Grade Card Model using Fuzzy Logic

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Abstract—The Students domain provides us a treasure to unveil many interesting applications of Fuzzy Logic, which in turn support the Education System for better decision making. The base of the Education System is the Students Performance which is represented by his/her Grade. This article presents a model for developing a Grade Card for a Graduate Student using Fuzzy Logic.

Keywords— Fuzzy Logic, Performance Evaluation, education System, membership function, Fuzzy Associate Memory.

I. INTRODUCTION

In 2011, Zahari[8], presented Grade Calculation model using Fuzzy Logic System to calculate the final grade of Data Structure and Algorithms for student's based on three categories which are cognitive, psychomotor and affective.In same year, Ramjeet Singh Yadav, utilized Fuzzy Expert System (FES) to estimate the performance of a student.

In2013, Rusmiarietal.[9], tried to resolve the issues related to students achievements using fuzzy logic.

In 2015, Vasantiand Viswanadham[11], [13], presented a restrictive model utilizing Intuitionistic touchy set (IFS) to explain shortcoming and inconsistency related with picking the understudy expected execution in a course utilizing systematized Euclidean division method by investigating the parcel between each understudy and predicted subject execution. In thesame year, the first author proposed Counseling/Performance Analysis system driven by fuzzy logic technique by providinga better self performance analysis based on counseling or performance test to the students. Meenakshi and Pankaj[12], evaluated student's academic performance through a new approach with the support of fuzzy logic, taking into consideration the attendance, internal and external marks using fuzzy logic based on Mamdani technique.

In 2016, Barlybayevaetal[15], to spread ICT in education and to get a qualitative education,Therefore, proposed a fuzzy model of execution assessment of understudies through the foundation of execution. Vasanti and VenkataRao, demonstrated a general best/favored proficient request model over observe a Best Performer (BP), an inside and out understudy subject to all qualities of the understudy, which merges I.Q, time the authorities, introduction aptitudes, quick, thriving, moral obligations, and so on. Matej [16], comprehended the problem to evaluate the competency development in an individual, which was assessed with 360° feedback using fuzzy logic tools.

The success of an Educational Institution is assessed by the level of Grades scored by their college students. On the other hand, Students impression about assessment and their approaches to learning are changing with Modernization. In general the Educational Institutes are awarding a student a Grade based on the students performance in internal and external examinations of the type:

Percentage	Grade Points	Letter Grade	Performance Index
95- 100%	10	A+	Excellent
85-<95%	9	A	Very Good
75-<85%	8	B^+	Good
65- <75%	7	B	Average
55- <65%	6	C	Fair
40- <55%	5	P	Pass
< 40%	0	F	(Fail)

In view of this, the author planned a model to motivate the students community towards the improvement in different attitudes like attendance, self study, knowledge gain in technology usage, ethical attitude which in turn supports to develop a beautiful society. Hence the author had designed this Grade Card Model using Fuzzy Logic.

II. METHODOLOGY

Here the author presents a Model "the grade Card of a student using Fuzzy logic".

Fuzzification joins the course of action of progress ing fresh impacting force into evaluation of joint exertion for linguis-tic terms of padded sets. Past what many would consider conceivable is utilized to relate an examination to each semantic term. The real stage in utilizing delicate reason inside this model is to see the parameters that will be fuzzified and to pick their individual degree of characteristics. The last conceded result of this affiliation is the inspiration for each perfor-mance parameter. A Fuzzy Inference System (FIS) hardens information and yield assurance limits, fuzzification, content with intuition motor, Fuzzy standard base and defuzzification. Fig. 1 demonstrates the blueprint of the complete process.

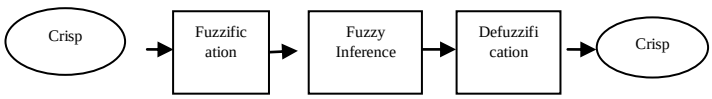

Figure 1: Fuzzy Logic Model

III. FUZZIFICATION

The input data can be categorized for each student in two modules: Academics and Non-Academics. Under Academics for each subject/course, k= 1, 2, …, 10 attributes like attendance, internal marks, external marks, seminar

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presentation marks, Faculty review score, course related technology/ application usage in the seminar presentation are considered and under Non-Academics, disciplinary action (if any based on the action taken by the authorized chairman of the disciplinary committee), participation in activities reviewed by class teacher, behavior reviewed by class teacher, behavior reviewed by peer group.

Measuring students performance involves assigning a number to mirror a teacher's presentation in the obvious estimations. Believe it or not, numbers are not required. Names, for example, "shocking", "stunning", "av-erage", "reasonable" and "poor" are utilized. Rating size of information and yield parameters is portrayed into abnormality ent portrayals as given in the table 1 and 2.

TABLE-I: Attribute Analysis in the Grade Card

		Attribute	Scale	Performance
Course 1, 2, 3.	A1	Attendance	0-10	Academics
	A2	Internal marks	0-10	
	A3	External marks	0-10	
	A4	Seminar presentation	0-10	
	A5	Faculty review score	0-10	
	A6	Course related Technology/ Application	0-10	
	A7	Disciplinary action (if any based on the action taken by the authorized chairman of the disciplinary committee)	0-10	Non-Academics
	A8	Activity participation review by class teacher	0-10	
	A9	Behavior review by class teacher	0-10	
	A10	Behavior review by peer group	0-10	

For students, the data regarding the above 10 attributes are required to be focused. Then the information collected is transformed into linguistic variable as shown in Table II, supporting the Grade of the student.

TABLE-II:Linguistic variable For Each Attribute

A	Attribute	Linguistic Variable
A1	Attendance	{Very Low, Low, Lower Medium, Medium, Higher Medium, High, Very High}
A2	Internal marks	{Very Low, Low, Lower Medium, Medium, Higher Medium, High, Very High}
A3	External marks	{Very Low, Low, Lower Medium, Medium, Higher Medium, High, Very High}
A4	Seminar presentation	{Very Low, Low, Lower Medium, Medium, Higher Medium, High, Very High}
A5	Faculty review score	{Very Low, Low, Lower Medium, Medium, Higher Medium, High, Very High}

A6	Course related Technology/ Application	{Very Low, Low, Lower Medium, Medium, Higher Medium, High, Very High}
A7	Disciplinary action (if any based on the action taken by the authorized chairman of the disciplinary committee)	{Very Low, Low, Lower Medium, Medium, Higher Medium, High, Very High}
A8	Activity participation review by class teacher	{Very Low, Low, Lower Medium, Medium, Higher Medium, High, Very High}
A9	Behavior review by class teacher	{Very Low, Low, Lower Medium, Medium, Higher Medium, High, Very High}
A10	Behavior review by peer group	{Very Low, Low, Lower Medium, Medium, Higher Medium, High, Very High}

The Fuzzification process involves the input variables to be converted into suitable value in the range of [0, 10]. The range is categorized into 7 linguistic variables which are "Very Low", "Low", "Lower Medium", "Medium", "Higher Medium", "High", "Very High" as shown in Table-II.

TABLE III: Linguistic variable for each Performance

Performance	Linguistic Variable
Academic	{Excellent(A+), Very Good(A), Good(B^+), Average(B), Fair(C), Pass(P)}
Non-Academic	{Excellent(A+), Very Good(A), Good(B^+), Average(B), Fair(C), Pass(P)}

The Grades/output regarding students Performance is divided into 7 linguistic variables which are "Excellent(A+)", "Very Good(A)", "Good(B^+)", "Average(B)", "Fair(C)", "Pass(P)" as shown in Table III.

The crisp values of different attributes are converted to the fuzzy value in range {0, 1}.Here, Trapezoidal function is used to generate the membership function.

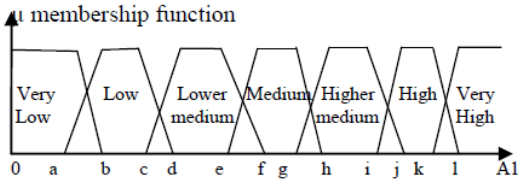

Fig- 2: Membership function for attribute 1(A1)

$$\mu_{A1}(x) = \begin{cases} 1, x < a \\ \frac{x-a}{b-a}, a \le x \le b \\ 1, b \le x \le c \\ \frac{x-c}{d-c}, c \le x \le d \\ 1, d \le x \le e \\ \frac{x-e}{f-e}, e \le x \le f \\ 1, f \le x \le g \\ \frac{x-g}{h-g}, g \le x \le h \\ 1, h \le x \le i \\ \frac{x-i}{j-i}, i \le x \le j \\ 1, j \le x \le k \\ \frac{k-x}{l-k}, k \le x \le l \\ 1, x > l \end{cases} \quad (1)$$

A membership function for a fuzzy set A1 in Fig.2 on X, is defined as μ_{A1}:X → [0, 1], where each x of X is mapped to a value between 0 and 1. This value, called as membership value, quantifies the grade of membership of x in X to the fuzzy set

A1. Since Trapezoidal function is applied, so equation (1) is used to convert all the crisp value from the input to a fuzzy value, where $a < b < c < d < e < f < g < h < I < j < k < l$. The value of a is 1, b is 2, c is 3,d is 4, e is 4.5, f is 5, g is 5.5, h is 6,I is 6.5,j is 7, k is 8, l is 9 .

IV. FUZZY INFERENCE& RESULTS

Fuzzy inference engine converts an input function to an output function using the fuzzy inference base. Among the Fuzzy Inference Techniques, Mamdani. In this study, we use the operators MIN and AND as inference rules to combine input attribute 1 (A1) and attribute 2 (A2) as:

$$\mu_{A1} \cap \mu_{A2} = \min[\mu_{A1}(x), \mu_{A2}(x)] \quad (2)$$

μA1 and μA2 are membership functions that define the fuzzy sets A1 and A2, respectively, on the whole set X. The intersection of fuzzy sets Ak, k=1,2,3…,10 is a fuzzy set defined by the membership function in equation (2).

Then the creation of fuzzy rule are produced based on value of FAM as show below where *x* is fuzzy value:

IF A1 is Q1 is No(*x*) AND Q2 is No(*x*) THEN Student Performance regarding Attendance is Weak(*x*)

A2 / A1	Very Low	Low	Lower Medium	Medium	Higher Medium	High	Very High
Very Low:0	Fail	Fail	Pass	Pass			Average
Low:0.5	Fail	Pass	Fair	Fair	Fair	Average	Average
Lower Medium	Pass	Fair	Fair	Fair	Average	Average	Good
Medium	Pass	Fair	Fair	Average	Average	Good	Good
Higher Medium	Pass	Fair	Average	Average	Good	Good	Very Good
High	Fair	Average	Average	Good	Good	Very Good	Excellent
Very High	Average	Average	Good	Good	Very Good	Excellent	Excellent

TABLE- IV: FUZZY INFERENCE TABLE FOR ATTRIBUTES A1 AND A2:

FAM in table IV show the result after applied the operator MIN and intersection AND in equation (2).

V. DEFUZZIFICATION

In any Fuzzy system or Fuzzy model, the output is pleasant. It is less unpredictable to take another choice if the yield is tended to by a solitary scalar total. This capability in a pleasant set to a solitary new worth is defuzzification and is turn reasoning of fuzzification.

For this condition, the explanation behind mixing of wholes (COS) approach is utilized and the resultant decision most remote point is work by taking the logarithmic aggregate of the yields from each contributing pleasing sets Ak. The defuzzified worth is given by

$$\text{COS}=\frac{\Sigma_{i=1}^{7} x_i \Sigma_k^{10} \mu_{Ak}(x_i)}{\Sigma_{i=1}^{7} \Sigma_k^{10} \mu_{Ak}(x_i)} \quad (3)$$

where k is the number of fuzzy sets and i is the number of fuzzy variables.

VI. CONCLUSION

The Grade Card for B.Tech students will benefit in improving their performance in more truly which in turn motivate the students to maintain all the attributes listed under Academics and Non-Academic performance. This improves the standards of the student, an Educational Institution and in turn our Society.

GRADE CARDName: Miss K.Sravya H.T.No.:17A51A0541		
	Attribute(Academics)	Scale
A1	Attendance	High
A2	Internal marks	Very High
A3	External marks	Very High
A4	Seminarpresentation	High
A5	Faculty review score	High
A6	Course related Technology/ Application	Higher Medium
Attribute(Non-Academics)		
A7	Disciplinary action (if any based on the action taken by the authorized chairman of the disciplinary committee)	Very Low
A8	Activity participation review by class teacher	Higher Medium
A9	Behavior review by class teacher	High
A10	Behavior review by peer group	High
Remarks: GRADE secured is A.		

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