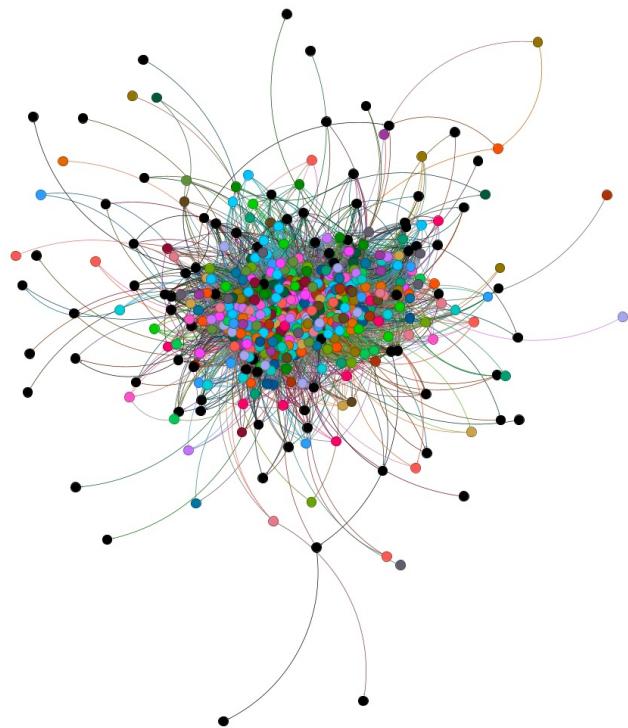


NETWORK ANALYSIS OF NBA MATCHUPS

ABHISHEK DHAR

MATCHUP NETWORK OF NBA PLAYERS FOR
THE 2021 – 2022 REGULAR SEASON.



WHAT IS A MATCHUP?

- A pair of players from opposing teams that guard one another
- Matchups are extremely important and are often exploited



DATASET

- All the data was collected from the nba stats website using the nba_api client
- The main dataset consists of all combination of player matchups for the 2021-2022 regular season

The screenshot shows a NBA player profile for Draymond Green. At the top, there is a photo of him in a Golden State Warriors jersey. To the left of the photo is the Golden State Warriors logo. To the right of the photo, the text reads "Golden State Warriors | #23 | Forward" and "DRAYMOND GREEN". Below the photo is a summary table with the following data:

PPG 8.5	RPG 7.2	APG 6.8	PIE 10.0	HEIGHT 6'6" (1.98m)	WEIGHT 230lb (104kg)	COUNTRY USA	LAST ATTENDED Michigan State
				AGE 33 years	BIRTHDATE March 4, 1990	DRAFT 2012 R2 Pick 35	EXPERIENCE 10 Years

Below the summary table are tabs for "Profile", "Stats", "Bio", "Videos", and "RotoWire". The "Stats" tab is currently selected. At the bottom of the stats section, there are links for "Roster", "warriors.com", "Store", "Tickets", and social media icons for Facebook, Instagram, and Twitter.

The main content area displays a "Matchups" section with dropdown menus for "SEASON" (2022-23), "SEASON TYPE" (Playoffs), "PER MODE" (Totals), and "PLAYER ON" (Defense). Below this, a note states: "Matchup possessions are derived using NBA Advanced Stats Player Tracking analysis." A table titled "Match Up" lists Draymond Green's matchups against other players in the 2022-23 season. The table includes columns for Match Up, GP, Matchup Min, Partial Poss, PTS, Team PTS, AST, TOV, BLK, FGM, FGA, FG%, 3PM, 3PA, 3P%, FT%, FTA, and SF%.

MATCH UP	GP	MATCHUP MIN	PARTIAL POSS	PTS	TEAM PTS	AST	TOV	BLK	FGM	FGA	FG%	3PM	3PA	3P%	FT%	FTA	SF%
Domantas Sabonis	3	10:48	58.6	10	56	6	5	0	4	10	40.0	0	0	0.0	2	2	1
Harrison Barnes	3	7:38	43.5	6	31	1	0	0	2	10	20.0	1	4	25.0	1	3	1
Alex Len	3	6:11	27.9	6	28	0	2	0	3	3	100	0	0	0.0	0	0	0
De'Aaron Fox	3	3:50	23.9	24	35	3	0	0	9	16	56.3	4	8	50.0	2	2	1
Malik Monk	3	2:19	14.7	9	31	2	0	0	3	8	37.5	1	2	50.0	2	2	0
Kevin Huerter	3	1:49	11.4	6	12	1	0	0	3	5	60.0	0	2	0.0	0	0	0
Trey Lyles	3	1:35	10	3	12	0	0	0	1	2	50.0	1	2	50.0	0	0	0
Keegan Murray	3	1:23	6.1	3	9	0	0	1	1	4	25.0	1	3	33.3	0	0	0
Davion Mitchell	3	0:44	5.3	2	2	0	0	0	1	1	100	0	0	0.0	0	0	0

GOALS FOR THE PROJECT



Construct a network of matchups



Group players into communities to determine the most common types of matchups across the different positions



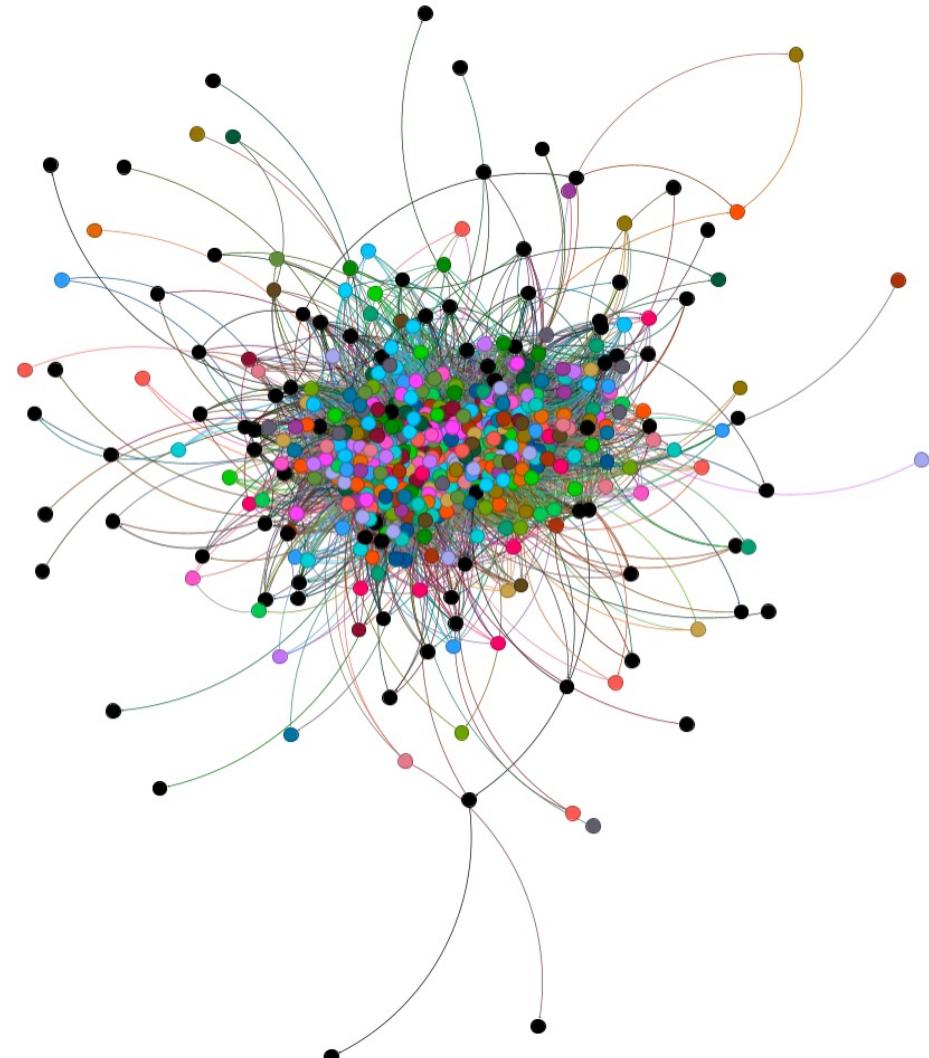
Identify the top-ranked players in matchups performance



Test whether the network can provide insights into outcomes of playoff matchups

THE NETWORK

- 564 Nodes and 24404 Edges
- Each node is an individual player
- An edge between two nodes represents a matchup
- Edges are directed towards the matchup winner
- Edges are weighted in terms of the total time two players were matched up



DETERMINING THE MATCHUP WINNER

$$score = \sum_{Stat \in \{S\}} \left(\frac{Matchup_{1,2}[Stat]}{Matchup_{1,2}[Time]} - \frac{Matchup_{2,1}[Stat]}{Matchup_{2,1}[Time]} \right) * switch$$

$S = \{ Assists, Blocks, Turnovers, Field Goals Made, 3 point FGM, Shooting Fouls \}$

$switch = -1 \text{ if } Stat \in \{Blocks, Turnovers\}$

```
player1_matchups[stats].head()
✓ 0.0s
```

	MATCHUP_AST	MATCHUP_BLK	MATCHUP_TOV	MATCHUP_FGM	MATCHUP_FG3M	SFL
	2	21	0	8	7	2 3


```
player2_matchups[stats].head()
✓ 0.0s
```

	MATCHUP_AST	MATCHUP_BLK	MATCHUP_TOV	MATCHUP_FGM	MATCHUP_FG3M	SFL
	71	0	1	3	4	1 1

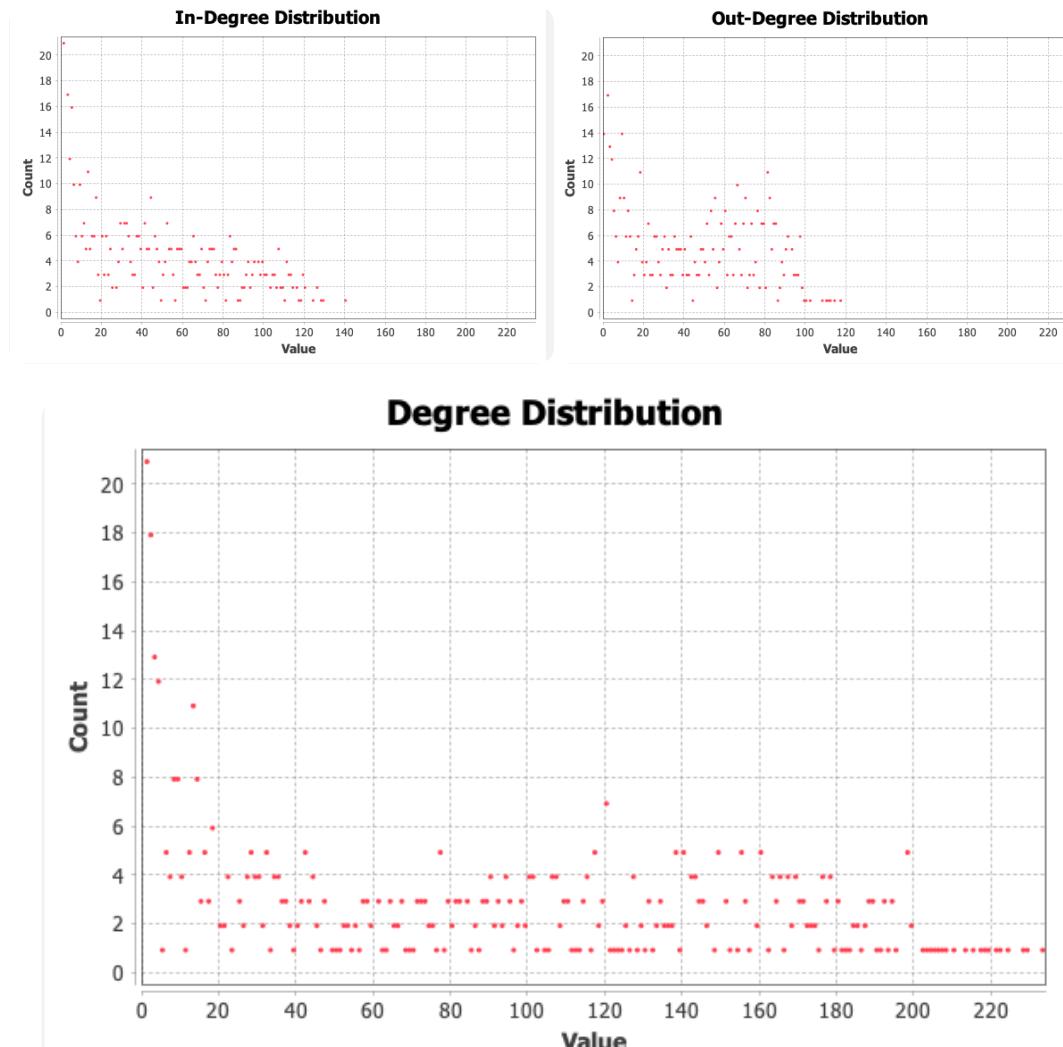
NETWORK CHARACTERISTICS

AVERAGE DEGREE: 43.362

DENSITY: 0.077

AVERAGE CLUSTERING COEFFICIENT:
0.192

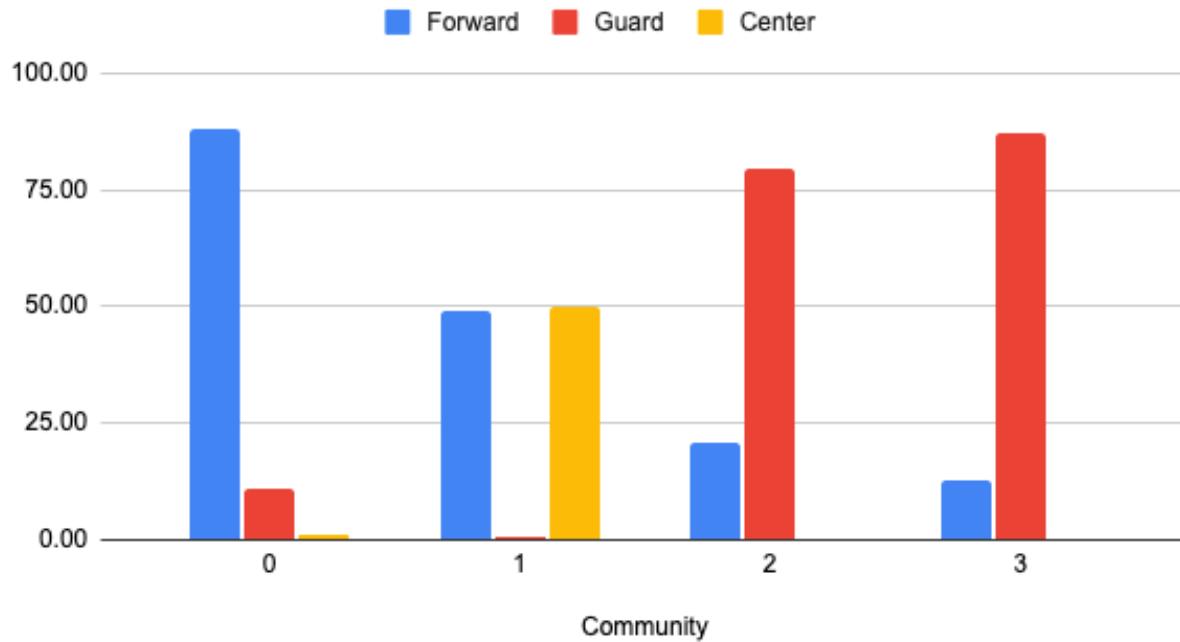
FRIENDSHIP PARADOX TEST: 72%



COMMUNITY DETECTION

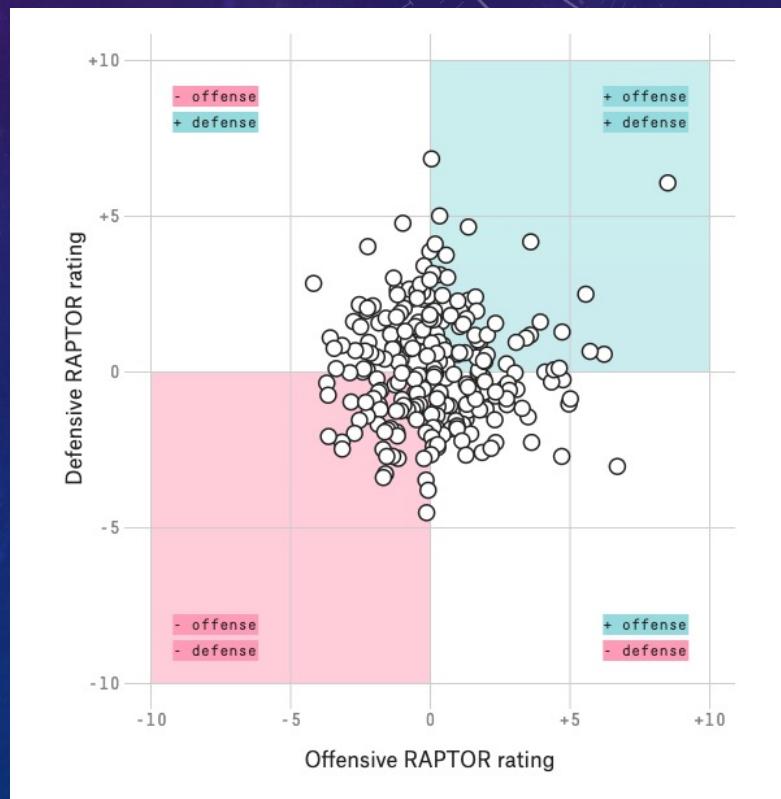
- Modularity score using the Louvain Method: 0.282
- Number of communities: 4

Breakdown of Communities by Positions



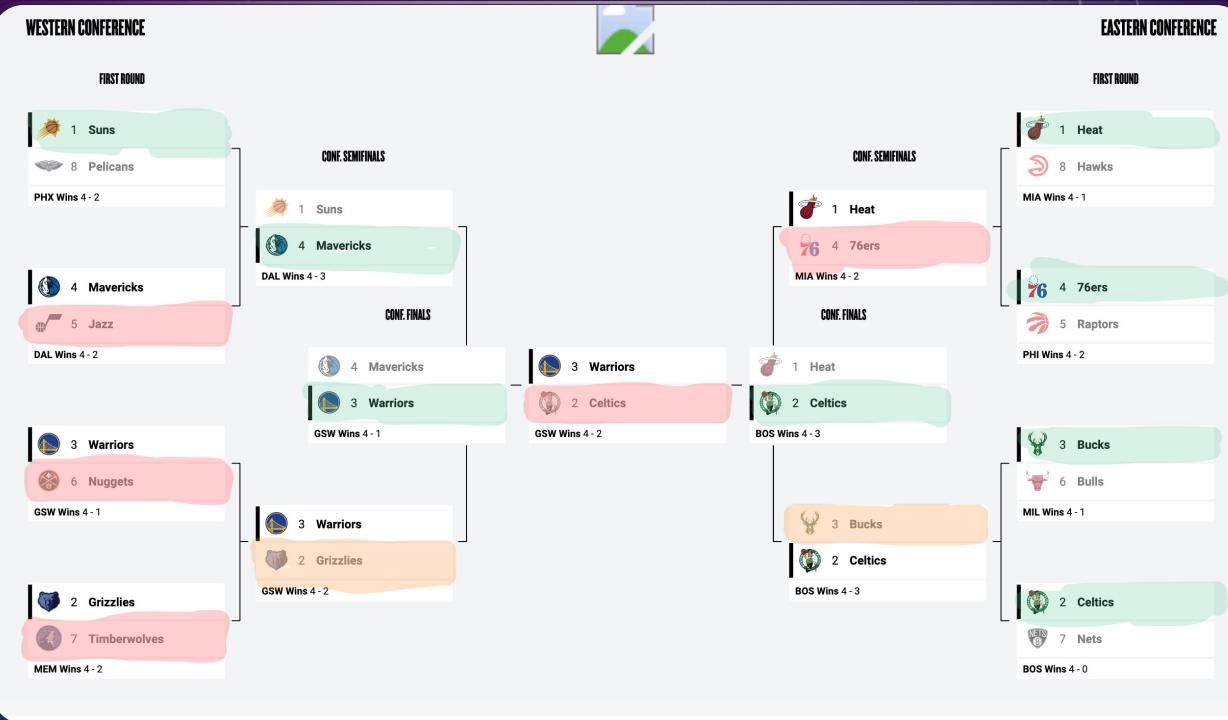
TOP RANKED MATCHUP WINNERS (USING PAGERANK)

Rank	Name	Position	RAPTOR OFF Ranking	RAPTOR DEF Ranking
1	Jayson Tatum	F	4.0	1.6
2	Dejounte Murray	G	3.1	0
3	DeMar DeRozan	G	3.6	-2.3
4	Donovan Mitchell	G	4.7	-2.7
5	Terry Rozier	G	2.7	0.2
6	Trae Young	G	6.7	-3
7	LaMelo Ball	G	2.7	-0.7
8	Darius Garland	G	4.8	0.3
9	Gary Trent Jr.	G	1.4	-1
10	Russell Westbrook	G	-1.2	2.1



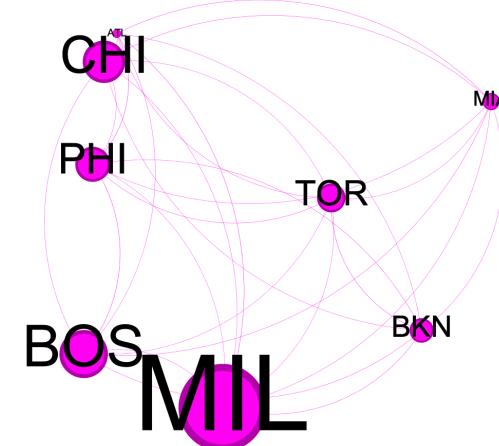
PLAYOFF INSIGHTS

- Made a Bipartite graph of teams with aggregate player edges
- Determine outcome based on direction of edges
- Accuracy in predicting winner: 53%



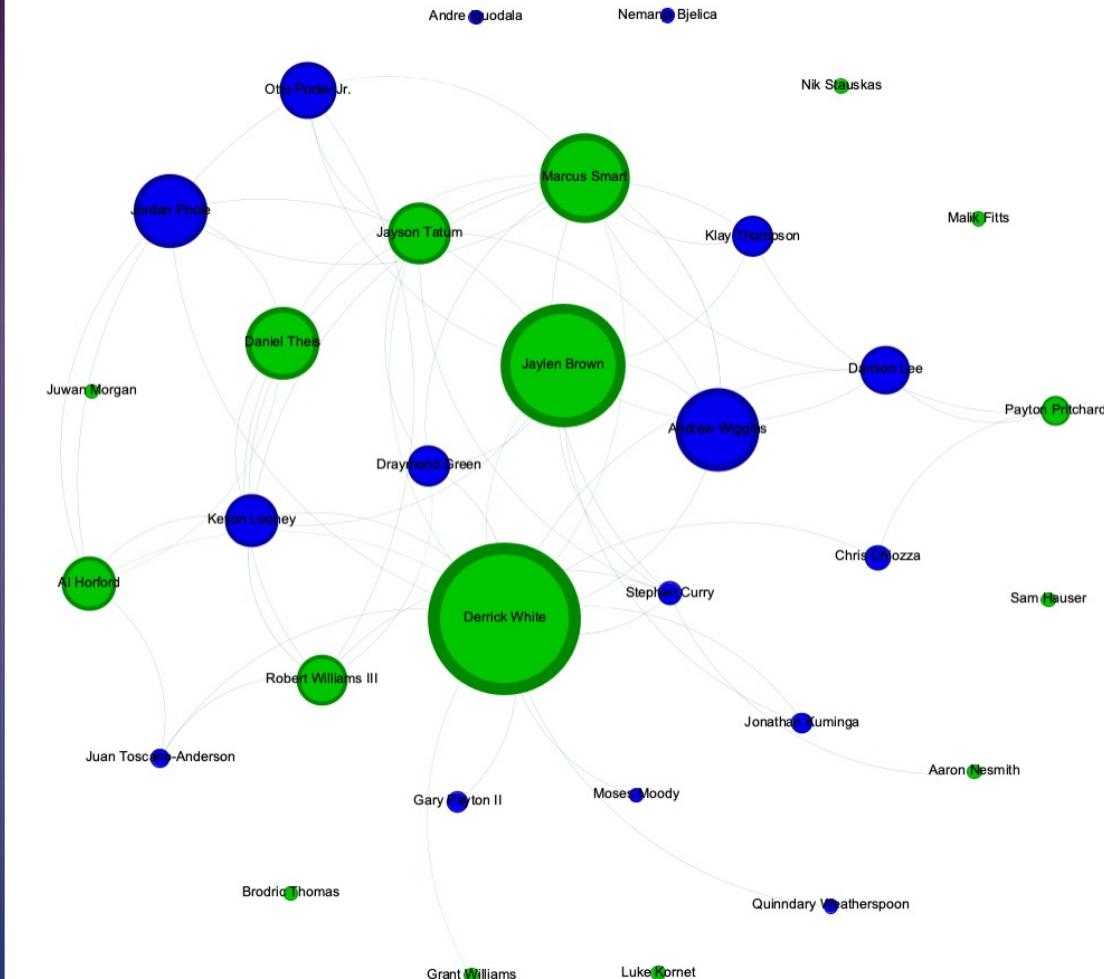
PER CONFERENCE INSIGHTS

- Graph is split into eastern and western conference
- Nodes are sized on PageRank Value
- Top 2 Teams in both conferences are previous conference champions (MIL, PHX) and eventual conference champions (BOS, GSW).



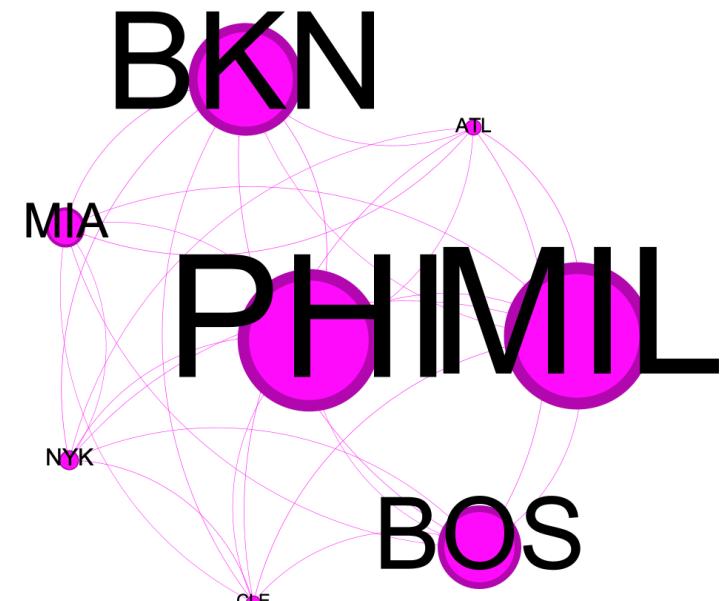
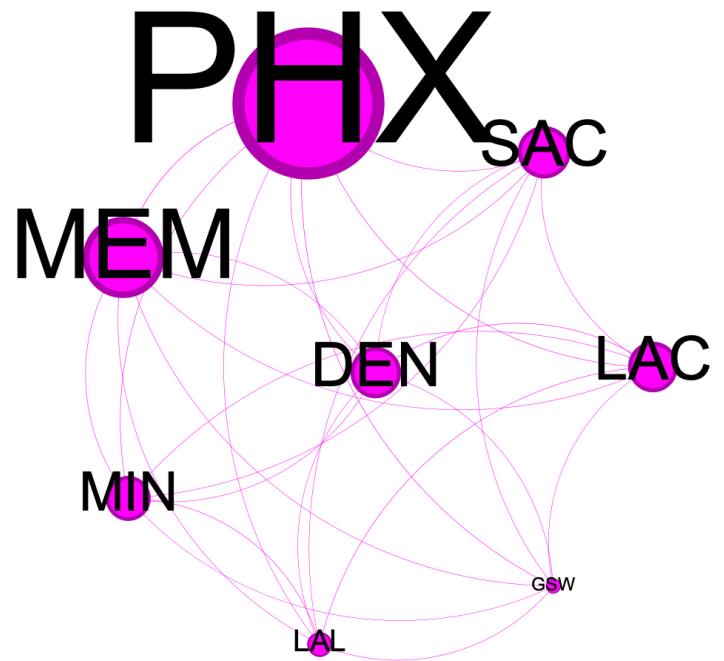
PER GAME INSIGHTS

- Split the matchup graph into a subgraph of two teams
- Calculate PageRank to determine the important players in the game



LIMITATIONS AND IMPROVEMENTS

- More metrics like defensive/offensive rebounds and steals would help balance the edge weight determination
- Ideally, two players would play against each other 4 times in a season. Could expand the network to span across several seasons
- Per game predictions could use dynamic subgraphs that change according to the lineup to account for injuries, absences, etc.



PREDICTIONS FOR THIS SEASON

THANK YOU!



REFERENCES

- <https://projects.fivethirtyeight.com/nba-player-ratings/>
- <https://www.youtube.com/shorts/GcTMpe30gp8>
- https://www.reddit.com/r/nba/comments/fg8g1m/lebron_matchuphunting_the_last_5_minutes_of_th/
- <https://www.nba.com/stats>
- https://github.com/swar/nba_api