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Fuzzy Logic in Student's Achievement

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Abstract: ***The productiveness of teaching students in universities is important to evaluate for declaring the results of their work. Their learning mainly depends on such factors as attendance, productiveness of learning, the material-technical base of the university and etc. Generally, when one interesting to assess the dependencies of these factors, an inventory of all elements is usually carried out, and management is advised to make a certain decision. But the influence of factors on student learning is not carried out. This paper aims to present an assessment of this student learning ability using system fuzzy logic. In this investigation discussed a procedure that can be used to assess students' performance and learning ability. This process is completely based on the principle of obtaining fuzzy sets about factors affecting learning: class attendance, learning efficiency and infrastructure instruction environment, which are objects of fuzzy arithmetic and allows one to get crisp values of performance results. In the paper is applied the fuzzy set method, which is used for further analysis with additional factors affecting student learning.***

Keywords: Fuzzy logic, Fuzzy Logic, Fuzzy Sets, learning, the Education, Fuzzy system, Fuzzy editor in MATLAB software.

I. INTRODUCTION

When it is required to conduct an assessment of student performance at a higher educational institution, we must consider the factors that influence their performance. As a rule, the factors affecting their achievement in terms of academic performance consist of attending classes by students, productive learning, such amenities as a student dormitory, laboratory equipment, teaching aids, including a whiteboard, whiteboard, computer and projector, and organizing their leisure and etc. One can qualitatively analyze and evaluate these factors as very low, High, excellent, etc. Even if quantitative indicators such as 50% of attendance, 80% of attendance are available, these indicators cannot be directly used to measure achievements using traditional methods. This article attempted to measure student achievement using a fuzzy logic system. A fuzzy logic system was used because the exact I / O relationship model is rarely available in this case.

This problem was simplified, and the analysis was done using only three input variables or factors. List these factors:

1. Class attendance by students(AC)
2. Productive learning (EL)
3. University infrastructure for students (UF)

In fig. 1 is shown a basic approach to the problem [1, 2]. The fuzzy logic system receives linguistic data, processes the information and displays the result. How to get these three factors, so that the leadership of the institution decides their use? First, input related to student attendance can be obtained by students attending classes. Productive training and the provision of training services can be obtained by conducting a survey or questioning of students.

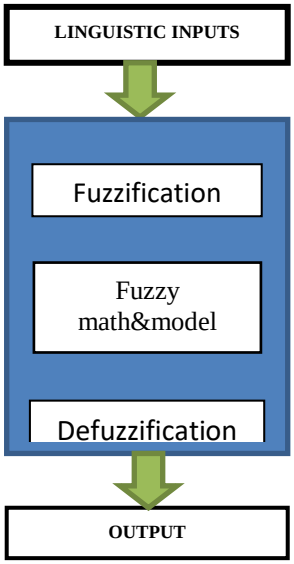

Figure 1. Basic Fuzzy block diagram

Fuzzy logic is applied for the problems in expert systems and real time systems that must use an imperfect environment with deeply variable, volatile or uncertainty conditions. A fuzzy set is a class of objects in which there is smooth boundary between objects [3]. In real situation, fuzzy systems applied set of linguistic rules, which are appropriately suited to describe behavior which is difficult to model mathematically [2]. The system a primarily designed to represent and provide some particular form of knowledge and is widely used in decision-making to cope with uncertainty. It means, that the thinking process is stated in terms of approximations. However, this approximate thinking is applied to precisely stated (numerical) inputs, and will produce precise numerical outputs. Fuzzy logic uses crisp values as inputs to a model and defuzzification procedure to obtain single scalar value. A fuzzy system contains three steps [1]

II. PROPOSED METHODOLOGY

Before considering the details of a fuzzy logic system,

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a system of possible values of input and output variables is determined. In the term of the theory of fuzzy sets, they are membership functions(MF), so input variable and membership functions, which are used to compare real measurement values with fuzzy values.

Figure 2 shows the labels of the input and output variables and their associated membership functions. Values of input variables are considered in percentage.

The fuzzy inference system is included the decision which are the follows from the rules that are stored in the database. They are stored as a set of rules. Essentially, rules are "if then" statements that are intuitive and easy because they are nothing more than ordinary English expressions. "If" refers to the antecedent, which is compared with the input data, and "Then" refers to the consequence, which is the result or output [1]. All rules that have any truth in their predecessor will work and contribute to a set of fuzzy conclusions. The rules used in this article are based on the author's experience and discussion with his colleagues.

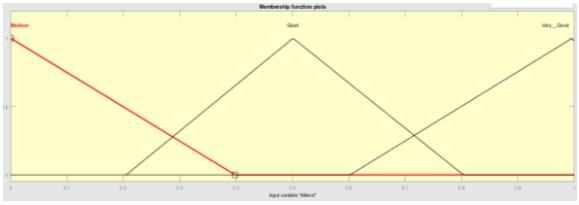

Figure 2. Fuzzy MF –AC

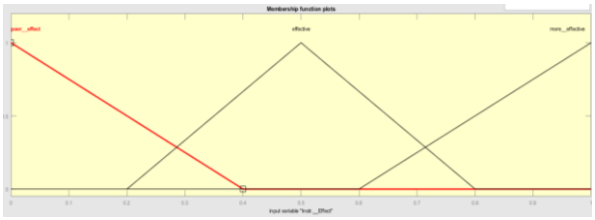

Figure 3. Fuzzy MF –EL

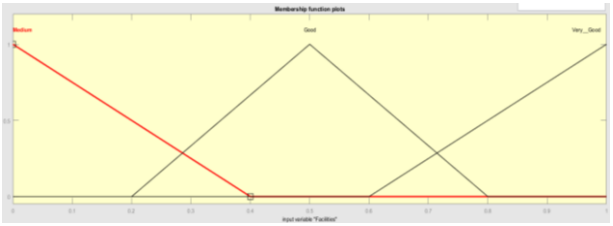

Figure 4 Fuzzy MF – Ufs

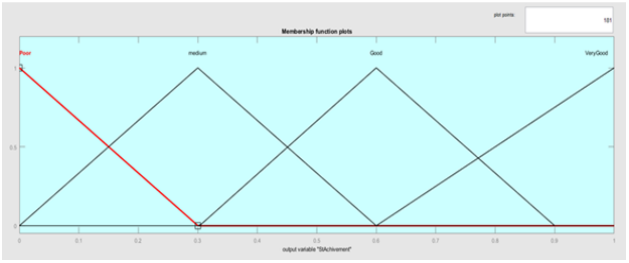

Figure 5. Fuzzy MF – Students Achievement

The following are the procedures for this study:

1. If AC is *Moderate*, EL is *Non Productive* and Instruction environment is *Moderate* then AS is Low.
2. If AC is *Properly*, EL is *Non Productive* and Instruction environment is *Moderate* then AS is *Moderate*.
3. If AC is *High*, EL is *Non Productive* and Instruction environment is *Moderate* then AS is *Moderate*.
4. If AC is *Moderate*, EL is *Productive* and Instruction environment is *Moderate* then AS is *Low*.
5. If AC is *Properly*, EL is *Productive* and Instruction environment is *Moderate* then AS is *Moderate*.
6. If AC is *High*, EL is *Productive* and Instruction environment is *Moderate* then AS is *Properly*.
7. If AC is *Moderate*, EL is Highly *Productive* and Instruction environment is *Moderate* then AS is *Low*.
8. If AC is *Properly*, EL is *Highly Productive* and Instruction environment is *Moderate* then AS is *Moderate*.
9. If AC is *High*, EL is *Highly Productive* and Instruction environment is *Moderate* then AS is *Properly*.
10. If AC is *Moderate*, EL is *Non Productive* and Instruction environment is *Properly* then AS is *Low*.
11. If AC is *Properly*, EL is *Non Productive* and Instruction environment is *Properly* then AS is *Low*.
12. If AC is *High*, EL is Non Productive and Instruction environment is *Properly* then AS is *Moderate*.
13. If AC is *Moderate*, EL is *Productive* and Instruction environment is *Properly* then AS is *Moderate*.
14. If AC is *Properly*, EL *Productive* and Instruction environment is *Properly* then AS is *Properly*.
15. If AC is *High*, EL is *Productive* and Instruction environment is *Properly* then AS is *Properly*.
16. If AC is *Moderate*, EL is *Highly Productive* and Instruction environment is *Properly* then AS is *Moderate*.
17. If AC is *Properly*, EL is *Highly Productive* and Instruction environment is *Properly* then AS is *Properly*.
18. If AC is *High*, EL is *Highly Productive* and Instruction environment is *Properly* then AS is *High*.
19. If AC is *Moderate*, EL is *Non Productive* and Instruction environment is *High* then AS is *Low*.
20. If AC is *Properly*, EL is *Non Productive* and Instruction environment is *High* then AS is *Moderate*
21. If AC is *High*, EL is *Non Productive* and Instruction environment is *High* then AS is *Moderate*.
22. If AC is *Moderate*, EL is *Productive* and Instruction environment is *High* then AS is *Properly*
23. If AC is *Properly*, EL is *Productive* and Instruction environment is *High* then AS is *Properly*.
24. If AC is *High*, EL is *Productive* and Instruction environment is *High* then AS is *High*.
25. If AC is *Moderate*, EL is *Highly Productive* and Instruction environment is *High* then AS is *Moderate*.
26. If AC is *Properly*, EL is *Highly Productive* and Instruction environment is *High* then AS is *Properly*.
27. If AC is *High*, EL is *Highly Productive* and Instruction environment is *High* then AS is *High*.

The structure of the rules in MATLAB is shown in Fig.3

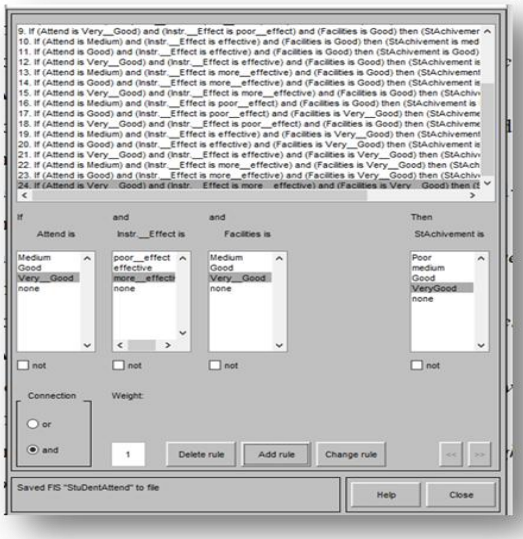

Figure 3. The rules framed on fuzzy inference system in MATLAB

Three input parameters are investigated in accordance with the triangular membership function of the corresponding variables. Triangular membership functions were also considered by many other authors, for example, the authors in [5] used them to analyze the fuzzy reliability of an electronic device. Here, the provisions of the general method were investigated to simplify the methodology for the analysis of failures and actions based on fuzzy logic (FMEA). The authors of the source [6] applied a method of reducing the number of rules that FMEA users should provide for the process of modeling the number of fuzzy risks (RPN), and also used Gaussian membership functions. Thus, the researchers examined together the triangular and trapezoidal fuzzy membership functions, this combination allows analysts / practitioners / engineers on the reliability of the system to analyze sequentially the behavior of the system in case of failures and accordingly plan the appropriate maintenance actions [7].

In addition to the curve of the membership function, fuzzy input variables are used to achieve a solution in the fuzzy output system. The fuzzy yield procedure is based on the compositional derivation approach proposed by Zadeh [1]. Using this procedure, the output fuzzy set is obtained from the rules and input variables. The exit methods "max-min" and "max-prod" are often used and are the most common types of exit systems. In this article, the author uses the Mamdani method of maximum inference, since the Mamdani method is usually used in modeling human expert knowledge. The min operator is used to connect the rule and the implicit function, and the max operator is used to aggregate fuzzy sets.

Finally, the clear meaning of Student Achievement is received as an answer. This is done by a fuzzy way out. There are many different methods of defuzzification in various literary sources, but the most commonly used methods are “centroid” and “maximum”. The criteria used to select the appropriate defuzzification method are ambiguity (a unique result), probability (approximately in the middle of the field) and ease of calculation. The centroid study uses the defuzzification method defined by

$$Dv = \frac{\int_x \mu_A(x) x dx}{\int_x \mu_A(x) dx}$$

where *A*- the output fuzzy set and $\mu_A(\cdot)$ is the membership function.

Figure 4. Fuzzy system output for ‘Student achievement’

III. RESULTS ANASYSIS

The above described input values and the model at the inputs are fuzzy fields that use simple if-else conditions. Then, using another system of fuzzy sets, a fuzzy output function is obtained, and using the criteria, an output value is obtained to achieve the students. Figure 4 shows one fuzzy output clipping for three different values of input variables using fuzzy if-then conditions. In Fig. Figure 5 shows a graph of the control surface of two inputs and outputs, as determined by the fuzzy output system. The result, as in the above graph, shows a way to achieve students in different conditions for entering variables. For ease of explanation, the fuzzy output for several different input values is presented in Table 1.

Table 1. Students Achievement for Different Input Values

No	Student Attendance (%)	Productive Instruction (%)	Instruction environment (%)	Achievement of Students (%)
1	40	60	50	60.00
2	80	60	70	64.54
3	80	90	70	84.70
4	30	90	40	47.20
5	90	90	30	72.76

IV. CONCLUSION

In this paper is made first attempt to model the processes of student evaluation as an intelligent system. The model was developed with assumptions drawn by the author and his colleagues. By the application of fuzzy inference system, one can obtain result for the achievement of students in varies input values of “Class Attendance”, “Productive Learning” and “University Instruction environment”. The conventional method may assume a probabilistic model to arrive at the achievement of students.

Though the analysis in this paper has been very crude, but this clearly depicts the advantage of using the fuzzy logic approach for the kind of problem considered.

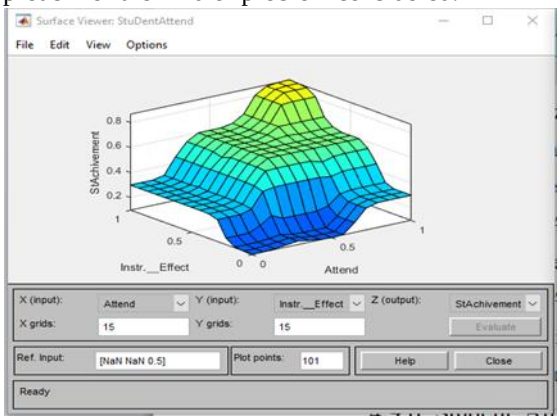

Figure 5. Control surface plot between Instruction Productive and Instruction environment with Students Achievement

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