongoDB database was built and hosted in Atlas. We found team colors and arenas information from teamcolorcodes.com [9] and arenas wiki[1] respectively. The rest of pre-processing work was handled in the front end before rendering the charts.

4 Approach

4.1 Design Process

In total, there are six graphs to show NBA game performance in different aspects. The detailed design process for each are shown blow.

1) Shooting map: To present shooting performance on each game, we used color to distinguish two teams and shape legends indicating shooting data on a basketball court canvas. Users can interact by selecting a certain game on a match day, and select or deselect any legend options.
2) Donut chart: Audiences can get a sense of the players' contribution and field goal percentage, as well as the match result in an integrative and straight-forward way. Users can choose their interested game in any match day. The size of slice represents a player's performance in a match, and the saturation of the color represents the field goal percentage. When first loading a game, the donut is shaped through an animation that it approaches the central axis from both side with winning team slices formed slower. When hovering on a slice, a tooltip will show detailed information. When the window resized smaller, the values will anchor to pieces.
3) Circle packing chart: Through nesting the bubble clouds the hierarchy structure represents the relationship among regions, teams and players. The size of the circle encodes current-level's entities' performance in one aspect. The audiences can select any aspects from dropdown menu and zoom each circle to get global and local information.
4) Bar chart: Based on the height of bars, bar chart represent the quantitative relationship of performance in a aspect among teams. Users can choose aspects they have interests in. Logos standing on each bar makes chart more clearly and straightforward. Furthermore, the smooth animation is feast for users' eyes when they switch among different filer or sort modes.
5) Choropleth map: The countries in the map are shaded by sequential colors proportional to the number of players coming from this country. Users can check the checked box to decide whether include player from the United States. Also, users can interact by clicking the country and a profile container besides map can be used to switch and identify players from this country.
6) Mapbox map: Starting centering on Staples Center, a Mapbox map with markers can be zoomed and recentered to show NBA arenas location in customized view mode. The fixed position information card besides map aids for identifying the arena will be shown when clicking a marker.

4.2   Design Considerations

– Color: We chose sequential color type for ordered data in choropleth map, and diverging color type for data in donut chart. Since these color types were used to indicate value, we carefully to make it vision deficiency friendly. But when color is only used to increase the sense of familiarity, we assigned the primary color codes of teams to bars in bar chart and markers in Mapbox map. Moreover, we assigned the primary color codes of teams to team-level circles and secondary color codes of teams to player-level circles in circle-packing layout.
– Chart Form: We chose donut chart for comparison within a team while bar chart for comparison among all teams. For data related to spatial information

like shooting performance, nationality, arenas location, we adopted map. For hierarchy relationship, packing data is a better choice.
– Interaction: All charts are interactive but do not use same methods. Clicking to show a fixed-postion informational box or hovering to show a tooltip are used accordingly. But images such as player pictures, team logos or arenas pictures, are always displayed aiding for identifying the entities.
– Layout: The header and footer of each pages are the same as that of home-page, which increases consistency,

5   System

We used the state-of-art technology: React Hooks to build the website, as well as Bulma and CSS Modules to style the website We chose Next as our framework, utilizing the server-side rendering feature, which allows MongoDB integration to query one of the dataset before rendering the chart. In the meantime, we are still able to generate a serverless website by pre-defining static rendering paths. This provides not only excellent infrastructure for data visualization, but also the flexibility to expand our work to a dynamic back-end server in the future.

All of our charts are interactive, and we implemented seamless transition in between pages. Our project is well structured, and code is split into highly re-usable components. The website is also scalable, ready for embracing data in more seasons.

6   Conclusion

6.1   Summary

The raw dataset are pre-processed through MongoDB and Python to structured data and then visualized using React Hooks, Next.js, Bulma and D3.js to provide a comprehensive and intuitive understanding of NBA game performance in 2018-2019 season for coaches, players, sponsors and audiences. Six interactive charts are built for depicting the shooting performance in a game, analyzing players' contribution, representing the subordinate relationship hierarchically, showing teams' average game performance, summarizing players' nationality, exploring arena locations.

6.2   Future works

There are still some improvements we can make in the future. For each page, we can add navigation bar to make smooth transition among every pages. And all elements inside a page can be resized properly when users resize their viewing windows. For Donut chart, we can use the timeline of every basket made to define the loading animation of the chart, which will better show the progress of the match. For circle packing layout, players pictures can be used to fill the innermost circle. For choropleth map, the function of search players can be implemented. Tooltip can be applied to shooting map, circle packing layout and bar chart. Now we only have data in one season, later we will include more seasons.

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