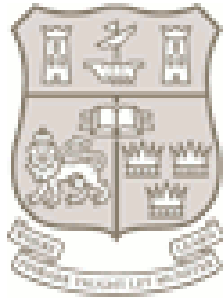# University College Cork

Coláiste na hOllscoile Corcaigh

2022-AM4065: Network Science: Theory and Applications

Initial Phase:

"Using Neural Networks to Assess Passing Data to Identify the Dominant and Intermediary Players for a given Team in the Champions League"

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Contents

1 Introduction

The aim of this project is to develop a network-based approach to analyse player passing data, in order to identify the dominant and intermediary player and how they contribute to the team performance. In this project we will use a selected team from The Champions League over a selected campaign.

Association Football (or Soccer) is best defined as a team sport between two opposing teams of 11 players each. The objective of the game is for one team to score more goals than the opposition. Throughout the modern era of football, a number of individual aspects have been emphasised which usually resulted in a widely adopted approach to playing football as a team. One of the biggest transitions was the change from an emphasis on dribbling to passing. The draw of passing over dribbling was the advantage passing brings with regards to securing possession of the ball, without allowing the opposing team an opportunity to attack.

In the initial phase of this project, we investigate why a football team is a good example of a neural network. We also will establish and compile our dataset. Finally, we will then look to what we hope to achieve in our final report.

2 Background

2.1 The Champions League

The UEFA Champions League, formally known as the European Cup, has a history spanning back to 1955. It is an annual football competition contested by Europe's top-division clubs. The competition occurs across thirteen matchdays (not including qualifying rounds) which is made up of:

- The Group Stage: First six matchdays are a double round robin qualifying system. The thirty-two qualifying teams are drawn into eight groups. Each team within each group plays each other on two occasion. Points are awarded to teams that win or draw these matches. The eight group winners and eight runners-up in each group proceed to the knockout phase.
- The Knockout Phase: The remaining seven match days are made up of four rounds that culminates with the final.

Each team must enter a squad of a maximum of 25 players, although in some cases not all 25 players are used over the course of the campaign.

Football is a game of 11 verses 11, with the following typical roles on each team:

- Goalkeeper
- Defender
- Midfielder
- Attacker

2.2   Passing Network

Passing networks are constructed from the observation of the ball exchange between players. In this scenario, the players (e.g. Jordan Henderson, Liverpool F.C) can be described as the network node (or vertices) and the number of passes, over the course of a campaign, between any two players of the team can be described as links (or edges). These links can be bidirectional as a player can both receive and give a pass from/to another player. As a result, we can construct a weighted and bidirectional passing network (see example in Figure 1 below).

Figure 1: Example of weighted bidirectional passing network
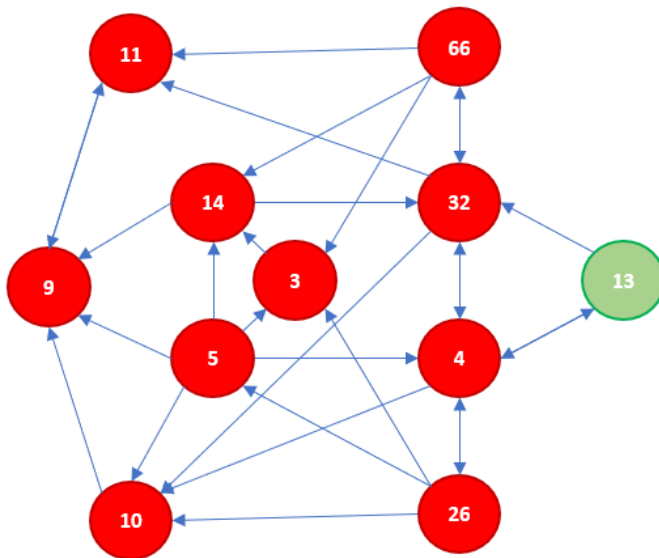
3   Dataset

The dataset is a total passing distribution of each player of the football club Liverpool Football Club over the course of the 2018/19 Champions League campaign. Liverpool played a total of 13 matchdays in this particular campaign, progressing to the competitions final and being crowed winner of the competition after defeating Tottenham Hotspur F.C.

Passing data was data for all 13 Liverpool games was complied. Since passing network differs by every match due to the change of in personal on a game by game basis depending on the personal available (individual players may be forced out of selection through injury) and the selected strategy for a particular game (depends on the perceived difficulty of the opponent) it is proposed to assess all players that were involved in the campaign.

Total passing distributions of every match in the UEFA Champions League are uploaded in press kits of UEFA.com [1]. As a result being only available in pdf format, I re-typed the data into an excel table format.

In the 2018/19 campaign, 20 of the allowable 25 players played in at least one match for Liverpool. Each of these players represent a node in the team network. For the purpose of this assessment, we will label each node with the corresponding players squad number (i.e. Sadio Mané is represented by his squad/shirt number 10).

3.1   Data Collation

In order to compile the passing data used for this assignment, publicly-available data from the UEFA.com website was utilised [1]. The per-player breakdowns of games statistics are available through the game press kits. The dataset used here was a detailed passing dashboard, which includes passes to and from between a selected player and their teammate.

The data is only available in a pdf format which meant that all of the data collected had to be retyped into an excel table format. Unfortunately, it was not possible to apply any automation to this process which meant it was quite time consuming and not easily collated.

3.2   Data Parsing

Once a passing dashboard for each game was recreated in excel, a combined adjacency matrix could be built which highlights the passes to and from between a selected player and their teammate across the entire competition. This is a matrix where the number of columns is the same as the number of rows (n x n, where n is the number of players on the team that have played throughout the campaign). The output value of this matrix, Aij can be described as the total number of passed from player i to player j. As player i cannot pass the ball to himself, the diagonal terms of the adjacency matrix are zero (no self-loops as previously stated). Figure 2 gives the passing adjacency matrix for Liverpool FC across the 13 games in the 2018/2019 season.

$$A_{ij}(Liverpool.F.C) =$$

+	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	#15	#18	#20	#23	#26	#27	#32	#66
#3	0	41	19	11	37	20	21	23	19	26	15	21	2	2	0	13	45	3	30	33
#4	50	0	47	37	80	19	14	31	12	58	50	34	3	3	4	3	118	10	48	25
#5	20	40	0	7	32	2	20	28	49	49	8	26	4	0	8	9	47	4	22	58
#6	11	35	4	0	11	3	2	0	8	8	11	12	1	0	0	1	2	0	0	23
#7	26	50	23	5	0	13	26	50	39	23	10	19	2	0	8	4	90	9	30	45
#8	16	13	7	3	15	0	10	8	8	3	1	15	2	0	0	0	14	0	2	3
#9	16	8	30	3	16	13	0	33	33	7	0	28	2	2	3	6	34	1	1	14
#10	16	14	21	1	30	11	27	0	30	10	2	12	1	0	6	4	56	4	5	11
#11	9	3	35	0	18	4	35	27	0	11	0	29	4	0	2	1	10	2	5	34
#12	23	65	32	8	27	1	14	22	21	0	21	27	0	1	6	10	9	1	19	40
#13	31	81	15	18	25	4	2	9	1	30	0	19	2	0	0	0	49	1	62	26
#14	27	32	23	12	31	12	21	24	38	23	7	0	5	0	0	11	47	6	28	65
#15	1	0	6	0	2	1	2	5	5	0	1	3	0	0	2	0	4	0	0	5
#18	2	1	1	0	0	0	3	2	0	0	0	0	1	0	1	0	0	0	0	0
#20	0	1	9	0	4	0	3	3	4	4	0	0	2	0	0	0	7	1	2	4
#23	6	3	4	1	3	0	5	3	5	5	1	6	0	0	0	0	5	1	4	15
#26	30	83	59	0	82	12	45	82	20	14	20	26	10	0	3	5	0	10	12	9
#27	1	3	2	0	6	0	4	3	3	0	0	5	0	0	0	4	5	0	1	1
#32	34	51	27	0	31	6	13	12	20	25	63	24	3	0	1	2	5	5	0	49
#66	24	17	41	16	25	5	31	13	62	21	8	49	9	0	7	17	8	1	31	0

Figure 2: Passing Adjacency Matrix for Liverpool .F.C for the 2018/19 Champions League Campaign

The excel file is output can be saved as a common separated value (.csv) or .txt file.

3.3   Data Visualisation

The intension going forward is to use the data harvested above to create a weighted, directed passing graph. This will be done using the *Network X* package. Base on a brief analyse of the complied data, the expected output would be a well-connected graph where the majority of the players have passed to all other teammates at least once. The passing network will be built up 20 nodes each representing a member of the squad. Most nodes will have two edges which represent both a pass to and from two selected players.

3.4   Proposed Analysis

Since the turn of the century, the level of research focused on applying the theory of social networks to football has increased significantly to the point where we are now seeing managers/coaches developing their team strategies with a huge consideration for such research.

The focus of this project is assessing the passing network of the given football team across a given campaign. With the data collected and the passing network formed we can assess it under the properties of passing networks.

The concept of centrality is one of the most widely used measures when discussing social networks analysis. The motive of centrality is to attempt to determine the key nodes in a

network. In the next stage of the project, we will use centrality and its various forms to identify the dominant and intermediary players and estimate the level of interaction between teammates of the assessed team. This will present us with a clearer picture of how the team are set up to play and what strategies they tend to implement.

4 References

[1] 2018/19 UEFA Champions League Press kits

https://www.uefa.com/insideuefa/mediaservices/presskits/uefachampionsleague/season=2019/index.html

Other references:

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https://rpubs.com/ihatestudying/passing-network-

[1] 2018/19 UEFA Champions League Press kits

https://www.uefa.com/insideuefa/mediaservices/presskits/uefachampionsleague/season=2019/index.html

[2] B.Goncalves, D.Coutinho, S.Santos, C.Lago-Penas, S.Jimenez and J.Sampaio, "Exploring Team Passing Networks and Player Movement Dynamics in Youth Association Footabll," 2017.

[3] P.Cintia, S. Rinzivillo and L. Pappalardo, "A Network-Based Approach to Evaluate the Performance of Football Teams," 2015

[4] Florian Korte*, Daniel Link, Johannes Groll and Martin Lames 'Play-by-Play Network Analysis in Football' 2019