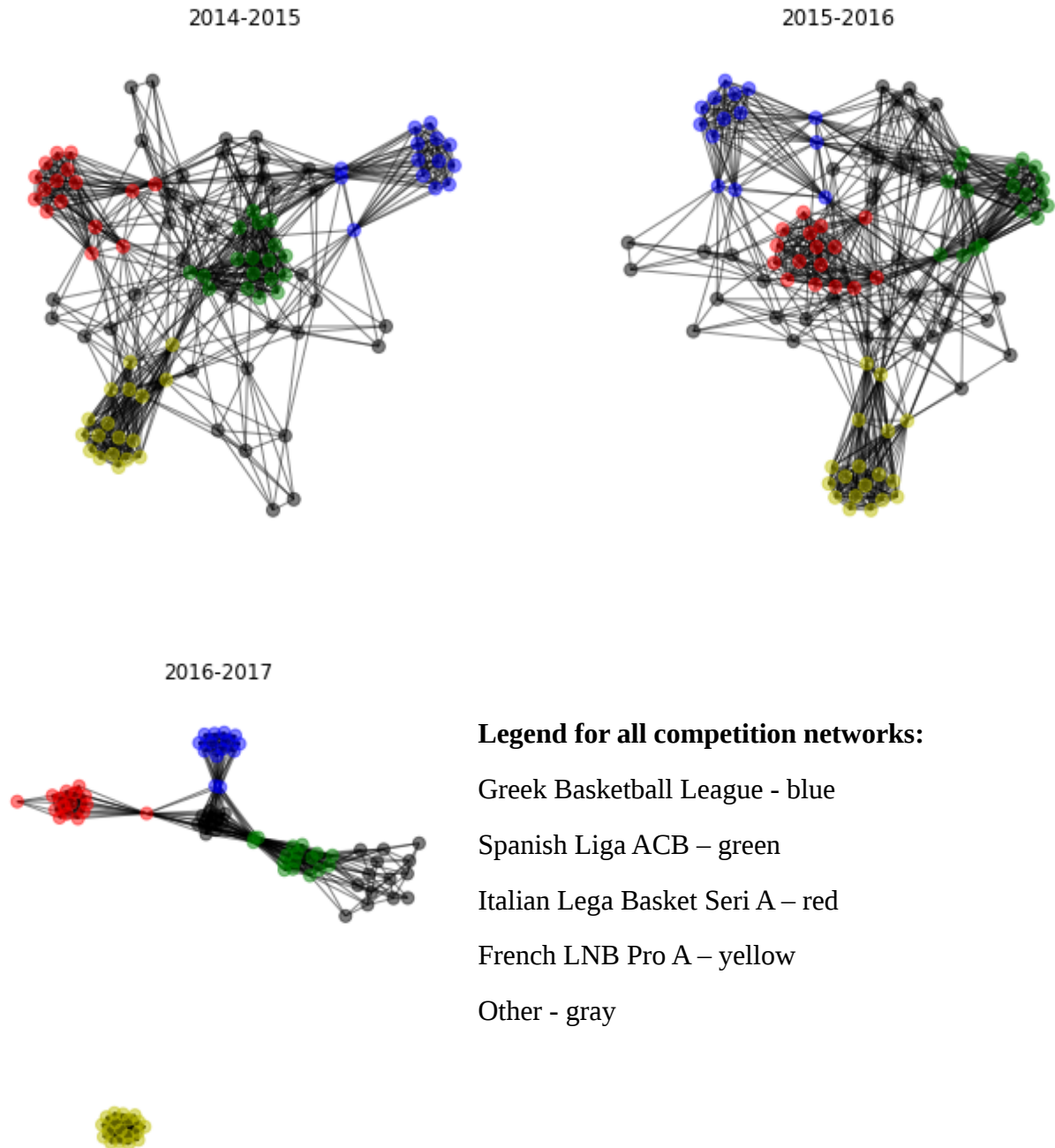


# Figures

**Figure 1: Competition Networks by Year – before any pruning**



Note: This is teams vs teams, which is different than players vs teams, but that competition network is so large it's hard to visualize well. Therefore, this is a simplified representation.

**Figure 2: Competition Networks by Year - Teams with no club play data removed**

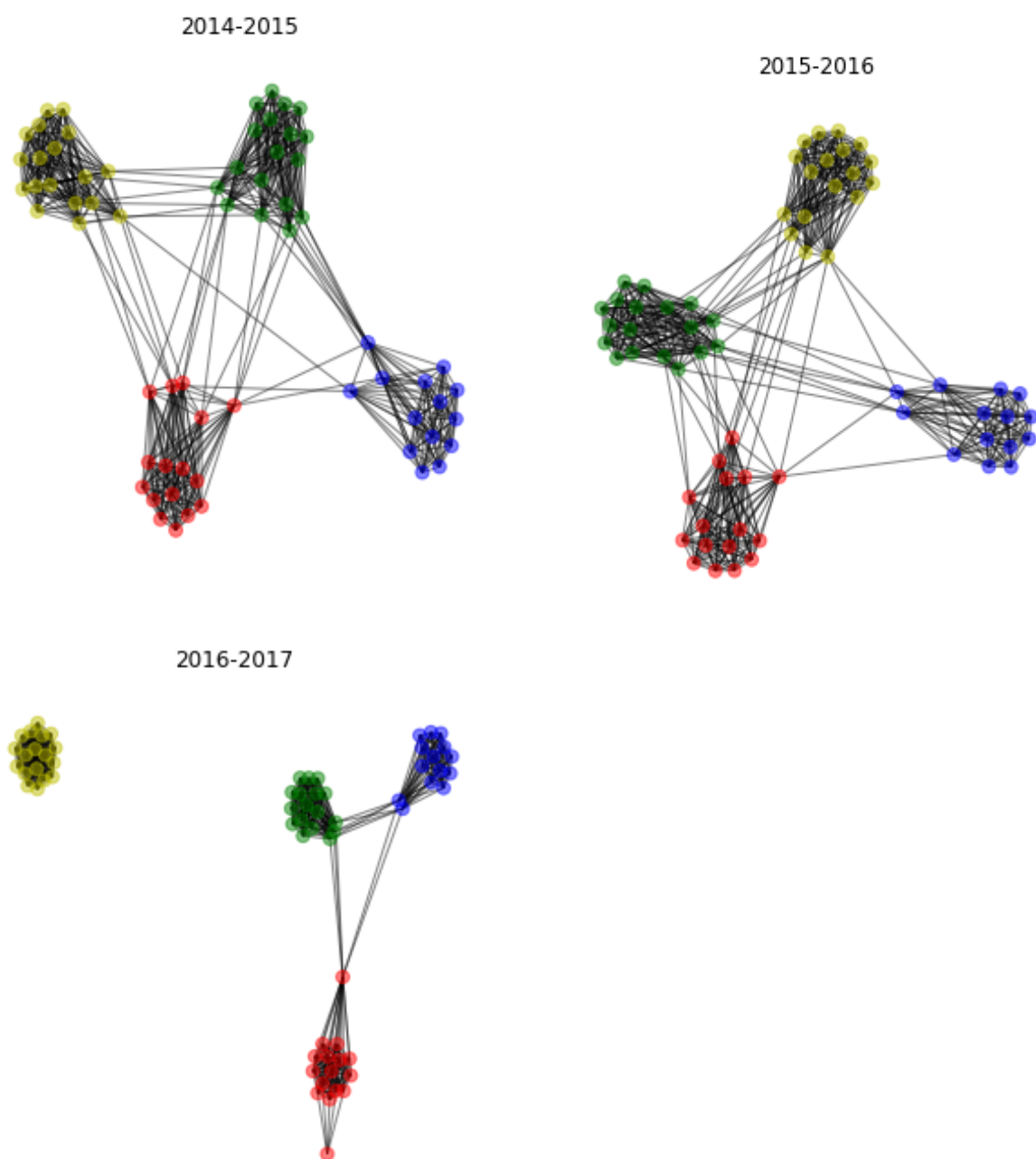


Figure 3: 2016-2017 Competition Network - French teams removed

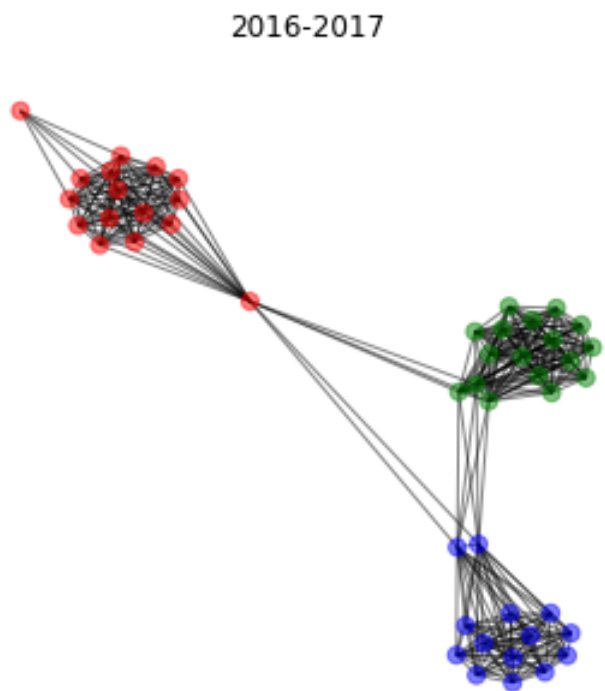





Figure 4: Sportsref Source webpage table

Per Game   Share & more ▼   Glossary

Season	Club	League(s)		G	GS	MP	FG	FGA	FG%	3P	3PA	3P%	2P	2PA	2P%	FT	FTA	FT%	ORB	DRB	TRB	AST	STL	BLK	TOV	PF	PTS
<a href="#">2014-15</a>	<a href="#">Real Madrid</a>	Liga ACB 		3		2.7	0.3	1.0	.333	0.3	0.7	.500	0.0	0.3	.000	1.0	1.3	.750	0.3	0.3	0.7	0.0	0.0	0.0	0.0	0.3	2.0
<a href="#">2015-16</a>	<a href="#">Real Madrid</a>	Liga ACB 		31		14.2	1.6	3.1	.526	0.6	1.4	.429	1.1	1.8	.600	1.0	1.4	.721	0.6	2.2	2.8	2.0	0.4	0.3	1.5	1.9	4.9
<a href="#">2016-17</a>	<a href="#">Real Madrid</a>	Liga ACB 		32		19.9	2.7	5.8	.460	0.9	2.8	.318	1.8	3.1	.586	1.5	1.9	.787	1.0	3.3	4.3	3.1	0.7	0.4	2.0	1.3	7.8
<a href="#">2017-18</a>	<a href="#">Real Madrid</a>	Liga ACB 		26		24.0	4.4	9.5	.466	1.1	4.2	.269	3.3	5.3	.619	3.0	3.8	.780	1.0	4.7	5.7	4.8	1.1	0.4	2.2	1.7	13.0
				92		18.6	2.8	5.8	.474	0.8	2.6	.317	1.9	3.2	.602	1.7	2.3	.769	0.8	3.2	4.1	3.1	0.7	0.3	1.8	1.6	8.1

Source:

[https://www.basketball-reference.com/euro/players/luka-doncic-1-club.html#per\\_gameCLU0::none](https://www.basketball-reference.com/euro/players/luka-doncic-1-club.html#per_gameCLU0::none)

**Figure 5: Python call and resulting DataFrame**

```
In [1]: from sportsref import euro
player = euro.Player('luka-doncic-1')
player.stats_per_game(level='C')
```

Out[1]:

	season	team_name	season	lg_name	lg_country	g	gs	mp_per_g	fg_per_g	fga_per_g	fg_pct	...	orb_per_g	drb_per_g	trb_per_g	ast_per_g	stl_per_g
0	2015	/euro/teams/real-madrid/2015.html		Liga ACB	es	3.0	NaN	2.7	0.3	1.0	0.333	...	0.3	0.3	0.7	0.0	
1	2016	/euro/teams/real-madrid/2016.html		Liga ACB	es	31.0	NaN	14.2	1.6	3.1	0.526	...	0.6	2.2	2.8	2.0	
2	2017	/euro/teams/real-madrid/2017.html		Liga ACB	es	32.0	NaN	19.9	2.7	5.8	0.460	...	1.0	3.3	4.3	3.1	
3	2018	/euro/teams/real-madrid/2018.html		Liga ACB	es	26.0	NaN	24.0	4.4	9.5	0.466	...	1.0	4.7	5.7	4.8	

4 rows × 29 columns

**Figure 6: Boxscore example**

```
In [2]: boxscore = euro.BoxScore('2018-02-01-cska-moscow')
boxscore.get_home_stats()
```

Out[2]:

	player_id	mp	fg	fga	fg3	fg3a	ft	fta	orb	trb	ast	stl	blk	tov	pf	pts	player_name
0	will-clyburn-1	31.0	4.0	11.0	1.0	4.0	2.0	2.0	0.0	10.0	1.0	0.0	0.0	2.0	3.0	11.0	Will Clyburn
1	nando-de-colo-1	27.0	3.0	9.0	0.0	2.0	4.0	4.0	0.0	0.0	5.0	0.0	0.0	3.0	2.0	10.0	Nando De Colo
2	cory-higgins-1	26.0	7.0	12.0	1.0	2.0	1.0	1.0	0.0	2.0	3.0	1.0	0.0	2.0	3.0	16.0	Cory Higgins
3	sergio-rodriguez-1	25.0	7.0	11.0	4.0	7.0	0.0	0.0	0.0	1.0	5.0	1.0	0.0	3.0	4.0	18.0	Sergio Rodriguez
4	othello-hunter-1	22.0	3.0	5.0	0.0	0.0	5.0	6.0	2.0	4.0	1.0	2.0	0.0	0.0	4.0	11.0	Othello Hunter
5	semen-antonov-1	21.0	1.0	4.0	1.0	2.0	2.0	2.0	1.0	1.0	1.0	0.0	1.0	0.0	2.0	5.0	Semen Antonov
6	nikita-kurbanov-1	17.0	2.0	3.0	2.0	3.0	4.0	4.0	1.0	4.0	0.0	0.0	0.0	1.0	3.0	10.0	Nikita Kurbanov
7	kyle-hines-1	16.0	3.0	5.0	0.0	0.0	1.0	2.0	2.0	3.0	0.0	1.0	0.0	0.0	3.0	7.0	Kyle Hines
8	andrey-vorontsevich-1	8.0	0.0	2.0	0.0	1.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	Andrey Vorontsevich
9	vitaly-fridzon-1	7.0	1.0	1.0	1.0	1.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	5.0	Vitaly Fridzon

Source:

<https://www.basketball-reference.com/euro/boxscores/2018-02-01-cska-moscow.html>

Figure 7: Cleaned Dataset preview

	defense	player	times_played	pts_per_min	trb_per_min	ast_per_min	blk_per_min	stl_per_min
0	Defense_aries-trikala	devyn-marble-1	1.0	0.586207	0.172414	0.000000	0.00	0.034483
1	Defense_aries-trikala	spiros-mourtos-1	2.0	0.160714	0.178571	0.053571	0.00	0.017857
2	Defense_aries-trikala	will-cummings-1	2.0	0.460591	0.075534	0.170772	0.00	0.000000
3	Defense_aries-trikala	eric-buckner-1	1.0	0.150000	0.400000	0.000000	0.05	0.000000
4	Defense_aries-trikala	michalis-tsarelis-1	2.0	0.283333	0.141667	0.025000	0.00	0.025000

Figure 8: Example Dataset 1

	defense	player	points
0	Defense_A	Player_X	20
1	Defense_B	Player_X	22
2	Defense_B	Player_Y	25

Figure 9: Resulting Network from Dataset 1

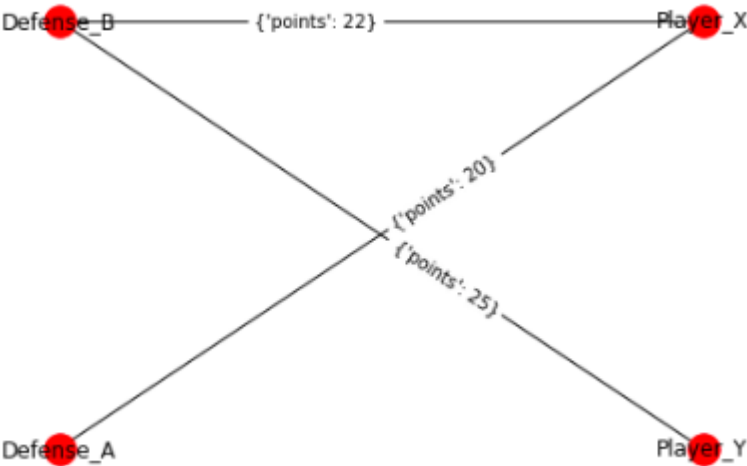


Figure 10: Example Dataset 1 Triangle Component

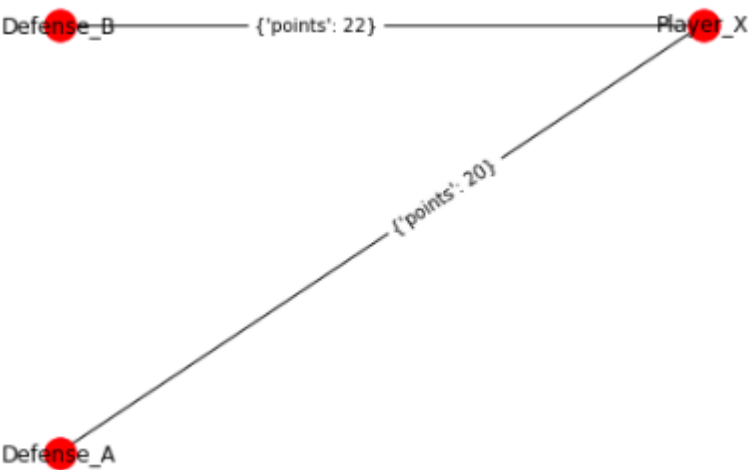
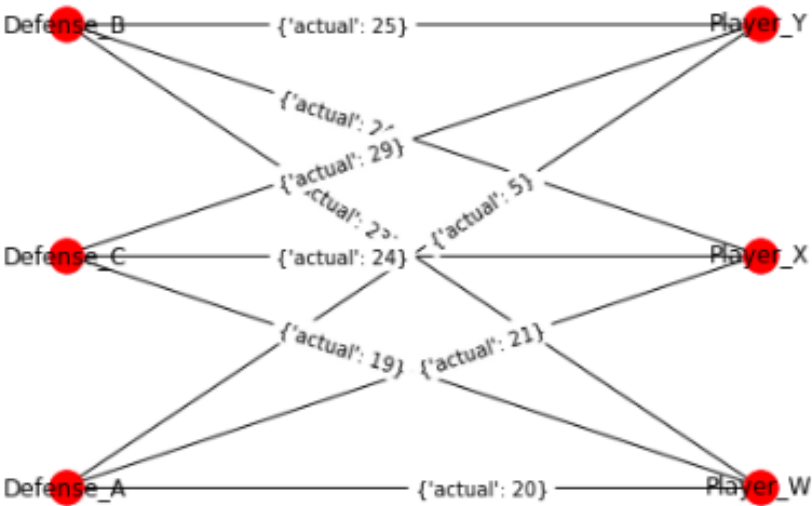


Figure 11: Example Dataset 2 and resulting Network-Based

	defense	player	actual
0	Defense_A	Player_W	20
1	Defense_A	Player_X	21
2	Defense_A	Player_Y	5
3	Defense_B	Player_W	23
4	Defense_B	Player_X	24
5	Defense_B	Player_Y	25
6	Defense_C	Player_W	19
7	Defense_C	Player_X	24
8	Defense_C	Player_Y	29



**Figure 12: Jagged Matrix (without any Triangle Selection/Ordering)**

Potential Matchup 1	T1	T2	...				
Potential Matchup 2							
...							

**Figure 13: Matrix Structure - 5 buckets, mean**

Potential Matchup 1:	Overall Mean	Overall Median	C1 Mean	C2 Mean	C3 Mean	C4 Mean	C5 Mean
Potential Matchup 2:	...	...	...	...	...	...	...
...							

Note: CX denotes Chunk X

**Figure 14: Linear Regression Example (using example Dataset 2)**

Feature Matrix

```
[ 3.28, 4.6 , 16.62, 20.12]
[ 4.14, 4.8 , 20.87, 25.26]
[ 21.74, 21.88, 25.38, 30.53]
[ 16.38, 19. , 22.86, 100. ]
[ 22.86, 23. , 26.68, 116. ]
[ 20.69, 24.15, 29.05, 105. ]
[ 19.83, 19.95, 27.84, 121.8 ]
[ 5.71, 5.75, 29. , 35.11]
[ 4.75, 5.71, 20.65, 25. ]
```

corresponding output (actual performances)

```
[20]
[21]
[ 5]
[23]
[19]
[24]
[24]
[25]
[29]
```

Resulting prediction from trained model

\*Model is trained with above features/output

```
[ 22.11]
[ 23.32]
[ 5.4 ]
[ 24.12]
[ 18.68]
[ 23.64]
[ 23.67]
[ 26.32]
[ 22.75]
```

Resulting intercept of line:

[ 13.58]

Resulting feature weights:

[-2.1 , 0.94, 0.47, 0.16]

\*In practice, training data and test data are split – see Cross-Validation section

## Figure 15: Random Forest Regressor Example

\*Using same training data as Figure 14

Resulting prediction from trained model:

21.8  
20.9  
15.0  
23.9  
16.2  
20.2  
22.4  
24.7  
27.7

## Figure 16: Residuals vs Actual across iterations – 2 examples

