VOL. 13, NO. 18, SEPTEMBER 2018 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

SIDUTSA: AN ALGORITHM BASED ON DECISION TREES FOR THE MANAGEMENT OFSOCCER COMPETITIONS

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ABSTRACT

Manage a soccer tournament can be a tedious task if it is done manually. This article presents the development of SIDUTSA, an on-line system based on decision trees, which allows the administration of the football tournaments to be automatic. By entering only, the participating teams and the results of the matches, the system organizes the matches automatically at each stage of the championship playoffs, quarter finals, semi finals and the final. SIDUTSA was developed using the language of Transact-SQL programming and a SQL server database manager. It is shown that it is possible to implement low-cost systems using efficient software architectures, easy to manage and potentially scalable. It was possible to develop software that allows you to: 1) automate the information corresponding to the management of soccer tournaments, 2) generate reports of the classification of the participating teams, 3) give independence to personnel in charge of the logistics, and 4) contributes to the decline in the use of paper. It is hoped that this tool can be used in other institutions that also carry out soccer tournaments.

Keywords: decision trees, computer applications, software architecture, software design, soccer competitions.

1. INTRODUCTION

The Artificial Intelligence (AI) is one of the most advanced disciplines within the new information technologies, and it has emerged as a response to the need to find models and programs of the so-called intelligent behavior. The AI deals with adaptation, learning or intelligent behavior, to be developed in machines or computers. In the origin and development of the AI two points of view joined: the scientific, that attempts to simulate with the computer verification of theories on the intelligence mechanisms; and the engineering, which tries to give the computers capabilities as close as possible to the human brain.

Within the area of the AI, and more precisely within the sub-area of machine learning are the decision trees. They are used mainly for purposes of classification but are also useful to discover characteristics of the data which are not directly visible. For this reason, decision trees are important in both applications of classification and data mining. A decision tree is a prediction model whose main objective is the inductive learning from observations and logical constructs. The knowledge obtained during the process of inductive learning is represented by a tree. A tree graphically is represented by a set of nodes, leaves and branches. These are very similar to the forecasting systems based on rules, which are used to represent and categorize a series of conditions that occur in succession for the solution of a problem. The schema of a decision tree is shown in Figure-1.

This model is constructed based on the narrative description of a problem, as it provides a graphical view of the decision, specifying the variables that are evaluated, the actions that must be taken and the order in which the decision will be made. Each time this type of model is run, only one path will be followed depending on the current value of the variable evaluated. The values that the variables can take for this type of models can be discrete or continuous [1]. The entries in the decision tree are a set of characteristics or attributes, which can represent objects or situations. The corresponding output of the tree is a value corresponding to the attribute that you want to view. You can also understand the output of the tree as a Boolean value Yes/No for the various attribute values of output.

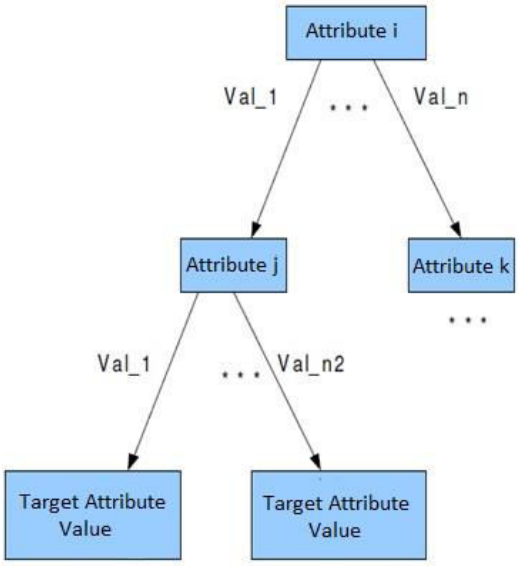

Figure-1. Outline of a decision tree.

This type of technique is quite used in different areas of knowledge as reported by [2-12]. This document presents the design of an algorithm based on decision trees to automate the programming of parties in an information system for the management of soccer tournaments and competitions.

2. MATERIALS AND METHODS

The system of tournaments management and competitions is to streamline and improve the processes involved in the management relating to the administration of a soccer tournament, that is, the registration of players, the programming of parties and the calculation of points for the score tables, on the other hand, contributes to the reduction of paper use in these processes.

To schedule an active tournament onto the system, the algorithm based on decision trees should consider the following rules of a match:

- The tournament can be one-way, in which case, each team faces another team only once, or roundtrip, in which case each team faces another team twice.
- Each match is composed of two teams: home and visitor
- Matches can be won by any of the following results:
- Goal difference
- Difference in goals per penalty shootouts (only in the late stages of the tournament)
- No presence of all team members, or whole team at the time of the match (W)
- It also need to be considered the stage of the match
- Preliminary
- Round of eighth finals
- Quarter final
- Semi-final
- Final
- Each match, belongs to a specific tournament
- Each match has a judge: Referee

Matches that comply with the attributes mentioned above must be classified in the following phases:

- Generation of parties in Preliminary stage
- Generation of matches in stages:
- Round of eighth finals
- Quarter final
- Semi-final
- Final

In the first phase some initialdata will be required on the teams registered in the system, such as: the order of initial registration and the number of registered teams, among others. In the second phase, table of positions is taken into a count, where the teams with the most points constitute the group of teams that will disputing the decisive stages of the tournament.

The algorithm that allows to automate the programming of the matches is defined by three decision trees which allows the following processes:

A. Sort groups in the tournament. This tree (Figure-2) considers the conditions and alternatives in order to allow us to sort the groups in the tournament:

- If the number of teams (**Ne**), registered to the Tournament, are between 3 and 7,we must create a single group.
- To create 2 groups in the tournament, the result of divide Ne into 2, it must be a number between 3 and 10.
- To create 4 groups in the tournament, the result of divide Ne into 4, it must be a number between 3 and 10.

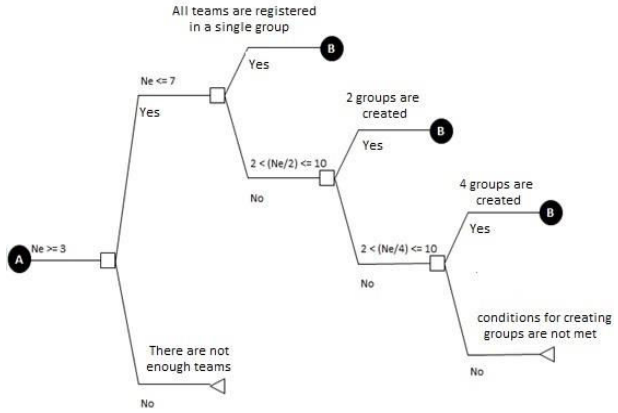

Figure-2. Tree design to sort the groups in the tournament.

B. Schedule the preliminary stage for each group. Once the teams of the tournament are distributed in the determined groups, it is necessary run the schedule of matches in the preliminary stage for each group. In Figure-3, you can see the design of the tree.

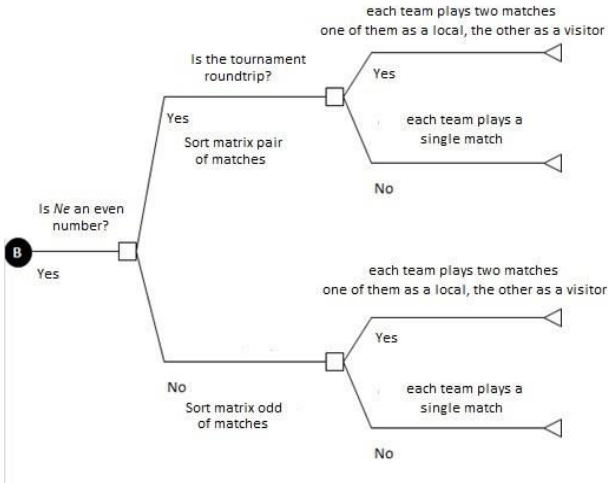

Figure-3. Design of the tree to schedule the preliminary stage for each group.

Where the array to sort the matches of the groups with an even number of registered teams is given by:

$$M \cdot [Ne - 1] \cdot [Ne/2] \quad (1)$$

And the array to sort the matches of groups with odd number of registered teams corresponds to:

$$M \cdot [Ne] \cdot [((Ne - 1))/2] \quad (2)$$

Where the number of rows of the array M allows to set the dates for the tournament, ensuring that matches (local- visitor) are not repeated in the stage of the tournament.

The alternatives at the end of this tree are:

- If the tournament is a roundtrip, teams of each group will play two matches where one of the teams is local and the other is a visitor and vice versa for the second match.
- If the tournament is a one way, the teams in each group will play a single match, at the preliminary stage.

In the information system, the user will be able to run the algorithms obtained with the trees corresponding to sort the groups in the tournament and schedule the matches of the preliminary stage for each group, making use of the graphical user interface (GUI) shown in Figure-4.

Figure-4. The management system GUI of tournaments and competitions, for the implementation of the algorithms.

C. Register teams in the late stages of the tournament. This decision tree allows performing an algorithm to register the highlighted teams in the table of positions, in the final stages of the tournament. The execution of this algorithm in the system of tournaments and competitions can only be performed if the games scheduled in the preliminary phase have been completed. See the design in Figure-5.

Where Ng, corresponds to the number of groups of the tournament, Ne, corresponds to the number of teams per group of the tournament. Conditions and alternatives of this decision tree are:

- If the tournament is made up of 4 groups and:
- There are more than6 teams in each group of the tournament, go to the final stages the first 4 teams in the table of positions, of each group.
- The number of teams in the tournament groups is less than 6; go to final stages the first 2 teams of each group.
- If the tournament is made up of 2 groups and:
- There are more than 6 teams in each group of the tournament, go to the final stages the first 4 teams in the table of positions, of each group.
- The number of teams in the tournament groups is less than 6; go to final stages the first 2 teams of each group.

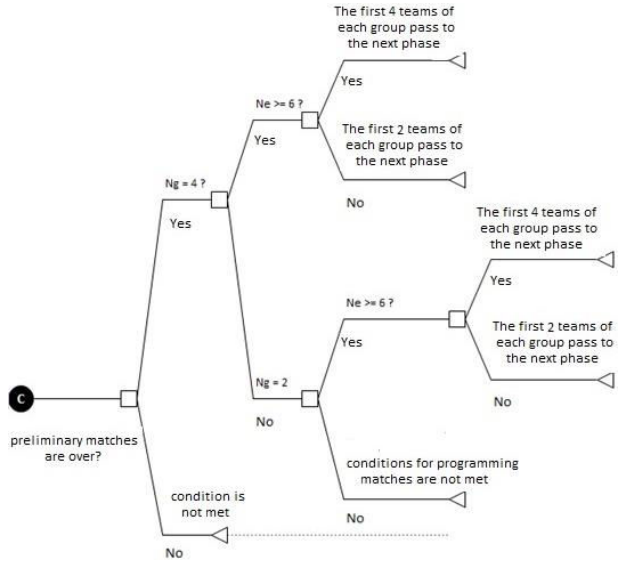

Figure-5. Design of the tree to schedule the matches in the final stages of the tournament.

Once the teams are in the final stages, the System of Management of tournaments and competitions, will organize the teams in accordance with the first condition indicated in the decision tree program the matches in the preliminary stage for each group. As shown in Figure-6.

Figure-6. Design of the tree to schedule the matches of the final stages of the tournament.

The algorithm obtained with the decision tree "Register teams in the late stages of the tournament", allows sorting out the matches of the final stage in the stages of direct elimination (Quarterfinals, Semi finals and Final) in the following manner:

- If the number of matches to play is 15, the registration of matches is started, from the quarter-final stage. See Figure-7.

- If the number of matches is 7, the teams are inscribed in semifinal stage. See Figure-8.
- If the number of matches is 3, the teams are inscribed directly to the Final. See Figure-9.

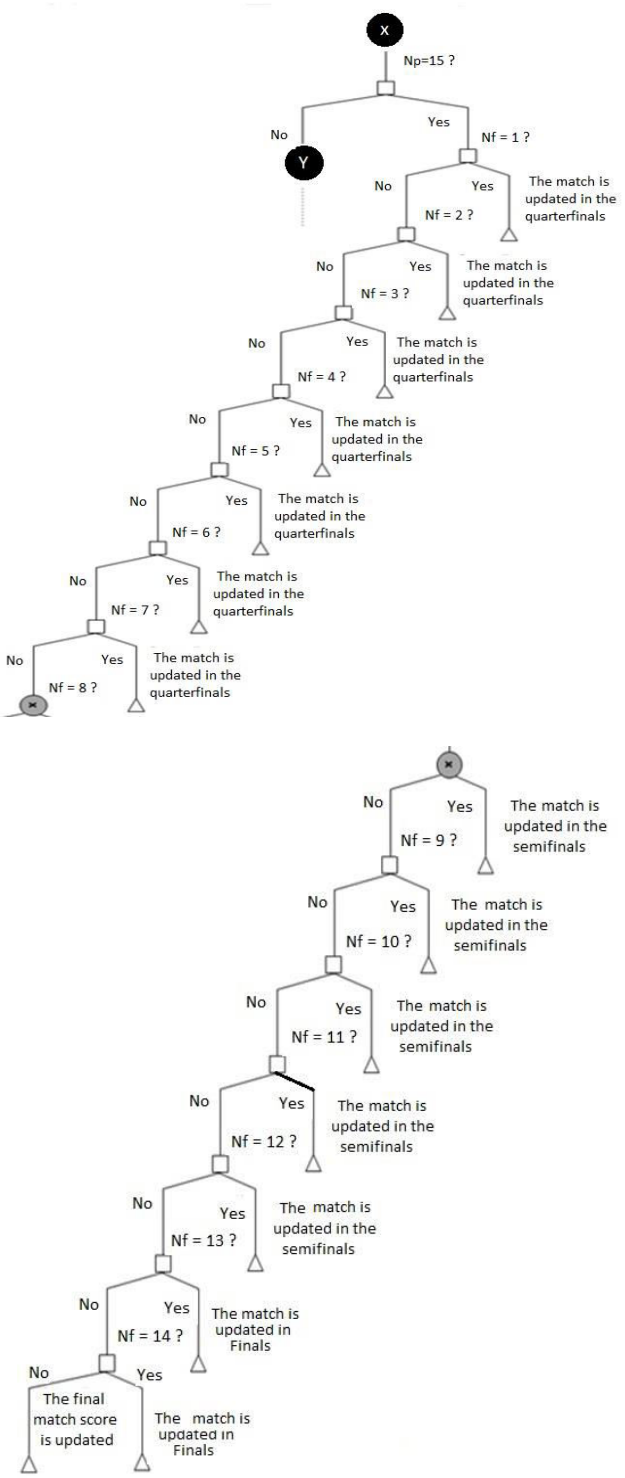

Figure-7. Design of the registration of matches from the quarter-final stage.

Where Np, is number of matches, and Nf, number of dates.

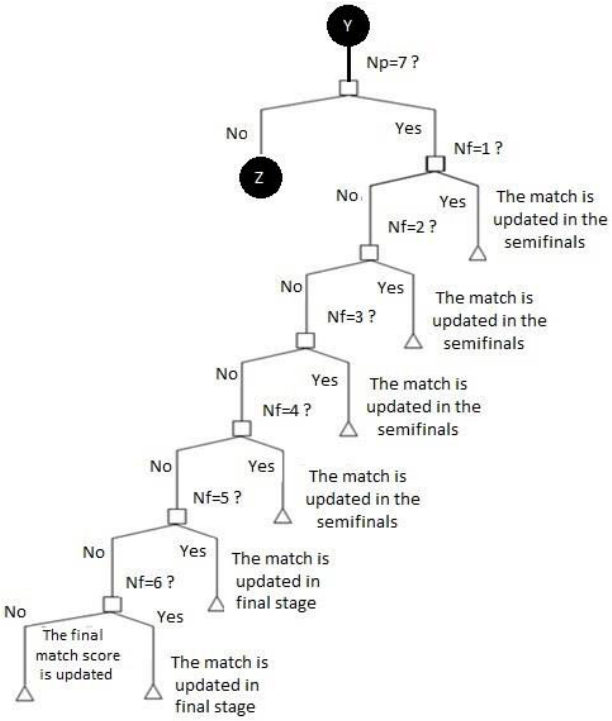

Figure-8. Design of the registration tree from semi final stage.

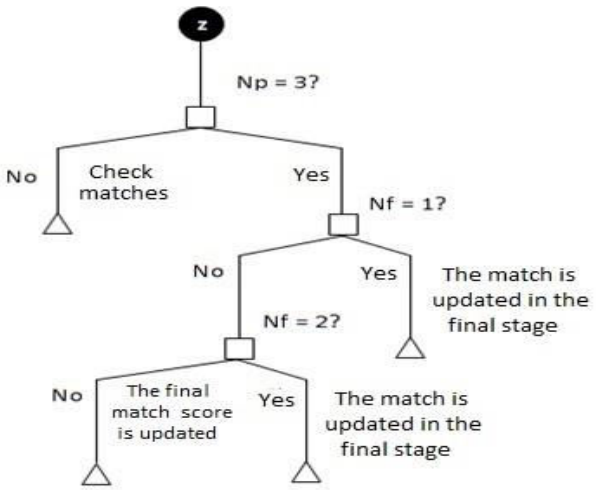

Figure-9. Design of the registration tree of matches to the final stage.

In the System of Management of tournaments and competitions, the user must enter in the final instance module, choose the option "Generate Matches - Final" to run the obtained algorithm with the tree register teams in the late stages of the tournament and their associated trees.

3. RESULTS

This online system for the administration of a soccer tournament was designed and programed to be used via web interface, support on the Transact-SQL language, with the use of the system of management of SQL Server

databases. From the design of decision trees presented, the algorithm was programmed, which allows programming of the matches of a soccer tournament.

The algorithm is segmented, in accordance with their specific processes, in stored procedures that are executable by an administrator in the System of Management of tournaments and competitions, ensuring the automation of processes related to the programming of matches and classification of teams in a sports tournament.

The navigation menu system is shown in Figure-10. To start, the user must choose the option "Generate matches - Playoffs" to schedule the first matches of the tournament. Once this stage is complete, the user will be able to perform the registration of teams in the final stages, by selecting the option "Generate Matches – Final".

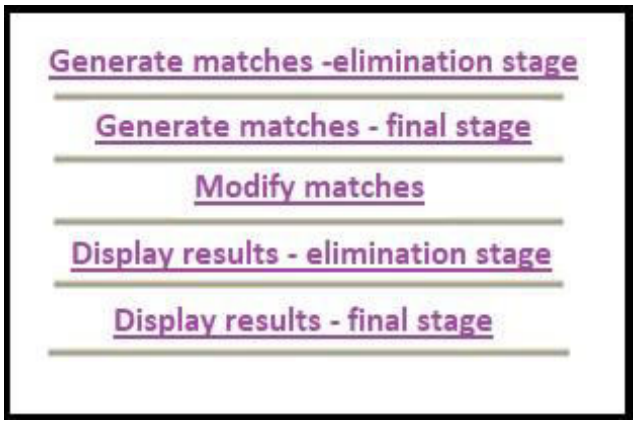

Figure-10. Menu of options for the administration of parties.

The results obtained once the matches of the tournament have been programmed and played, can be seen in the following options:

- View Results - stage Playoffs
- View results - final stage

In Figures-11and12, we can see tests performed to the GUI of the system of management of tournaments and competitions.

Local Team	GoalsL	Visitor Team	GoalsV
Team 9	1	Team 5	3
Team 5	2	Team 1	2
Team 1	3	Team 9	1
Team 10	1	Team 6	3
Team 6	2	Team 2	2

1 2 3

Figure-11. Score table of the matches scheduled at a preliminary stage.

Stage	Local Team	GoalsL	Visitor Team	GoalsV	State
Quarter	Team 1	1	Team 6	3	Finished
Quarter	Team 2	7	Team 5	2	Finished
Quarter	Team 3	4	Team 8	1	Finished
Quarter	Team 4	0	Team 7	3	Finished
Semifinal	Team 1	0	Team 2	2	In Progress

1 2

Figure-12. Score tables of the matches scheduled in the late stages.

The Table in Figure-12, it can be observed the teams which went to the final stages were the winning teams in each group in the preliminary stage. This was achieved with the implementation of the algorithm to register teams in the late stages of the tournament, as indicated in Figures 6 and 7.

This system can be implemented to manage any soccer tournament, the manual work will consist only in register the teams and record the scores for every match, and the system automatically organizes the matches of each one of the phases and will be showing the tables of positions.

4. CONCLUSIONS

The use of decision trees to processes of qualifiers or schedule of events is quite useful and satisfactory; it allows the analysis and discovery of the alternatives that may result in a decision-making process.

Identifies the need to evaluate the alternatives in detail considering the specific conditions that should direct the decisions of a process, in this way, it could guarantee optimal results in the implementation.

The implementation of the development obtained from the programming algorithms and its operation through the System of Management of tournaments and competitions, proved useful in the total automation of the programming of the soccer tournaments. It is hoped that this tool can be used in other institutions that include sports tournaments as part of the welfare policies for their employees.

The system is efficient in any sport that fits in the design rules of the tournament, independent of the context in which it is applied.

ACKNOWLEDGEMENTS

The authors would like to thank at Universidad de La Sabana for the support and provided facilities.

REFERENCES

[1] Breiman L, Friedman JH, Olshen RA, Stone CJ. Classification and Regression Trees, Wadsworth (New York); 1994.

[2] Santa J., Veloza J., Arias R. 2013. Application of automatic learning with decision trees to the study of the variables of the management indicators model of public universities. Scientia et Technica Año XVIII. 18(4): 725-731.

[3] Riascos J., Molina J. 2016. Brief considerations about the importance of decision trees in portfolio analysis. Revista de la Facultad de Ciencias Económicas y Administrativas, XVII (1): 11-33.

[4] Barrientos R., Cruz N., Acosta H., Rabatte I., Gogeascoechea M., Pavón P., Blásquez S. 2007. Decision trees as a tool in the medical diagnosis. Revista Médica de la Universidad Veracruz. 9(2): 19-24.

[5] Solarte G., Soto J. 2011. Decision trees in the diagnosis of cardiovascular diseases. Scientia et Technica Año XVI(49): 104-109.

[6] Segura A. 2012. Implementation of decision trees in public health. Revista CES Salud Pública. 3(1): 94-103.

[7] Landin M., Romero R. 2012. Decision trees for the diagnosis and treatment of patients with neovascular glaucoma. Revista Archivos médicosde Camagüey. 16(4): 514-527.

[8] Gama J., Rocha R., Medas P. 2003. Accurate decision trees for mining high-speed data streams. In Proceedings of the Ninth ACM SIGKDD International Conference on Knowledge Discovery and Data Mining. Washington, DC, USA.

[9] Perea M., Ladera V., Blanco A., Morales F. 1999. Diagnostic decision tree for the correct use of neuropsychological evaluation techniques in head trauma. Revista de Neurología. 28(10): 999-1006.

[10] Turney P. D. 1995. Cost-sensitive classification: Empirical evaluation of a hybrid genetic decision tree induction algorithm. Journal of Artificial Intelligence Research. 2: 369-409.

[11] Franco A., Carrasco J., Sánchez G., Martinez J. 2013. Decision Tree based Classifiers for Large Datasets. Computación y Sistemas. 17(1): 95-102.

[12] Cardona P. 2004. Application of decision trees in credit risk models. Revista Colombiana de Estadística. 27(2): 139-151.