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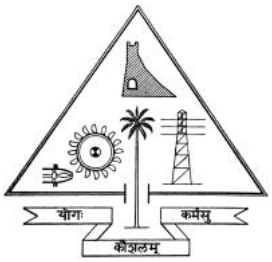

2019

CS451 - B.TECH SEMINAR REPORT

ON

Team Composition in PES2018 Using Submodular Function Optimization

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ABSTRACT

With the development of computer game technologies,we know that gameplay becomes very realistic in many sports games, therefore providing appealing play experience to game players. To get the victory in a football pitch, team composition is one of the most important thing needed. There is little research on the automatic team composition in sports games particularly in a popular game of Pro Evolution Soccer (PES). So we consider the team composition as one team player recommendation problem.We also know that a paticular team is composed of several players in a game. Subsequently, we aim to recommend a list of sufficiently good football players to game players.

We will convert the team player recommendation into one optimization problem and produce greedy algorithm-based solutions. We deal with a coverage function that quantifies the degree of soccer skills to be covered by each selected players.Also we improve the greedy algorithm to solve the function optimization problem.

ACKNOWLEDGEMENT

It gives me great pleasure to present my seminar report on "Team Composition in PES2018 Using Submodular Function Optimization".No work, however big or small,has ever been done without the contribution of others.So these words of acknowledgement come as a small gesture of gratitude towards all those people, without whom the successful completion of this report would not have been possible.
I would like to express my gratitude towards seminar coordinators Prof. Helen K J,Associate Professor and Prof. George Mathew, Assistant Professor, Department of Computer Science and Engineering who gave me their valuable suggestions, reviews, motivation and direction.
I would also like to thank all lab staff for providing with the necessary facilities for the presentation, it would have been impossible to complete seminar without their prompt cooperation. Last but not the least I would like to thank all my friends, who supported me with their valuable criticism, advice and support.

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PES Pro Evolution Soccer
PS4 Play Station 4
CEFG Cost Effective Forward selection Greedy
MAB Man Blue
MSB Mercyside Blue
HER HampshirE Red

1 Introduction

1.1 Pro Evolution Soccer

In this modern world, many sport games have appeared and attracted more and more players in game markets. Pro Evo- lution Soccer 2018 (PES2018) is one of the popular football game produced and released by Konami.It can be played on a personal computer, PS4 or XBOX and in Mobiles. This game can be controlled by human or computer players, and can fully simulate a football match. It gives the human player an opportunity to compose a team of avatars each of which sim- ulates a real-world football player, e.g. Lionel Messi, Cristiano Ronaldo,Eden Hazard etc., in a competitive game. So as usual the selection of team members becomes more interesting and important in PES..

We all see football and it is the worlds game,it gets reflected in a game like PES.The team composition depends on preferences and knowledge of a human-player who, however, still expects inputs from the gaming system.We,the human players,will be satisfied if we get a team that we are dreaming of ad gets the favorite players to our team. This is well aligned with entertainment spirit in the content recommendation in computer games.Hence a team recommender becomes an important feature in a sport game not just limited in PES

In PES, every football player is specified by a set of attributes

- Attacking Prowess
- Ball Control
- Speed
- Jump etc...

Each attribute is associated with a specific value all of which decide the player performance in a match. The strength of a team is mainly influenced by the performance of individual players. The team is more likely to win a match if more skillful players are selected into the team. However, as each player has a specific position and a limited number of positions (a football match needs 11 players) exist in a pitch, the team composition is not straightforward given the known ratings of the players that indicate their performance. Things become more complicated since a human-player is often given a limited budget for purchasing a team of players each of which costs a certain value corresponding to his skills. It is very much difficult ,if we even compare with the various fantasy leagues for various sports.A fixed cost will be given earlier and we need to get our ideal an optimized team within that cost limit.It have to be done all manually and need to observe all the games to select a team for the next gameweek and its all based on humans knowledge about various players,their playing styles and positions.As an example,we can take the fantasy leagues to know more about the team composition.

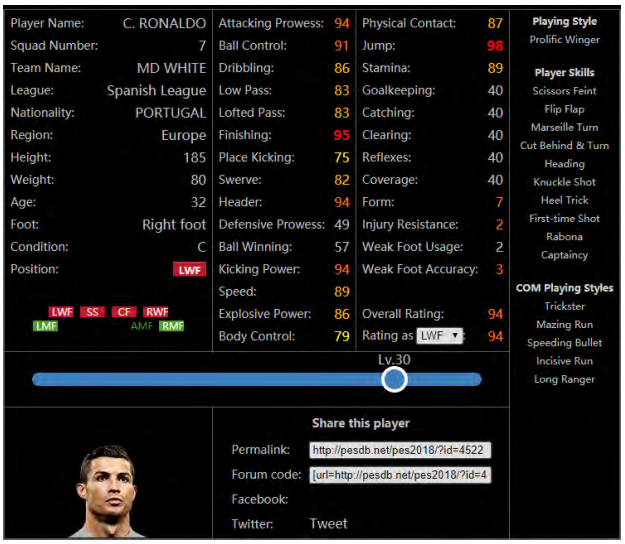

Figure 1: Player attributes in PES2018

1.2 Submodular Function

A function is submodular if it complies the following property: when you add a set to a solution "A" the improvement is worst than adding the same set to a subset of "A". Submodularity is a discrete version of concavity.

An example is the set cover problem. You have a set of sets and you have to find the minimum combination of those sets to cover some universe of elements.

For example let the universe be: U=1,2,3,4,5,6,7,8 and our sets: S1 = 1,2,3 S2= 1,4,5,6 S3= 4,5,7 S4 = 2,4,6,8 S5 =6,8 S6 =1,3,5,7

The solution is of course S4 S6.

So in more mathematical way,For a set of objects V = v 1 , . . . , v n and a function f : 2 V R, if for each A B V and e V B, it holds that M (e p A) greater than equal to M (e p B), then the function f is submodular, where

(e1 A)=f(A U e)-f(A)

One important property of submodularity is diminishing marginal returns, i.e., adding an element to a small set is more influential than adding it to a large set.

2 Related Work

Research of team composition is most important and relevant to team recommendation where a list of teams are recommended. More often,team recommendation comes from organizational andbehavioral sciences and research on social web application thathas appeared for a team recommendation since 2012.

	ID	1	2	3	4	...
	player_name	C.RONALDO	L.MESSI	L.SUAREZ	M.NEUER	...
	position	LWF	RWF	CF	GK	...
	rating	94	94	92	91	...
ability	attacking_prowess	94	95	95	42	...
	ball_control	91	96	86	68	...
	dribbling	86	96	84	60	...
	low_pass	83	88	82	65	...
	lofted_pass	83	86	77	69	...
	finishing	95	95	95	43	...
	header	94	68	77	70	...
	defensive_prowess	49	43	58	60	...
	speed	89	86	78	71	...
	goalkeeping	40	40	40	98	...

Figure 2: Player attributes and possible values for the attributes

3 Player Recommendation As A Submodular Function Optimization

Here,we formulate the player recommendation into one optimization problem and prove the submodularity property of this function as well.

3.1 Function for skill coverage

Given the PES platform, we choose ten players attributes as the most important skills for the team composition,i.e. attacking prowess, ball control, dribbling, low pass,lofted pass, finishing, header, defensive prowess, speed, and goalkeeping. In addition, we consider the players number, name, position, salary and overall rating. Hence each player has 15 attributes.
For each player pi,we use s to represent the players ability such as attacking prowess, ball control, and speed.

$$cov_{s_j}(p_i) = a_{s_j}(p_i)/(\sum_{p_k \in U} a_{s_j}(p_k))$$

Subsequently, we can define the skill coverage function for a set of team players, T , that is a subset of all potential players. We measures the degree to which the ability sj is covered by at least one player in T .

$$cov_{s_j}(T) = 1 - \prod_{p_i \in T} (1 - cov_{s_j}(p_i))$$

$$F(T) = \sum_{s_j \in S} \beta cov_{s_j}(T)$$

Figure 3: Function of T covering S defined as F(T

3.2 Recommender model

We aim to find an optimal team that maximizes the coverage value,also we need to consider the cost of composing the team of players for optimization. So this can also be seen as solving the below optimization problem.

maxF(T) subject to mod T = 11 and c(T) less that or equal to C

where c(T) is the sum of the salary of the total eleven players in T and C is the salary constraint for the entire team.

Proposition 1: The monotone function $F(T)$ (in Eq. 4) is submodular.

proof: We calculate the marginal gain of the skill coverage when one player is added into a potential team $\hat{T} \subseteq U$.

$$cov(\hat{T} \cup p_j) - cov(\hat{T})(1 - \prod_{p_i \in \hat{T}} (1 - cov(p_i)) * (1 - cov(p_j)))$$

$$-(1 - \prod_{p_i \in \hat{T}} (1 - cov(p_i)))$$

$$= cov(p_j) * \prod_{p_i \in \hat{T}} (1 - cov(p_i))$$

Similarly, for a small team $\check{T}$, we have

$$cov(\check{T} \cup p_j) - cov(\check{T}) = cov(p_j) * \prod_{p_i \in \check{T}} (1 - cov(p_i)),$$

where $\check{T} \subseteq \hat{T} \subseteq U$. Moreover, since $1 - cov(p_i) < 1, cov(\hat{T} \cup p_j) - cov(\hat{T}) \leq cov(\check{T} \cup p_j) - cov(\check{T})$, we have $cov(T)$ is submodular.

Figure 4: Proof for submodular

4 Algorithms For Optimization

Here we will be making use of Greedy Algorithms to solve the recommendation problem that is formulated as one submodular function optimization problem