

## Evergreen science programme: A fuzzy evaluation approach

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### Abstract

Fuzzy logic is finding its way in Educational and Management sectors for Evaluation and Decision making. Evaluation in education is mandatory process. The aim of this paper is to propose a Fuzzy Approach for finding the best Programme based on feedback given by Students.

**Keywords:** fuzzy logic, decision making, centroid method educational institute

### 1. Introduction

The concept of fuzzy logic was conceived by Lofti Zadeh, a Professor at the University California at Berkley, and presented not as a control methodology, but as a way of processing data by allowing partial set membership rather than crisp set membership or non-membership. This approach to set theory was not applied to control systems until the 70's due to insufficient small-computer capability prior to that time. Professor Zadeh reasoned that people do not required precise, numerical information input, and yet they are capable of highly adaptive control. If feedback controllers could be programmed to accept noisy, imprecise input, they would be much more effective and perhaps easier to implement.

Evaluation of Programme on the basis of performance motivates the students and gives justice to their qualities. Many Colleges, institutes collect feedback from stakeholders about their institute, staff, student's progress, activities conducted etc. The performance of the programme 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.

R. Poornima [6] has reported application of fuzzy logic in choice based credit system. Here an attempt has been made to explore the modeling abilities for imprecision, vagueness and uncertainty that are inevitable in the performance evaluation process. In many occasion small performance difference between two programmes 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 programme.

The Feedback for every programme on the basis of certain criteria has been collected from the students.

The collection of Feedback data can be

- i) Single feedback for every programme from single student.
- ii) Single feedback for every programme from multiple Students.

iii) Multiple feedback for every programme from single Student.

iv) Multiple feedback for every programme from multiple Students.

Although the (iv) seems to be most promising way to collect the evaluation data, the present approach has been confined to (ii) where the opinion about every programme has been collected from a multiple. 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 are 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 variable rather than numerical values.
- 3) Implementation of system and comparison with traditional system.

### 2. Fuzzy Sets: Basic Types

**Fuzzy sets** — Sets with vague boundaries  
 — Membership of  $x$  in  $A$  is a matter of degree to which  $x$  is in  $A$

#### Utilization of fuzzy sets

- 1) Representation of uncertainty
- 2) Representation of conceptual entities

**Example:** expensive, close, greater, sunny, tall

○ **Fuzzy Sets**  $\Leftrightarrow$   $\tilde{U}$  **Crisp Sets**

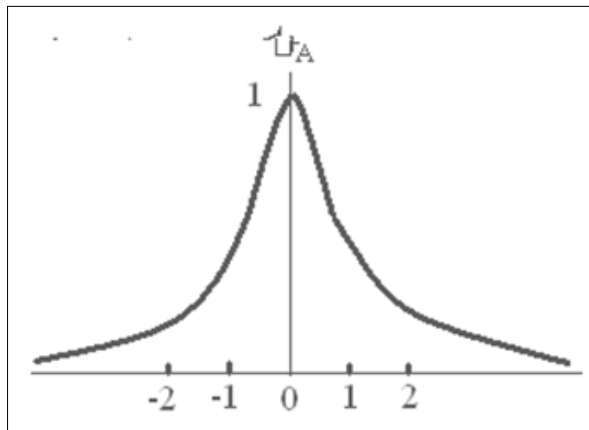
Membership Function  $\Leftrightarrow$  characteristic Function  
 $\mu_A : X \rightarrow [0,1] \Leftrightarrow m_A : X \rightarrow \{0,1\}$

e.g.,

i) "close to 0" :  $\mu_A(x) = \frac{1}{1+10x^2}$

ii) "very close to 0" :  $\mu_A(x) = \left(\frac{1}{1+10x^2}\right)^2$

iii) "close to a" : 
$$\mu_A(x) = \frac{1}{1+10(x-a)^2}$$



### 3. 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.

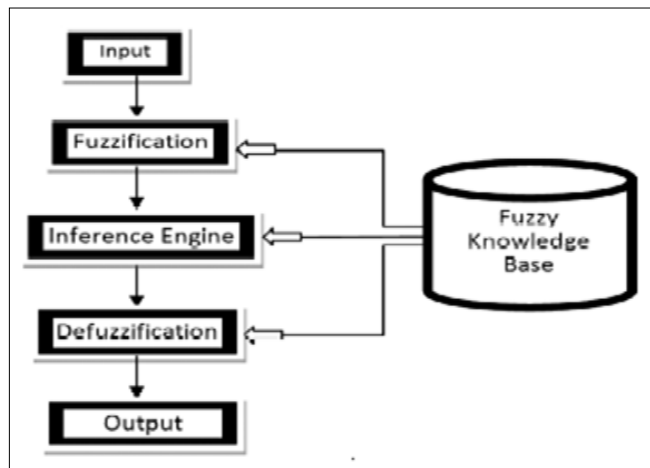


Fig 1: Fuzzy inference Scheme Diagram

### 3.1 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 have understood the system.

### Fuzzy inference methods are classified as

- Direct methods
- 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).

### 3.2 Working Principle

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

1. Potential for joint courses
2. Graduate prospects
3. Transferable skills
4. Job options
5. Salary advantages
6. Research and teaching/tutoring opportunities
7. Summer internship opportunities
8. Develop problem solving skills
9. Increase capacity of think analytically
10. Innovation

### 3.3 Defuzzification

$$\mu_c(\gamma) = \min_k [\max [\mu_x(\text{input}(p)), \mu_y(\text{input}(q)), \mu_z(\text{input}(r))]]$$

$$k=1,2,3,\dots,r \tag{1}$$

The 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:

- Transferable skills
- Job options
- Increase capacity of think analytically

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

Table 1: Fuzzy set for output variable

Average	2 to 4
Good	5 to 7
Very good	8 to 10

Physics

Student	Transferable skills	Job options	Increase capacity of think analytically
1	4	6	5
2	5	6	5
3	6	7	4
4	7	6	5
5	6	7	4
6	4	6	3
7	7	7	5
8	5	6	3
9	4	5	4
10	6	5	4

Min (max (7, 7, 6)), Grade= Good

Mathematics

Student	Transferable skills	Job options	Increase capacity of think analytically
1	5	6	7
2	3	4	6
3	5	7	8
4	8	9	7
5	5	6	6
6	4	4	5
7	6	7	8
8	7	6	5
9	9	7	8
10	6	8	8

Min (max (9, 9, 8)) Grade= Best

Chemistry

Student	Transferable skills	Job options	Increase capacity of think analytically
1	4	3	3
2	4	4	4
3	3	4	3
4	4	3	5
5	4	4	6
6	3	2	3
7	4	4	4
8	3	4	3
9	3	3	2
10	4	4	4

Min (max (4, 4, 6)), Grade= average

Table 2: Fuzzy rule base

PGM	Criteria considered			grade
	Transferable skills	Job options	Increase capacity of think analytically	
Physics	Good	good	Good	Good
Maths	V.Good	V.Good	Good	Best
Che	Average	Average	Good	Average

4. Results and Discussion

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	-	23.334%	20%
Good	66.67%	35%	40%
Best	33.34%	41.667%	40%

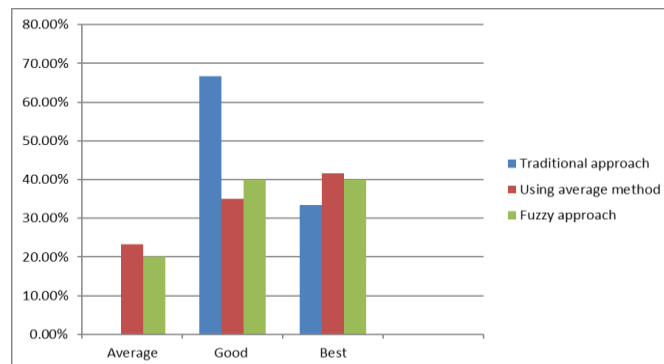


Fig 2: Comparison of Different Approach

With a Fuzzy approach has given fairly accurate result for finding Best programme (Performance Evaluation of programme) than traditional approach. Table 3 and Figure 2 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 students, there some hidden biasor other factors might have contributed in selection of best programme.

5. 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 programme 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.

6. References

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