

# A Fuzzy Logic Decision Making Of Student Performance Using Minimization of Weighted Regret Method

J. Betty jane, E.N. Ganesh



**Abstract:** *The method of reasoning which is similar to that of human reasoning is known as fuzzy logic. In this competitive world, in the field of education, more data has been generated and kept as records for the evaluation of student's performance. With these large databases of records of the student, the experts would feel difficult to make a decision, since they cannot judge or decide a student understanding just by the paper test because some students could not write well but they are good in solving problems practically. So, there are some uncertainties that are found in evaluating a student's performance. Here in this paper, we have proposed a model for making a decision from the uncertain data to find in which part of this academic skills the students is low, whether in practical or written or in workshop. Hence to make a decision we need to evaluate the students separately for their practical competence, written test and other academic skills. Then with the help of the expert opinion we will be able to decide in which part the students are low in competence. We have proposed a fuzzy decision making approach called Minimization of regret method(MMR) with the Weighted Average (OWA) operator known as MWR approach for making a decision to find in which part of the attribute the students score low marks and give them training and improve their ability in that particular area of skills such as practical or written or in workshop.*

**Keywords:** *fuzzy logic method, fuzzification., fuzzy sets, OWA operator.*

## I. INTRODUCTION

Education institutions are working in an highly competitive and increasingly complex environment.an increase in pressure is growing in certain disciplines of economic,global,areas to increase the quality of learning of students both global and national.[1].In the education field time management is crucial for students.so the life of the student can be categorized in to education,social,extracurricular activities for developing a personal record of a student expectation of students are to be good in academic, physical fitness and active socially and establishing their interest in their respective fields. This interest will help the students in giving them a balanced life but also involve in all activities [2]. If an assessor has been asked to evaluate on the competence status of a candidate, based on a performance of evidence it is difficult to analyse whether he/she has performance up to the mark.

Revised Manuscript Received on October 30, 2019.

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The assessor's tendency would naturally think of possibilities of a range, candidate's competence could be located.By using the fuzzy logic, we can identify the range of probabilities and the candidate's overall competence.[3]. It is a challenging task for the students to be competitor with the students, from the internationally developed countries. Hence, the quality education is developed as a needed one of the education systems in country. To improve the quality education in India the learners and faculty capability needed to be improved. If the knowledge of the faculty and students is found, it will be helpful to understand the weakness and develop their knowledge. A debate has been there over the teaching talents and skills of teaching for the development of the system of education. It is effective for the faculty and learning students to know how broad to enhance the teaching techniques. Educators and the academicians are builders of the nation. Their work is to bring out the students excel in the subjects they choose and a educated human being [4]. In this article for calculating learner's knowledge and talents we develop a fuzzy model. The characteristics of students in this model kept in evaluation (ability in the theory subjects, practical solving and reasoning logical abilities skills) are denoted as a set of linguistic terms called fuzzy subset deciding their ability, and the student labels priorities are calculated. A thorough qualitative study is done by obtaining the students' performance evaluation. Here they use centroid defuzzification method and total uncertainty of total probability are used in transforming the fuzzy output to a crisp number output. The center of gravity in the centroid method, of the coordinates of the graph of the function of membership involved gives a ability of the learners' performance. This paper gives the assessing techniques of the individual student and the examples are also presented with results.[5]

## II.RELATED WORK:

The education quality has become a concern among education researchers since they trust on the expectations and the essential needs of people in order to shine themselves in their academic quality, faculty and student relationship. In spite of being clearly identified as a difficult task to identify which part has a greater impact for determining the educative quality [6]. Fuzzy logic is a human reasoning approach which is implemented by the devices of computer, and hence they exactly imitate the intelligence of humans. Fuzzy logic helps us to understand unknown or unclear concepts through computer devices. Fuzzy logic is also known for defining as uncertain logic. It mainly helps in decision making and gives the attempts for well-planned decisions.

Fuzzy logic helps in finalizing the conclusion and helps as a tool for consulting by experts. In the education field, the fuzzy logic application is used for decision making as well as learning. Some experiments should be done to evaluate the students' performance for giving them an education with quality. [7]. In order to apply the search algorithm, we determine the educational path. We need to select the data of students such as their marks submitted to the committee of selection, based on the entrance marks, subsidies from government, data of tuition fees, income expected in the two-year of time span continued by the university graduation. According to the survey, the student's graduation fees is three years lesser years. The optimal paths will be connected with the choices of the applicant.[8]. Since 1960's applications on educations are developed using computer technology. the classification was described as computer -assisted instruction where the programmed instruction is centered on the educational methods as the expert form. to enhance the understanding of the students the student must understand the subject and then answer the questions according to their understanding. The educational psychologists' perspectives have tended to another psychology known as cognitive psychology. Based on the own initiative and with the real features the persons can build their ability. This procedure is similar to that of CAI development system. The intelligence of CAI systems and the cognitive science research has been improved with the vast improvement of Artificial Intelligence (AI) techniques. They are said to be as Intelligent Tutoring Systems. To improve the learning environments with computers is the motivation of artificial intelligence technique. Artificial intelligence is designed for students to have essential knowledge and are beneficial.[9].

### III. PROBLEM STATEMENT

All the educational institutions are facing the challenge of analyzing the student performance and ranking. The challenges will be mainly based on the placements, academic excellence and admission. The data are mainly generated more when ranking a student's performance based on their academic excellence. The university ranking is built on academic ranking of the student. In the research work a fuzzy logic implementation is used to find the student performance and grouping the students in different sections to improve their skills to compete consistently in this world.[10]. students' achievements evaluation in subjects is a great challenge. Adding these scores does not give accurate details about which student is good and which one is lacking the performance. Fuzzy logic will help in a good way to solve this problem. In this paper, students' achievements are calculated based on fuzzy logic algorithm. First, fuzzification of all input values will be done Then scores and ranking can be computed. After that, a rule-based inference engine is applied and with that execution a fuzzy output set is given. After defuzzification, the result shows accurate students evaluation, which will benefit the future education.[11]. Early prediction of grade or ranking is done in institutions to know the students performance in the

tool for consulting by experts. subjects and provide special attention to the students who have less grades at the earlier stages. Fuzzy logic can be used for grade prediction and to know the ranking of the student .[12]

### IV. METRICS USED

Metrics are computed which are:

- i. **Fuzzification** of all input values and converting it into membership functions.
- ii. **Execution** of rules for computing fuzzy output sets
- iii. **Defuzzification** of output functions to get a crisp output
- iv. **Membership function**: Membership function is a characteristic function which indicates degrees of membership between values 0 and 1.
- v. **Fuzzy set**: The elements which have degrees of membership is called as fuzzy set.

### V. SYSTEM OVERVIEW:

#### A. FUZZY THEORY:

Fuzzy theory is used for decision making process, just because it is difficult to find with human feeling and recognition. Hence fuzzy theory is helpful in finding the vagueness in the human perception. Zadeh implemented a procedure computationally for fuzzy logic inference which deals with an inference and function of implication.  $A$  and  $B$  are considered as fuzzy set over  $U$  and  $V$  the min-max, max-product relations are stated as follows:

$$\mu_{R}(x, y) = \min(\mu_A(x), \mu_B(y))$$

where min is a function of implication. Given a rule is  $A'$  and a rule is  $A \rightarrow B$ , Zadeh's rule of composition says

$$B' = A' \circ R_{A \rightarrow B}$$

$$\mu_{B'}(y) = \max_x$$

$$\min(\mu_{A'}(x), \mu_{R_{A \rightarrow B}}(x, y)).$$

A set of linguistic statements denoted by FLS is given by educational expert that map inputs and outputs. The knowledge base inference rule is denoted and represented in the form of a set of "IF-THEN" rules, called as production rules, expressed as:

IF (a set of conditions are fulfilled)

THEN (a set of actions that are concluded)

Fuzzy logic was brought out or developed by Lotfi-zadeh, in 1965, where the term fuzzy comes from the decision making from imprecise information or a vague information.

**Design of a Fuzzy logic process:**

#### i. Fuzzification of inputs:

Fuzzification is the procedure of converting crisp input values into linguistic values and membership functions. Two steps are performed in fuzzification: 1. The input values are converted in to linguistic terms which are then denoted as fuzzy set. 2. The function of membership are then put to the calculations and measurements and then the membership degree is found.

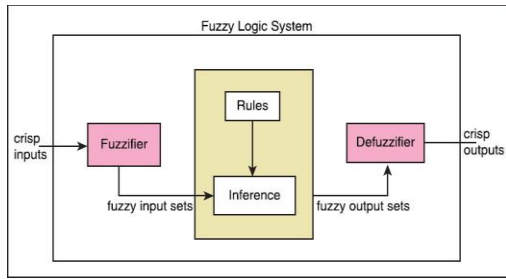


Fig 1: fuzzy logic system

The fuzzification of inputs is done by

```
Get_inputs()
For i=1,num_inputs
{
Get_X(i)
Fill_weight(Xi,Mi)
}
```

get\_inputs()

To find the weight values associated with every input membership function with the help of the given inputs X1,X2.

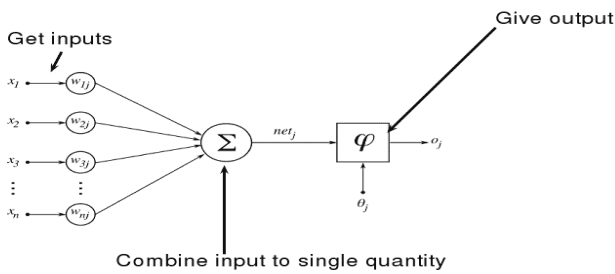


Fig 2: combining input into single quantity

ii. Fuzzy inference engine:

The knowledge base is the important part of the FLS system. There are two ways in constructing the knowledge base rule. Using experts to develop the rule based proposed system using if-then rules. Execution of rules for computing fuzzy output sets.

if  $l_1$  is  $A_1$  and  $l_2$  is  $B_1$  then  $m$  is  $L_1$       rule 1

if  $l_1$  is  $A_2$  and  $l_2$  is  $B_2$  then  $m$  is  $L_2$       rule Given  
is the fact that  
 $l_1$  is  $A'$  and  $l_2$  is  $B'$       fact

the problem is to find the conclusion

$m$  is  $L'$       conclusion

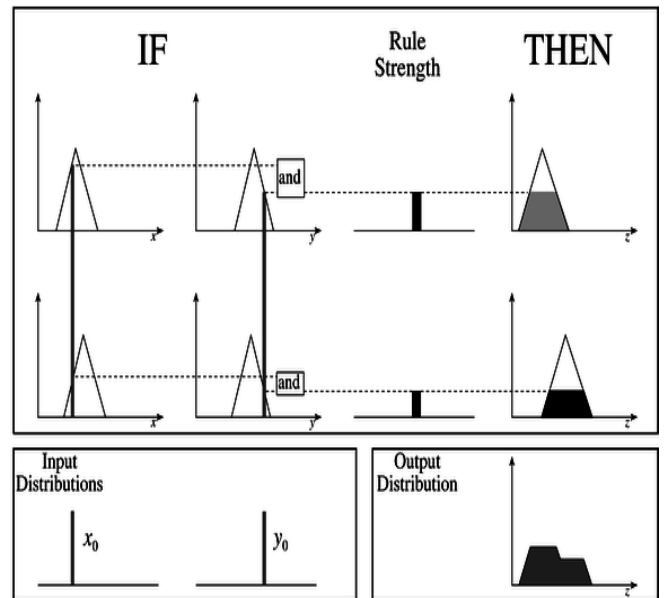


Fig 3: if -then rule strength

iii. Defuzzification of output functions:

Defuzzification is the process of converting the degree of membership of output linguistic variable into numerical value.

B. STUDENT PERFORMANCE MODELLING USING FUZZY LOGIC:

A fuzzy decision system for evaluation of student performance is modelled and solved. For this first a set of ranking attributes and their possible opinion linguistic terms are selected. A decision fuzzy set is formed which denote the judging opinion for each student ranking attributes. For each attribute a fuzzy set is defined. A subset of fuzzy is developed for all linguistic terms. A judging panel is formed for student evaluation. Students present their skills with a written test, practical test, assignment, attendance. Expert faculties give their opinion by giving possible linguistic terms for each of the student attribute. For example, written test the student performance can be Excellent, Very good, Good, Average, Fair or Bad. The modularity can be High, Medium, Low, Very low or Nil.

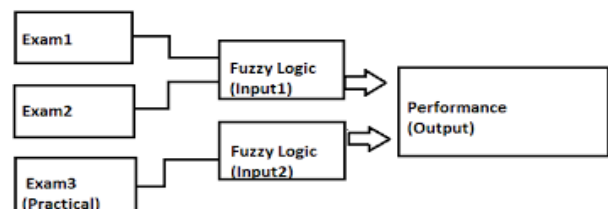


Fig 4: Fuzzy performance on student ranking

In this paper, five levels of fuzzy sets are used.  $k = >80$  use for term of linguistic terms "Low",  $k = >40$  use for "More or Less Low",  $k = >60$  use for "medium",

**Applying fuzzy logic for student performance evaluation:**

A decision system of fuzzy logic is modelled and evaluation is solved.

1. First select a set of performance attributes such as practical written test, workshop and their opinion linguistic terms such as good, excellent, fair etc.
2. Form a fuzzy decision set for each performance attributes of expert opinion.
3. Define a fuzzy set for each attribute.
4. A fuzzy subset is formed for all linguistic terms.
5. The Experts give their opinion for each student in the linguistic terms such as good, fair etc.

**i. The attributes:**

we consider following three attributes and considerable corresponding linguistic terms are selected for student evaluation:

1. Practical test -A1
  - >150 -very good (VG)
  - >100 -good (G)
  - <50 -low (L)
2. Written test-A2
  - >80 -very good (VG)
  - >70 -good (G)
  - <50 -low (L)
3. Workshop-A3
  - >90 -very good (VG)
  - >80 -good (G)
  - <50 -low (L)

**ii. Creation of fuzzy subset:**

The fuzzy subset can be created through knowledge and human reasoning.

Let fuzzy subset be denoted as A in real line. The fuzzy number is A if it is normalized, i.e., if  $A(l) = 1$  for some  $l \in \mathbb{R}$  and for all  $l, m, n \in \mathbb{R}$  such that  $l < m < n$ , it is  $A(m) \geq \min(A(l), A(n))$ .

If A is a fuzzy number, then

set  $A_\alpha = \{l \in \mathbb{R} : A(l) \geq \alpha\}$  for  $\alpha \in [0, 1]$  is the  $\alpha$ -cut of fuzzy number A.

$A1 = \text{written test} = 120 \times 0.1 + 110 \times 0.3 + 30 \times 0.2 + 5 \times 0.3 + 0$

$A2 = \text{practical test} = 90 \times 0.1 + 85 \times 0.3 + 15 \times 0.2 + 0 + 0$

$A3 = \text{workshop} = 170 \times 0.1 + 150 \times 0.3 + 80 \times 0.2 + 25 \times 0.3 + 0$

**iii. Calculating lowest performance using opinion matrix and grading for decision making:**

Ideally, a best performance must be calculated. We choose best performance also as an ideal performance.

The student evaluation performance of the students is done by panel of members in different areas and aspects of the students such as practical test, written test, workshop.

**C. PROPOSED WORK:**

**Minimization of regret (MWR) for decision making:**

Minimization of regret decision making was introduced by savage and made widely applicable by yager and is done by OWA (Ordered weighted average) operator. Assume that we have a problem for decision making with the set of alternatives  $\{A1, \dots, An\}$  and the state of type  $\{S1, \dots, Sn\}$ . consider  $Cij$  as the decision maker with the payoff matrix and suppose the person selects expert attribute as  $EAi$  and state of student as  $Sj$ .  $rij$  is the regret matrix of the matrix R.

The Main aim of the problem is to select which satisfies the matrix to the alternative decision maker.

For approach MMR following steps are followed.

- 1- Calculate the payoff matrix
- 2- for each  $Sj$  Calculate  $Cij = \text{Max}\{cij\}$
- 3 -for every pair of  $Ai$  Calculate  $Sj rij = Cj - Cij$
- 4 -for every  $Ai$  pair Calculate regret matrix  $Ri = \text{Max}\{rij\}$
- 5 -  $Ri = \text{Min}\{Ri\}$ , Select  $R1$  such that

**MMR Generalization:**

EA	S1	S2	S3	S4	S5
EA 1	12 0	15 0	90	14 0	30
EA 2	11 0	60	12 0	25 0	65
EA 3	12 5	70	95	80	15 0
Ma x	12 5	15 0	12 0	25 0	15 0

The MMR generalization is done by yager who generalized the approach by an operator called OWA operator which has a family of aggregation operators. OWA operators are used for aggregating inputs that are present between the max and min operators.

$F(a1, a2, \dots, an) = \text{WTB}$

Where  $bj$  is the  $j$ th arguments of the largest and  $wj$  are weights of collection having properties  $wj \in [0, 1]$  and  $\sum wj = 1$ . The vector B with n dimension is called the argument ordered vector and has  $bj$  as the components. W with components  $wj$  is an n dimensional vector known as a weighting vector

**MMR with OWA operator:**

EA	S1	S2	S3	S4	S5
EA1	5	0	30	110	120
EA2	15	90	0	0	85
EA3	0	80	25	170	150

OWA operator is an averaging mean operator.

For approach MWR following steps are followed.

1. Calculate the payoff matrix
2. For each  $Sj$  Calculate  $Cij = \text{Max}\{cij\}$





3. For every pair  $A_i$  Calculate  $S_j r_{ij} = C_j - C_{ij}$
4. For every  $A_i$  pair Calculate regret matrix  $R_i = OWA(r_{i1}, \dots, r_{in})$
5.  $R_i = \text{Min}\{R_i\}$ , Select  $R_1$  such that

**VI: EVALUATION RESULTS:**

Here we have selected 3 attributes and corresponding terms are used for student ranking. We also assume following weighting vectors  $w = 0.1, 0.3, 0.2, 0.30$ .

Let  $EA_1, EA_2, EA_3$  be the Expert attributes with that are used to assess the performance evaluation in practical and written test, workshop Let  $s_1, s_2, s_3, s_4, s_5$  be the expert results given as  $s_1$ -excellent,  $s_2$  as very good,  $s_3$  as good,  $s_4$  as fair,  $s_5$  as low Applying the MWR approach step by step for decision making in student evaluation.

**Step 1- Payoff Matrix:**

EA	S1	S2	S3	S4	S5
EA 1-	120	150	90	140	30
EA 2	110	60	120	150	65
EA 3	125	70	95	80	150

**Step 2- Calculation of  $C_{ij} = \text{Max}\{c_{ij}\}$  for each  $S_j$**

**Step 3 and 4 – Calculate for every pair  $A_i$  and  $S_j r_{ij} = C_j - C_{ij}$  and obtain regret matrix**

**Step 5 – Calculate  $R_i = OWA(r_{i1}, \dots, r_{in})$  for each  $A_i$**

By using formula, we calculate OWA for  $A_1, A_2$  and  $A_3$

$E_1 = \text{written test} = 120 \times 0.1 + 110 \times 0.3 + 30 \times 0.2 + 5 \times 0.3 + 0 = 52.5$

$E_2 = \text{practical test} = 90 \times 0.1 + 85 \times 0.3 + 15 \times 0.2 + 0 + 0 = 37.5$

$E_3 = \text{workshop} = 170 \times 0.1 + 150 \times 0.3 + 80 \times 0.2 + 25 \times 0.3 + 0 = 85.5$

So, from the above calculations the experts can come to a conclusion that the students’ performance is low in practical compared to the other exams. so the lowest performance is  $E_2$  as it has lowest value as compare to other tests.

**VII. CONCLUSION**

This paper presents a framework for evaluating the performance of students of educational institutes using Fuzzy Logic. Generally, all the educational institute students are required to build a good performance. For the performance evaluation a group of internal and external faculty members is formed. Students show their skills with help of practical, written test and workshop. First the faculty crew used to give a linguistic opinion like excellent, good etc. then the grade of the students ranking will be updated and review of the grades will be discussed and discussion will be held. A solution is given using fuzzy logic for the evaluation of the performance problem.

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