International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 4 Issue 10, October-2015

A Machine Learning Application for Football Players' Selection

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***Abstract*: The process of football team player selection is ultimately where the success of a team is determined. This is because the successful collection of individual talented players forms an effective team. In general, the selection of players in a football team is a decision made by the club on the basis of the best available information. This paper proposes a model that groups the attributes needed for player selection into four major categories which include the player's technique, the player's speed, the player's physical status and the player's resistance using neural network technique to determine these major attributes for each player. The system was developed and implemented using Matlab 2008. The result has shown that Neural Network is a good tool for selecting players in a football team.**

Keywords: ***Football Team, Decision Support System, Player Selection, Neural Network.***

I. INTRODUCTION

The success of any football match lies in player selection which a difficult decision is making task for football managers. Football managers may need to use a decision support system to aid their decision making process. These attributes may include the player's individual skills and performance statistics, combination of players, physical fitness, psychological factors, and injuries among others [1]. Some coaches may also use importance weights to determine the impact of each attribute. Importance weights are useful to the football managers since they indicate how the impact of a particular attribute relates to the probability of a successful outcome.

Football is a team sport that is popular in almost every country in the world. The player selection process for professional football teams is crucial in the quest for winning. So much so that a wrong selection can cost football team the championship and even millions of dollars if the player turns out not living up to the team's expectations [22]. Traditionally, professional football teams use a variety of sports psychology assessments for evaluating players. There is no doubt that these assessments are of great benefit and are extremely useful when trying to form a winning football team. However, this is just one part of the big puzzle when trying to assess a player's suitability for a team. The ability to select suitable players is indispensable when it comes to building an effective team [11].

This paper makes use of Neural Network technique to build a decision support system for player selection in a football team. The system uses neural network to evaluate some attribute that makes up the four major categories to be considered by the football managers in selecting a player for a football team. A selected player will be judged based on these four categories which include the player's technique, the player's speed, the player's physical status and the player's resistance.

II. LITERATURE REVIEW

Katzenbach and Smith (1993) defined a team as a small number of people with complementary skills who are committed to a common purpose, performance goals, and approach for which they hold themselves mutually accountable [11]. A variety of approaches for the selection of team members have been proposed in the literature. Most of these studies have focused on the use of teams in business and industry. The business and industry's adoption of a teamwork methodology in the pursuit of cost effectiveness and greater innovation has spawned significant research [9][7][10].

Braha (2002) has proposed a team-building approach based on task partitioning by specifying task dependencies and partitioning the tasks among a number of teams [13].

Chen and Lin (2004) proposed a team member model for the formation of a multi-functional team in concurrent engineering. They used the analytic hierarchy process and Myers–Briggs type indicators to model team member characteristics [14].

Gronau et al (2006) developed an algorithm to propose a team composition for a specific task by analyzing the knowledge and skills of the employees in the project management field [15]. Durmusoglu and Kulak (2008) proposed a team building process using axiomatic design principles. They proposed to establish teams by identifying the needed skills and preparing a skill development procedure to ensure maximum utilization of team members' talents[20].

Feng, et al (2010) proposed a member selection method in cross functional teams where both the individual performance of the candidates and the collaborative performance between candidates were considered. Fuzzy set theory has also been used in the team member selection and team formation research [19].

Liang and Wang (1992) proposed integrating fuzzy logic into weighted complete bipartite graphs and developing a polynomial time algorithm for solving personnel placement[18].

DeKorvin, et al(2002) developed a model for the selection of personnel in multiple phase projects, which took into account the match between the skills possessed by each individual, the skills needed for each phase, and flexible budget considerations. They used the fuzzy construct of compatibility to measure the fit of a person's skill set to the goal set for each project phase in fuzzy environment [16]

Boon and Sierksma (2003) formulated a linear optimization model to headhunt or scout a new team in soccer and volleyball by combining the qualities of the candidates and players with the functional requirements.[4].

Merigo´ and Gil-Lafuente (2011) analyzed the use of the ordered weighted averaging (OWA) operator in the selection of human resources in sport management. They used the Hamming distance, the adequacy coefficient and the index of maximum and minimum level to parameterize these decision-making techniques and select of a football player for a team.[12]

Ahmed et al (2011) considered the overall batting and bowling strength of a cricket team and proposed a constrained multi-objective optimization model for selection of the players on the team [2].

Askin and Sodhi (1994) have presented a novel method for organizing teams in concurrent engineering. They developedfive different criteria for team formation and discussed team training, leadership, and computer support issues [2].

Zakarian and Kusiak (1999) proposed an analytical model for the selection of multi-functional teams. They used the analytic hierarchyprocess and the quality function deployment method to prioritize ''team membership'' based on customer requirements andproduct specifications under fuzzy environment[21].

II. MATERIALS AND METHOD

Neural network technique was used to develop a model for player selection, in this model different attributes needed for player selection is analyzed into four major categories using a neural network model and this major categories which include the player's technique, the player's speed, the player's physical status and the player's resistance. The data used in this paper was collected from www.pesstatsdatabase.com/PSD/playerClassic.php?id=15798&club=0. These major categories will be used to make the final decision on which player to be selected for a football team.Figure1, figure 2, figure 3. and fig 4 shows the neural network model architecture for calculating the player's technique, the player's speed, the player's physical status and the player's resistance respectively.

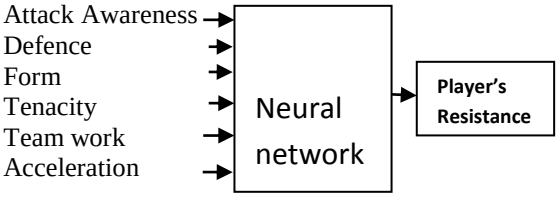

Figure1. Neural Network Model Architecture for Player's Resistance Status

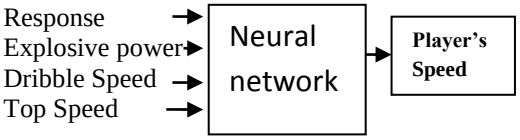

Figure 2. Neural Network Model Architecture for Player's Speed Status

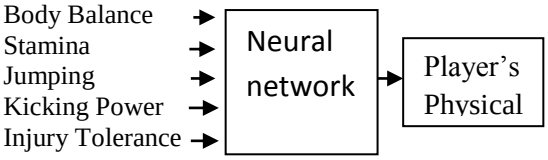

Figure 3. Neural Network Model Architecture for Player's Physical status

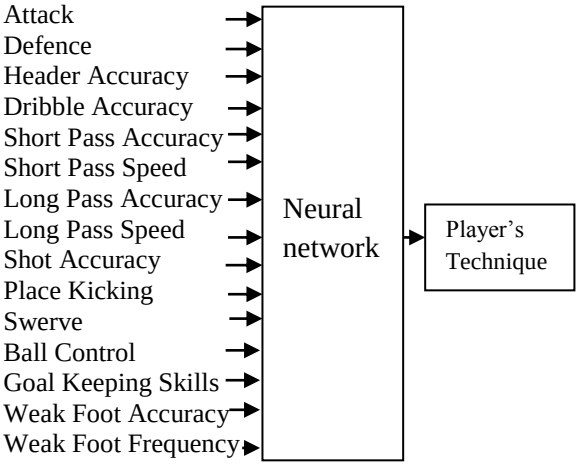

Figure 4. Neural Network Model Architecture for Player's Technique

The feed forward algorithm was used to calculate the optimal weights of the individual attributes that make up these categories. The mathematical models for the feed forward algorithm are as follows:

$$\boldsymbol{Input}_j = \boldsymbol{x}_j = \sum y_i w_{ij} \quad \text{.....1}$$

$y_i$is the generated output and w_{ij} represents weights

$$f(x) = \frac{1}{1+e^{-x_j}} \quad \text{.....2}$$

f (x) is a sigmoid that is used as the activation function

$$\boldsymbol{Error} = T_k - O_k \quad \text{.....3}$$

T_k is the observed (True) output while Ok is the calculated (actual) output

The error in the output layer is calculated by using the formula in equation 3.4

$$\delta_k = o_k(1 - o_k)(T_k - o_k) \quad \text{.....4}$$

Where O_k is the calculated (actual) output expressed in equation 3.5

$$O_k = \frac{1}{1+e^{-x_k}} \quad \text{.....5}$$

T_k is the observed (True) output

The back propagation error in the hidden layer is calculated by using the formula in equation 3.6

$$\delta_j = o_j(1 - o_j)\sum_k \delta_k * w_{jk} \quad \text{.....6}$$

Where w_{jk} is the weight of the connection from unit j to unit k in the next layer and δ_k is the error of unit k.

The weight adjustment formula in equation (3.7) is used to adjust the weights to produce new weights which are fed back into the input layer.

$$W_{new} = W_{old} + \eta * \delta * input \quad \text{.....7}$$

Where η is a constant called the learning rate. The learning rate takes value between 0 and 1.

A. THE CONDITION FOR PLAYER SELECTION

The Average Status = (Physical status + Technique status + Speed status + Resistance status) / 4

Average stat (X) =
- X < 50
- X = 50
- X > 50

From the first condition, if the player's average status is below 50 then the player rating is below average and with this information the coach will reject the player. If the player's average status is equal to 50 then the player rating is average and with this information the coach can choose the player but he must not be in the starting eleven, which means he/she can be in the bench. If the player's average status is above 50 thenthe player rating is above average and with this information the coach can choose the player in the starting eleven.

IV. EXPERIMENTS AND RESULTS

The simulation was done using Matlab 2008. Figure 5 shows the Neural Network fitting tool for data selection. This Interface helps in collection of input data and the target data from the work space.

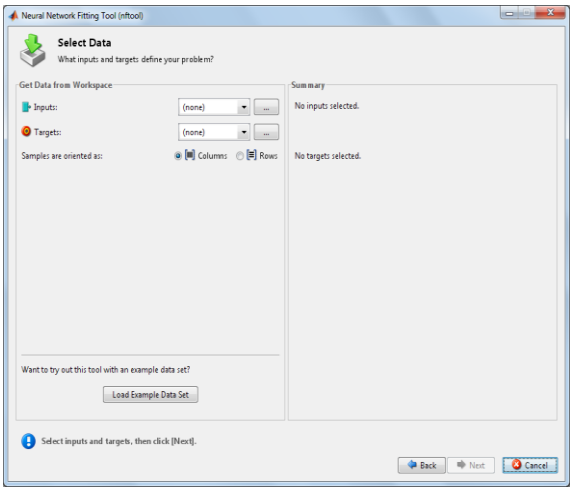

Figure 5. Neural Network Fitting Tool for Data Selection

Figure 6 shows the Neural Network fitting tool for selection of network size. This interface gives the user the opportunity to select the number of neuron in the network's hidden layer. The user can return to this panel and change the number of the neuron if the network does not perform well after training.

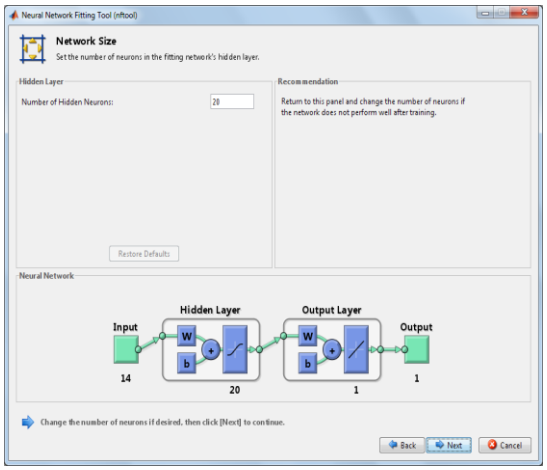

Figure 6. Neural Network Fitting Tool for Network Size Selection

Figure 7.shows the Neural Network training. The Neural Network model was trained using Levenberg-Marquardt back propagation. The network is trained to fit the inputs and the target. This means that neural network map between a data of numeric inputs and a set of numeric targets. Training automatically stops when generalization stops improving as indicated by the increase in the mean square error of the validation samples.

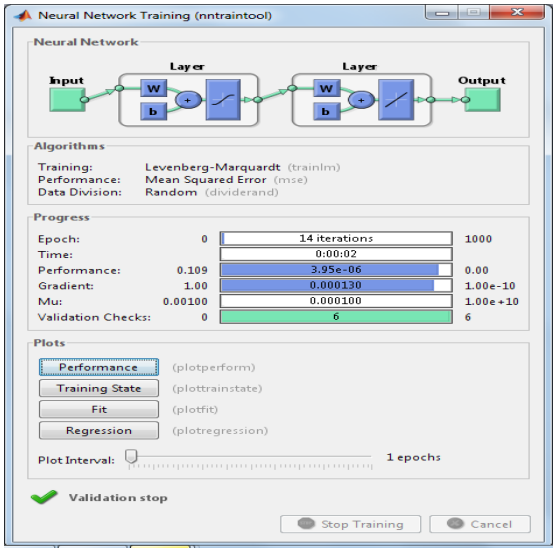

Figure 7. Neural Network Training Tool

The neural network fitting tool will help in training network and evaluation its performance using mean square error and regression analysis. Training multiple times will generate different results due to different initial condition and sampling. Figure 8.shows the result of the trained Network.

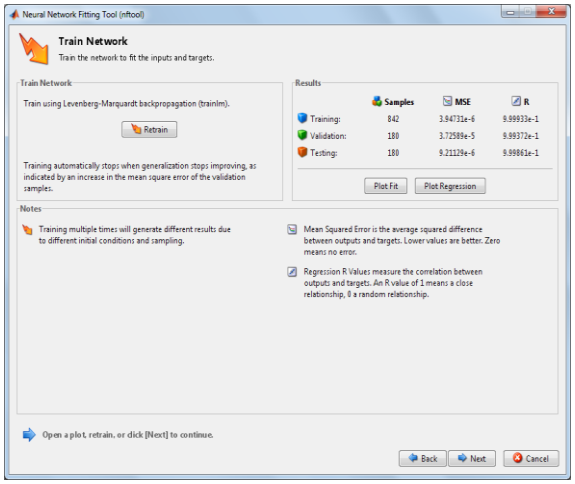

Fig 8. Neural Network Fitting Tool for Displaying the Result of the Trained Network.

Table 1. shows the comprehensive summary of the results from the developed system. The result shows the different player capabilities, and the team managers select their players' base on the generated result. The table also displays the average result based on the four major categories for easy clarification and selection.

Table 1: The Comprehensive Summary of the Results from the developed system

Players Name	Technique status	Speed status	Physical status	Resistance status	Average status	Player rating	Decision
Lionel Messi	85.1	92.1	62.9	28.2	67.075	Above Average	Select
Christiano Ronaldo	82.3	92.4	78.3	33.4	71.6	Above Average	Select
Arjen Robben	82.2	93.1	64.6	32.8	68.175	Above Average	Select
Andres Iniesta	88.4	76.3	62.8	59.3	71.7	Above Average	Select
Luis Suarez	79.6	83.7	79.4	43.3	71.5	Above Average	Select
Franck Ribery	86.2	88.8	62.3	30.5	66.95	Above Average	Select
Eden Hazard	85.1	88.1	63.5	32.6	67.325	Above Average	Select

Table 2: The Comprehensive Summary of the online Results on 16th Dec 2014

Players Name	Technique status	Speed status	Physical status	Resistance status
Lionel Messi	86	93	62	27
Christiano Ronaldo	81	93	79	32
Arjen Robben	83	93	64	32
Andres Iniesta	89	75	63	59
Luis Suarez	79	83	79	42
Franck Ribery	85	89	62	29
Eden Hazard	84	89	64	32

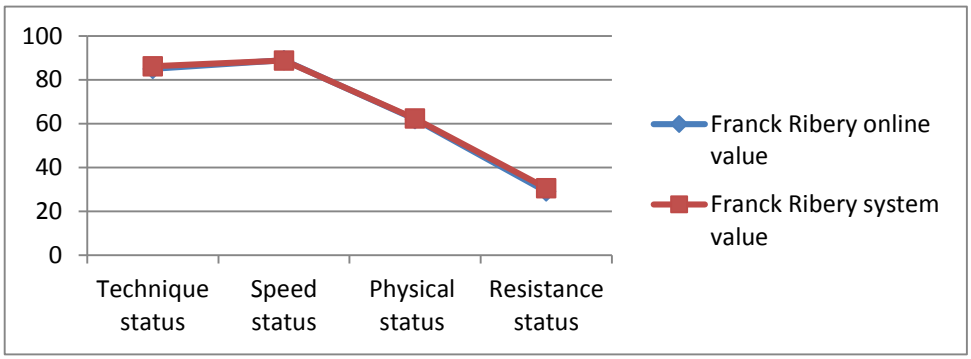

Figure 10: A Line Graph That Shows the Relationship Between Online and System Result of Frank Ribery

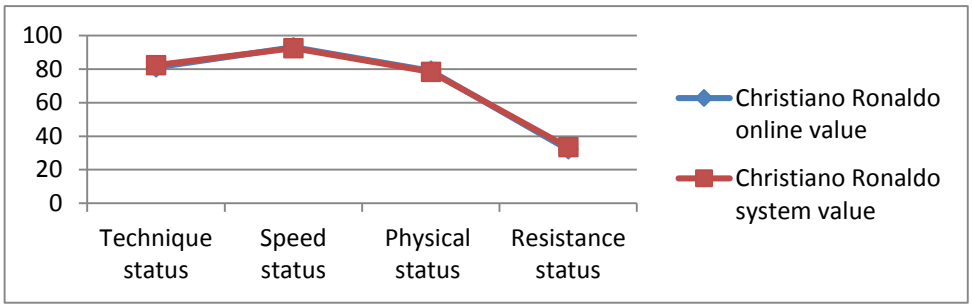

Figure 11: A Line Graph That Shows the Relationship Between Online and System Result of Christiano Ronaldo

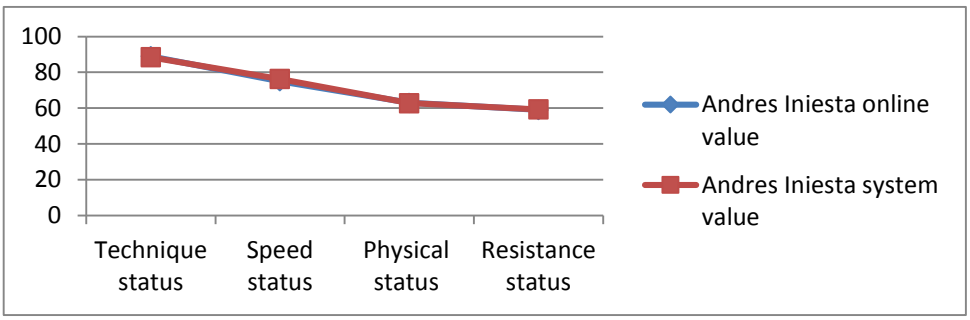

Figure 12: A Line Graph That Shows the Relationship Between Online and System Result of Andres Iniesta

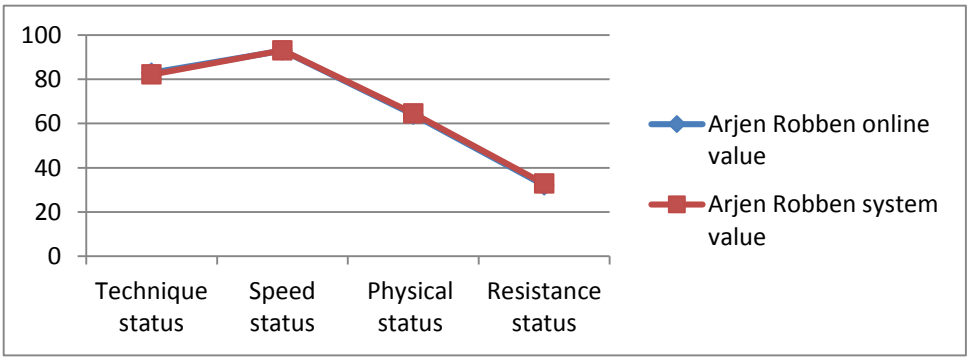

Figure 13: A Line Graph That Shows the Relationship between Online and System Result of Arjen Robben

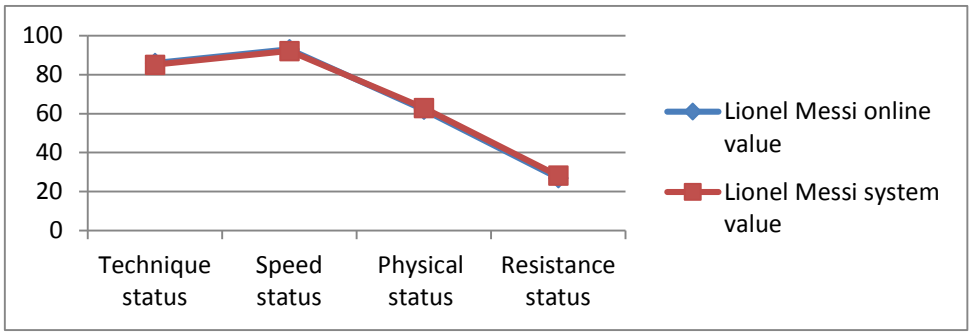

Figure 14: A Line Graph That Shows the Relationship Between Online and System Result of Lionel Messi

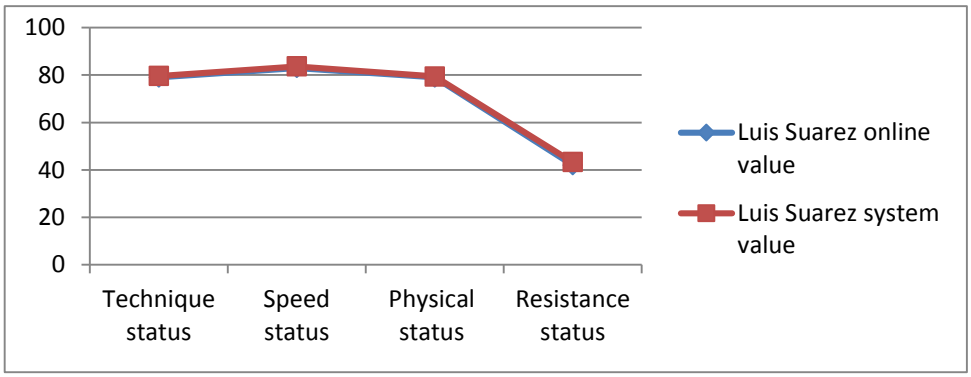

Figure 15: A Line Graph That Shows the Relationship Between Online and System Result of Luis Suarez

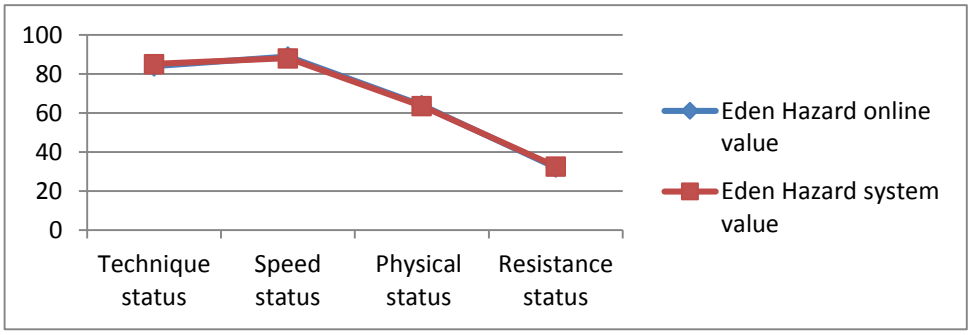

Figure 16: A Line Graph That Shows the Relationship Between Online and System Result of Eden Hazard

V. RESULT DISCUSSION

Table 1.shows the comprehensive summary of the results from the developed system. The result shows the different player capabilities. Based on this generated result, players are being selected by the team manager. The table also displays the average result based on the four major categories for easy clarification and selection. Table 2.displays the comprehensive summary of the online results on 16th Dec 2014. The reason for this result is to compare the accuracy of the developed system with the existing system. Figures 10, 11, 12, 13, 14, 15 and 16 show a line graph displaying the relationship between online and system result ofFrank Ribery,Christiano Ronaldo, Andres Iniesta, ArjenRobben, Lionel Messi, Luis Suarez and Eden Hazard respectively. From the graphs, it can be seen that neural network can be used to predict player performance in a team with minimum error. These results have shown that Neural Network is a good tool in building a decision support system for a football team manager.

VI. CONCLUSION

Neural Network has been proven in the paper to be a good tool for building a decision support system for a football team manager. There are some attributes that a football player may have which cannot be neglected when it comes to choosing a rightful player for a football team. This system has employed the idea of neural network in considering this large amount of attributes needed in secting the rightful player for a football team. The result generated from the system has shown that neural network technique can help the football managers in player selection for a football team.

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