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BEST STUDENT AWARD – A FUZZY EVALUATION APPROACH

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ABSTRACT

Today's technology development has widened the application areas of fuzzy logic. Fuzzy Logic is finding its way in the Management sectors for Decision Making and Evaluation. Evaluation in education is mandatory process. Various institutes honor a student by *Best Student Award* depending on his/her all round performance. Many Institutes rely on the feedback provided by the Teachers which may depend upon imprecise, incomplete and uncertain information. This paper focuses on the fuzzy based approach to circumvent the performance evaluation of the student based purely upon the numeric grading without entailing the human judgmental component. Comparison of results with existing traditional method has shown the potential applicability of Fuzzy Logic in the student performance evaluation.

Keywords: Fuzzy logic, performance evaluation, decision making, educational institute.

1. INTRODUCTION

Evaluation of student on the basis of performance motivates the student and gives justice to his qualities. Many Colleges, institutes collect feedback from stakeholders about their institute, staff, student's progress, activities conducted etc. The performance of the student can be evaluated by statistical analysis of such feedback. This feedback may be in terms of grade or percentage and the results may not be always correct. The reason behind is that it is difficult to interpolate actual quality in between grades. Also in some cases quality is defined in linguistic words such as *poor, average, good, best* etc which are associated with imprecision and vagueness. Here an attempt has been made to explore the modeling abilities for imprecision, vagueness and uncertainty that are inevitable in the performance evaluation process.

Abdur Rashid Khan [1] has reported application of Expert System with Fuzzy Logic in Teacher's Performance Evaluation. *Cetin Semerci* [2] has demonstrated the influence of fuzzy logic theory on student's achievement. *G.Gokmen* [3] has put some light on Evaluation of Student Performance Using Fuzzy Logic. The aim of this paper is to propose a Fuzzy Approach for finding the Best Student based on feedback given by Teachers. In many occasion small performance difference between two students leads to little bewildering for decision making. The human has a tendency practice a biased decision depending upon some other criteria's which may lead to partiality. With the use of fuzzy logic the decision making remains transparent. In this paper we have prepared a feedback form for student. The feedback for every student on the basis of certain criteria has been collected from the Teachers. The collection of feedback data can be.

(i) Single feedback for every student from single Teacher.

(ii) Single feedback for every student from multiple Teachers.

(iii) Multiple feedback for every student from single Teacher.

(iv) Multiple feedback for every student from multiple Teachers.

Although the (iv) seems to be most promising way to collect the evaluation data, the present approach has been confined to (i) where the opinion about every student has been collected from a single Teacher. The good choice for this purpose could be a *Class Teacher.*

It is expected that the reasoning based on fuzzy models will provide an alternative way of handling various kinds of imprecise data, which often reflects the way people think and make judgments. It is also dilutes the possibility of partiality.

The objectives of the proposed study were to:

1. Survey the traditional methods and fuzzy modeling.
2. Develop a FIS (Fuzzy Inference System) for such an application which allows inference to be performed in a more natural way using linguistic variables rather than numerical values.
3. Implementation of system and comparison with traditional system.

2. FUZZY LOGIC THEORY

"Fuzzy" means "not clear". Fuzzy Logic (FL) [4] is a multi-valued logic that allows intermediate values to be defined between conventional evaluations like true/false, yes/no, high/low etc. Thus, we can describe fuzzy logic is a form of knowledge representation [5] opposite for notions that cannot be defined precisely, but which depend upon their contexts. It works with uncertainty. An environment around man is full of uncertainties. Since long ago people are trying to model and handle uncertainty in several ways in order to understand the capability of human to reach the conclusions under high degree of uncertainty and vagueness. The central concept of the Fuzzy Logic is the fuzzy sets. In real time situation number of times the boundaries of demarcation are not sharp enough leading to multiple outcome dependent upon context, person and ambient conditions. Boolean logic allows statements to be only 100% "TRUE" or "FALSE", in contrast the Fuzzy logic allows statements to be partially "TRUE" and partially "FALSE" at the same time. This peculiar nature of fuzzy logic [6] has underlying strength that has made a powerful tool for problems solving in broad range of applications with evaluation being not an exception.

One of the basic limitations of classic logic is that it is restricted to two values, true or false, however it is easy to model the two-value logic system that leads to precise deduction. Number of the two-valued subjects in the real world is few that discourage the approach of conventional logic. The real world is an analogical in nature and not a discrete. Fuzzy logic though appears superficially to be an extension of a multi-value logic; its goal and application are different from multi-value logic. Fuzzy logic is an approximate reasoning logic [7] not a precise multi-value logic. In general, approximation or fuzzy reasoning is the deduction of a precise conclusion emerging out of possible and imprecise initial sets.

3. MOTIVATION FOR THIS PAPER

A feedback form to be filled by Teacher contains in all 10 criteria and also overall grade of a student. Traditional method may be subjected to chance of bias while assigning the grade points for the students which significantly influences the overall grade. Computation of statistical average of points assigned for every criterion in the feedback form may fail to offer contextual amount of justice to all criteria. For example among 10 criteria - the *punctuality* may not receive good attention as compared to *success* in the examinations. So in this case a fuzzy approach with fuzzy rule base will yield justifiable results.

4. METHODOLOGY

Briony Oates has defined the 6P's of a research [8] which includes *Purpose, Process, Paradigm, Participant, Product, and Presentation.* The paper makes use of some of 6P's. Purpose of the research is to propose a Fuzzy Approach in the evaluation process of Best Student Award. The product will be a system which will help evaluate the Best Student by giving grade from 1 to 10. Participants of the research are the Students, Teachers. Process used for the evaluation fuzzy reasoning driven by questionnaire included in the feedback form. To achieve the goal of evaluation the feedback from Teachers is a vital factor. We have collected data for 50 students and analyzed to evaluate performance of a student. It is interesting to point out that the aim of the proposed method is not to replace the present traditional method of evaluation; instead strengthen the present system by providing additional and supportive information to be used in the decision making process. Such collected information about a student is input to the Fuzzy Inference Scheme.

5. STRUCTURE OF A FUZZY INFERENCE SYSTEM

In general, a fuzzy inference system consists of four modules as shown in Figure 1.

- ***Fuzzification module*** transforms the system inputs, which are crisp numbers into fuzzy sets. This is done by constructing the membership functions.
- ***Knowledge base*** stores IF-THEN rules provided by experts.
- ***Inference engine*** simulates the human reasoning process by making fuzzy inference on the inputs and IF-THEN rules.
- ***Defuzzification module*** transforms the fuzzy set generated by the inference engine into a crisp value.

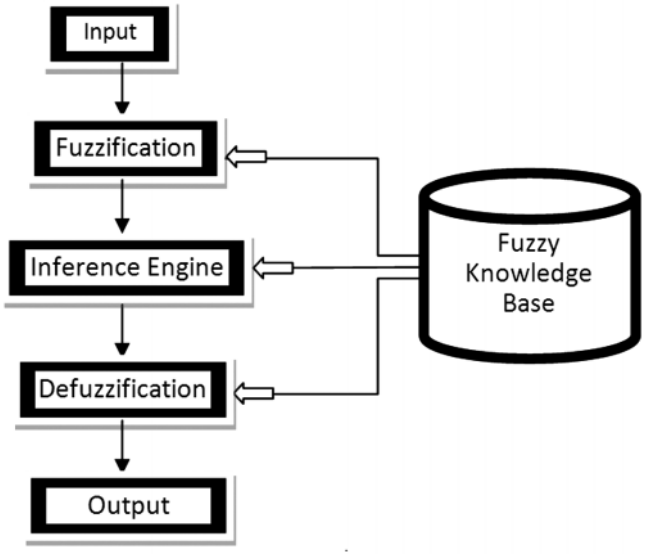

Figure 1: Fuzzy Inference Scheme Diagram.

5.1. Reasons for using FIS

- Fuzzy logic does not solve new problems. It uses new methods to solve everyday problems.
- Mathematical concepts within fuzzy reasoning are very simple.

- Fuzzy logic is flexible. It is easy to modify a FIS just by adding or deleting rules. There is no need to create a new FIS from scratch.
- Fuzzy logic allows processing of imprecise data.
- Fuzzy logic is built on top of the knowledge of experts: it relies on the *know-how* of the ones who has understood the system.

5.2. Working of FIS

For the evaluation of student performance criteria taken into consideration were as follows:

- Punctuality
- Sincerity
- Hardworking
- Attentive during the class room teaching and in laboratory work.
- Depth of Knowledge
- Communication Skills
- Interactive abilities
- Social networking
- Leadership
- Technical Knowledge

For each criterion the Teacher was permitted to give feedback in the form of ranking from 1 to 10 numeric values.

Fuzzy inference methods are classified as Direct methods and Indirect methods. Direct methods viz. Mamdani's and Sugeno's, are the most commonly used which differ in the way of inferring the outputs). Indirect methods are more complex. In this paper Mamdani's method for Fuzzy Inference has been employed. The method proposed by Mamdani logically works according to equation (1).

$$\mu_c(y) = \max_k [\min [\mu_A(\text{input } (i), \mu_B (\text{input } (j))]], \quad k = 1, 2, 3, 4,...r \qquad (1)$$

This equation (1) determines an output membership function value for each active rule. When one rule is active, an AND operation is applied between inputs. The smaller input value is chosen and its membership value is determined as membership value of the output for that rule. This method is repeated, so that output membership functions are determined for all the rules. For aggregation of all the rules for consequent output OR operation is adopted. To sum up, AND (min) operation are applied between inputs and OR (max) operations are between output.

In FIS Bell shaped membership function is used for all criteria for converting the crisp set into fuzzy set. For Defuzzification, Centroid Method is used. Out of 10 criteria included in the feedback form only three have been considered for the demonstration purpose in the present paper which are as follows:

- Hardworking
- Knowledge Depth
- Technical Knowledge

The range assigned for these three variables are 1 to 10. The output variable called Grade of a student is determined by fuzzy logic. The final grade of a student is divided as *Average, Good* and *Best* as given in Table 1.

Table 1
Fuzzy Set for Output Variable

Average Student	1 to 4
Good Student	5 to 7
Best Student	8 to 10

The distinct fuzzy rules for this FIS are shown in Table 2. For remaining combinations of these criteria the grade of the student will be Average.

Table 2
Fuzzy Rule Base

Sr. No.	*Criteria considered*			*Grade*
	Hard working	*Depth of Knowledge*	*Technical Knowledge*	
1	Good	Good	Excellent	Best
2	Good	Good	Good	Best
3	Very Good	Good	Excellent	Best
4	Very Good	Good	Good	Best
5	Average	Good	Excellent	Best
6	Good	Average	Excellent	Best
7	Very Good	Average	Excellent	Best
8	Average	Good	Good	Good
9	Good	Average	Good	Good
10	Poor	Average	Good	Good

The example is given below illustrates the working of this FIS.

Example: If a student is given rank for *Hardworking* as 7, rank for *Depth of Knowledge* as 8 and rank for *Technical Knowledge* as 8 then final grade of the student inferred to be 7.97 as shown in Figure 2. It means according to FIS he is a *Best Student*. The traditional method has given overall performance-grade as 8 for the same student.

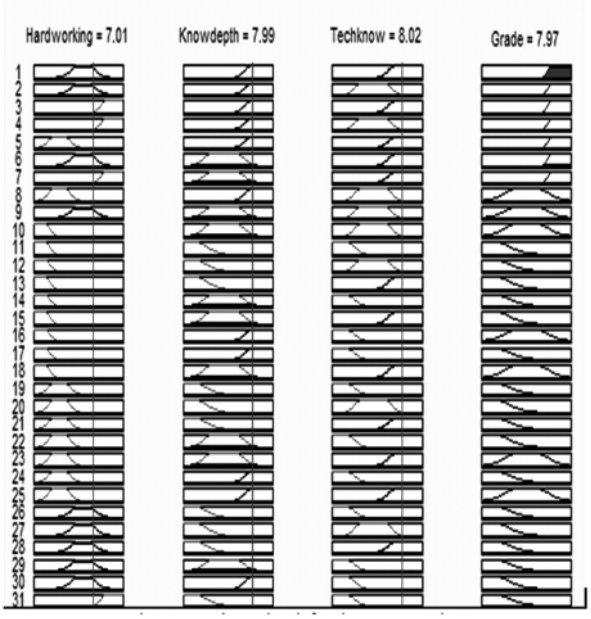

Figure 2: Rules Fired for Input 7 and 8.

6. RESULTS AND DISCUSSION

In this research paper, proposed Fuzzy approach for best student evaluation has been implemented in MATLAB. We have used Fuzzy Tool for compiling the FIS. The proposed System has been tested with 50 students. For each student ranks of all criteria were fuzzified by means of the bell shaped membership functions. Active membership functions were calculated according to rule table using the Mamdani's Fuzzy Inference Techniques.

The output (Final Grade) was calculated and then defuzzified by calculating the center (Centriod) of the resulting geometrical shape.

Table 3
Comparison of Different Approach

	Traditional Approach	*Using Average Method*	*Fuzzy Approach*
Average	–	6.67%	6.67%
Good	66.67%	53.33%	53.34%
Best	33.34%	40%	40%

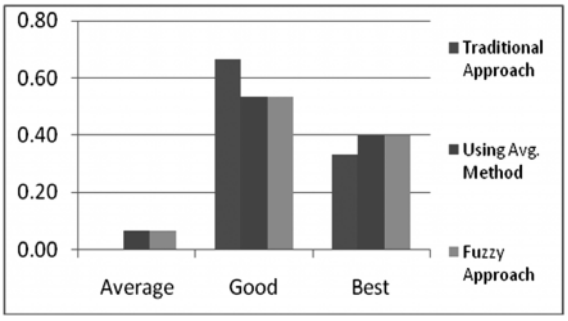

Figure 3: Comparison of Different Approach

With a Fuzzy approach has given fairly accurate result for finding *Best Student* (Performance Evaluation of student) than traditional approach. Table 3 and Figure 3 shows that results using Fuzzy approach matches with Statistical Average Method, whereas in comparison with Traditional Approach, the Fuzzy Approach shows considerable difference in the results. It means in case of Traditional Approach where the overall final grade is taken from Teacher, there some hidden bias or other factors might have contributed in selection of best student.

7. CONCLUSION

According to the Fuzzy Logic Theory, everything is a matter of degree. The fuzzy sets can be applied in Educational day-to-day functioning. A meaningful difference was found in favor of the fuzzy logic theory when traditional method was compared with the approach using fuzzy logic theory. The traditional approach neglects the human tendency of qualitative nature employed in grading student's qualities. Fuzzy logic aims to model inexact nature of human decision-making based on imprecise data. This is demonstrated in this paper. The evaluation with Fuzzy Logic has great flexibility and reliability. In conclusion, the student performance evaluation using Fuzzy Logic is not only theoretically proved but can be an integral part of decision making and evaluation process in Educational Institutes.

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