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Applications of Fuzzy Logic in Education System

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Abstract: - Indian Education System is one of the best education system in the world. There are so many school, colleges and universities which are responsible for giving better future to the students. With the responsibility of giving best career and bright future, there is very big challenge also to evaluate the students according to their skills and knowledge. In the today's world we need one assistant which can help teachers and students to take decisions and guide them for better results. In this paper we have discussed the fuzzy logic expert systems in education field and we have given one example also which will describe the use of fuzzy logic in education system to predict the performance of student. The proposed fuzzy based student performance prediction expert system is designed and implemented in MATLAB. This expert system will take multiple inputs and will give single output.

I. Introduction of fuzzy: - The usefulness of fuzzy logic is increasing rapidly. The fuzzy gives very optimal and effective solutions of any kind of non- linear problem. These solutions which are given by fuzzy expert systems are easy to use, due this reason the fuzzy systems are using by researchers of every field. Fuzzy can embed with any type of technology or hardware to solve nonlinear problem. In 1965 fuzzy was introduced by "***Zadeh".*** Fuzzy Logic Controller (FLC) generate the results in required format. There are so many application areas of fuzzy expert system like health care, education banking, agriculture, sciences, engineering and mechanics. After this part of paper, section II includes the fuzzy logic implementation in education system, section III consists the fuzzy expert system to evaluate the performance of any student, section IV will give you the result analysis and the last section V is for conclusion of the paper.

II. Fuzzy Applications in education: - Now a days, fuzzy logic has many applications in different fields. Education is the very important area where we can implement fuzzy to analyze the performance of a student or can predict the behavior of any student. In last few year, the researchers have done in depth research in this field. In 2013 **Voskoglou, et al.** has introduced one fuzzy system to evaluate the acquaintance and abilities of group of students [1]. In 2015 ***Buniyamin , et al.*** features the significance of using fuzzy logic in education. This paper describes the fuzzy tool for teachers to predict and categorize the student's performance according to their academic results [2]. In 2016 ***Novak, et al.*** a system has been designed to estimate the difficulty level of course for the students. The students and the colleges can take the advantage from this proposed tools to plan their strategies of learning [3]. In 2017 ***Aly, et al.*** to assist students with finding an appropriate choice in brief time and exertion, one intelligent algorithm has been used to make one smart phone application. This application is tested and validated by using real world data [4]. In 2018 ***Tarasyev*** **et al.** the researchers have proposed one application which can evaluate

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the possibility of informative approach change for every understudy and advance the training procedure in the University [5].In 2018 ***Ilahi, et al.*** has explained the importance of using fuzzy in education to evaluate the performance of group of students and individual students by using their academic data and behavior as inputs[6]. In 2019 Sudhagar***, et al.*** fuzzy cognitive maps and the role of these have been studied by the researchers. They proposed one model to solve the problems in the static and digital culture atmosphere [7]. In the same year ***Natividad, et al.*** The researcher has introduced one career guidance tool which can help students and career guidance analyst to choose the domain of their choice. The counselor helps the undergraduate to make choice on what vocation they will seek after [8].

III. Fuzzy based student performance prediction expert system: - For making the clear understanding of the fuzzy system, we have designed a fuzzy expert system to evaluate the performance of students on the basis of common parameters like percentage in exams, aggregate attendance, participation in co-curricular activities and communication skill. The following all the tables are showing the input data, the range of the values and fuzzy sets.

Table 1 fuzzy sets for percentage of marks

Data Input	Value	Fuzzy Set
Percentage	65=>100	Good
	40=>70	Average
	0=>50	Poor

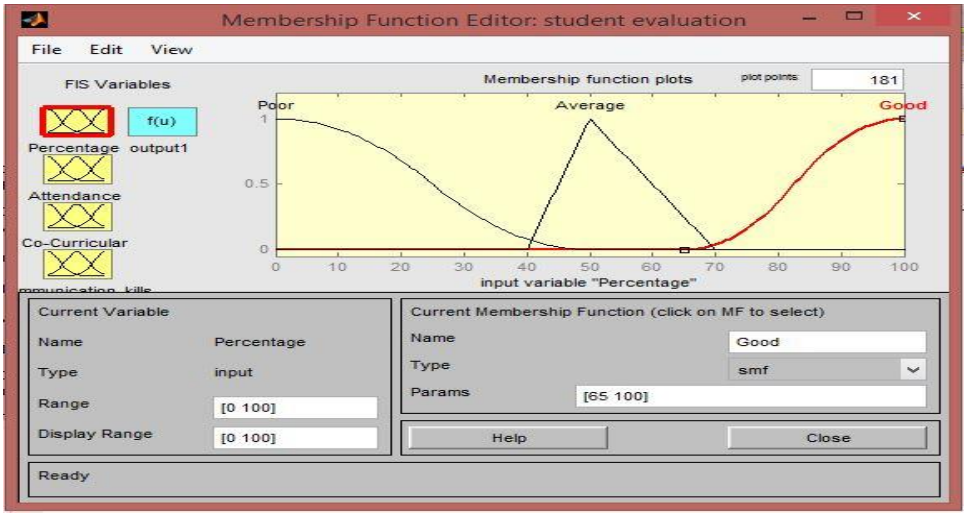


Fig. 1 Membership values for percentage of marks

$$\rho\, Poor(x) = 1 \qquad x \geq 0$$

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$$\frac{50-x}{50} \qquad 0 \le x \le 50$$

$$\rho\, Average(x) = \frac{x-40}{10} \qquad 40 \le x \le 50$$

$$1 \qquad x = 50$$

$$\frac{70-x}{20} \qquad 50 \le x \le 70$$

$$\rho\, Good\,(x) = \frac{x-65}{5} \qquad 65 \le x \le 70$$

$$1 \qquad x = 70$$

$$\frac{100-x}{30} \qquad 70 \le x \le 100$$

Table 2 fuzzy sets for aggregate attendance

Data Input	Value	Fuzzy Set
Attendance	65=>100 40=>80 0=>50	Good Average Poor

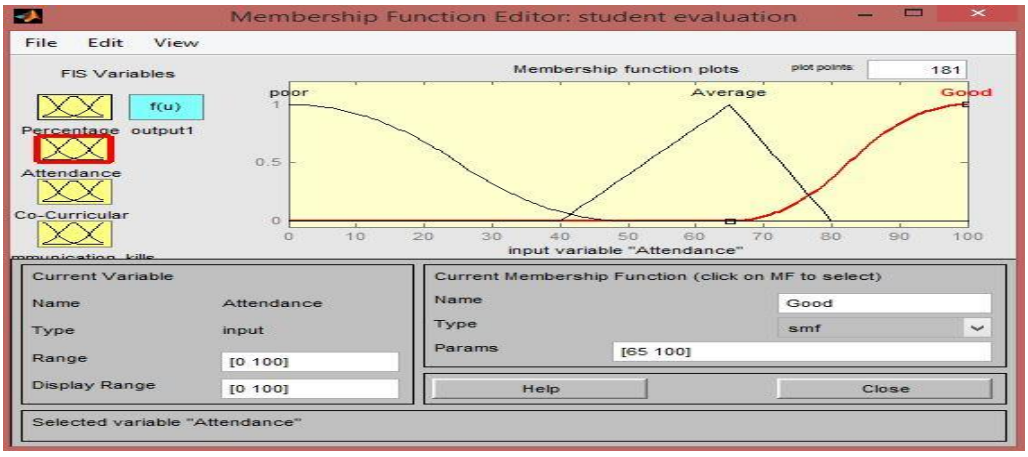


Fig. 2 Membership values of aggregate attendance

$$\rho\, Poor(x) = 1 \qquad x \ge 0$$

$$\frac{50-x}{50} \qquad 0 \le x \le 50$$

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$$\rho\, Average(x) = \frac{x-40}{10} \qquad 40 \le x \le 50$$

$$1 \qquad x = 50$$

$$\frac{80-x}{30} \qquad 50 \le x \le 80$$

$$\rho\, Good\,(x) = \frac{x-65}{15} \qquad 65 \le x \le 80$$

$$1 \qquad x = 80$$

$$\frac{100-x}{20} \qquad 80 \le x \le 100$$

Table 3 fuzzy sets for participation in co-curricular activities

Data Input	Value	Fuzzy Set
Co-curricular Activities	70=>100 35=>75 0=>45	High Medium Low

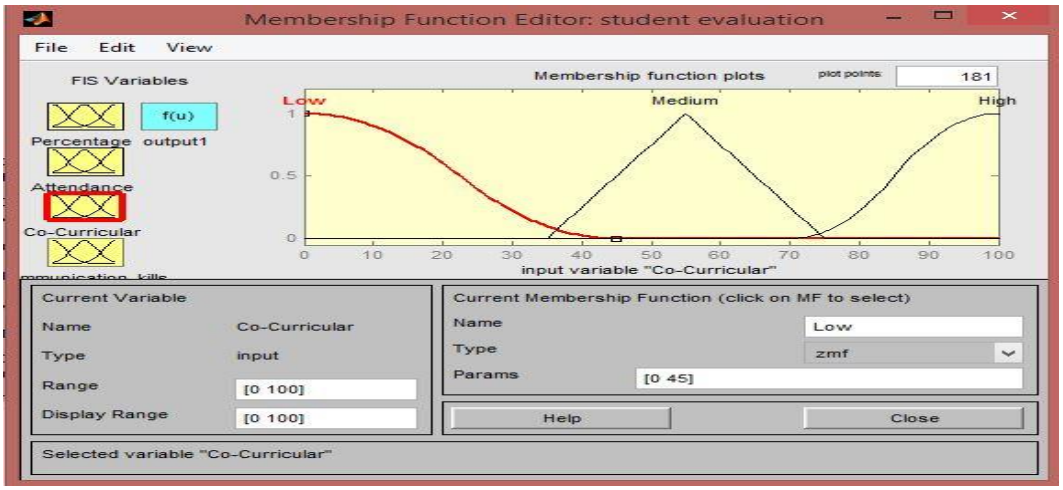


Fig. 3 Membership values of co-curricular activities

$$\rho\, Low(x) = \quad 1 \qquad x \ge 0$$

$$\frac{45-x}{45} \qquad 0 \le x \le 45$$

$$\rho\, Medium(x) = \frac{x-35}{10} \qquad 35 \le x \le 45$$

$$1 \qquad x = 45$$

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$$\frac{75-x}{30} \qquad 45 \leq x \leq 75$$

$$\rho\, High\,(x) = \frac{x-70}{5} \qquad 70 \leq x \leq 75$$

$$1 \qquad x = 75$$

$$\frac{100-x}{25} \qquad 75 \leq x \leq 100$$

Table 4 fuzzy sets for communication skills

Data Input	Value	Fuzzy Set
Communication Skills	65=>100 40=>75 0=>45	Good Average Poor

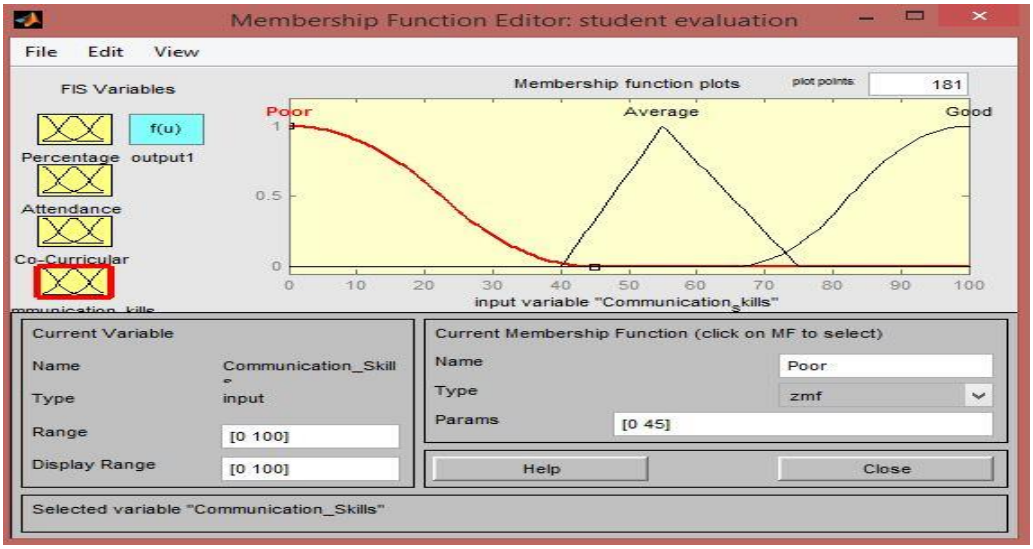


Fig. 4 Membership values of communication skills

$$\rho\, Poor(x) = 1 \qquad x \geq 0$$

$$\frac{45-x}{45} \qquad 0 \leq x \leq 45$$

$$\rho\, Average(x) = \frac{x-40}{5} \qquad 40 \leq x \leq 45$$

$$1 \qquad x = 45$$

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$$\frac{75-x}{30} \qquad 45 \leq x \leq 75$$

$$\rho\, Good\,(x) = \frac{x-65}{10} \qquad 65 \leq x \leq 75$$

$$1 \qquad x = 75$$

$$\frac{100-x}{25} \qquad 75 \leq x \leq 100$$

We have implemented this example by using sugeno method in MATLAB. The Figure 5 shows the inputs for evaluating any student.

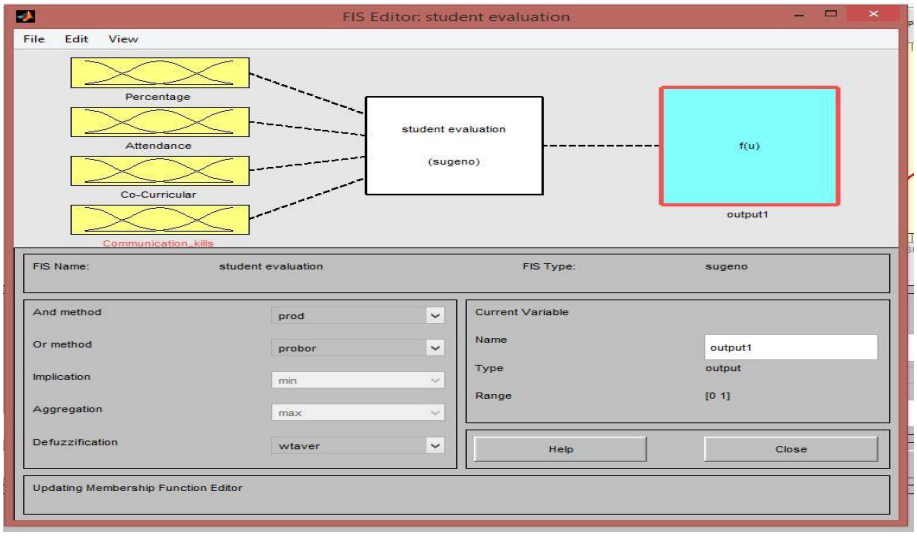


Fig. 5 Student evaluation parameters by using sugeno

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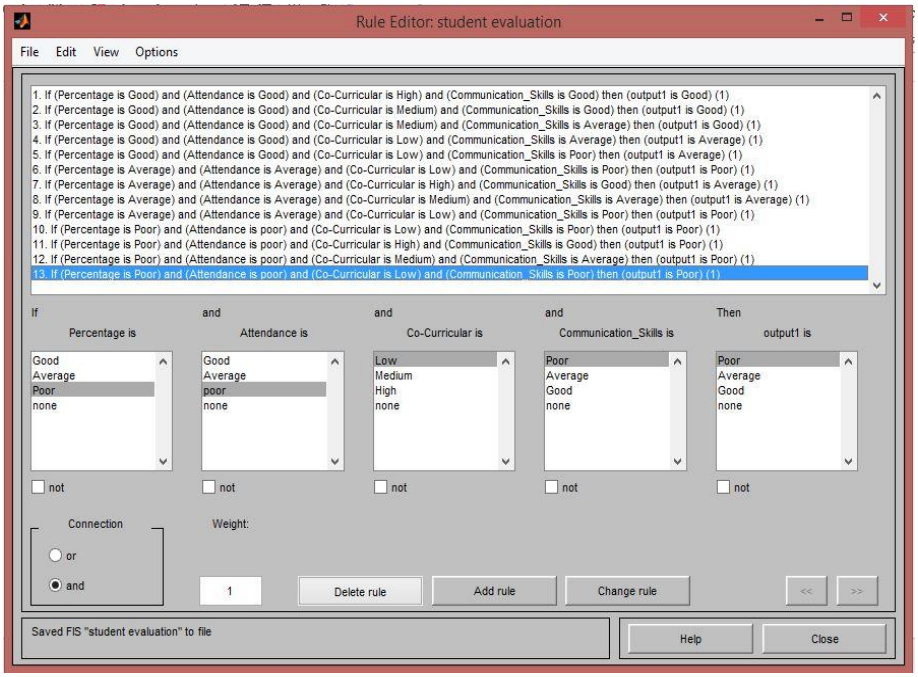


Fig. 6 Rules for evaluation

The following figure 6 shows the rules for student's evaluation

IV Result and analysis: - The results of the fuzzy system is shown in given figure.

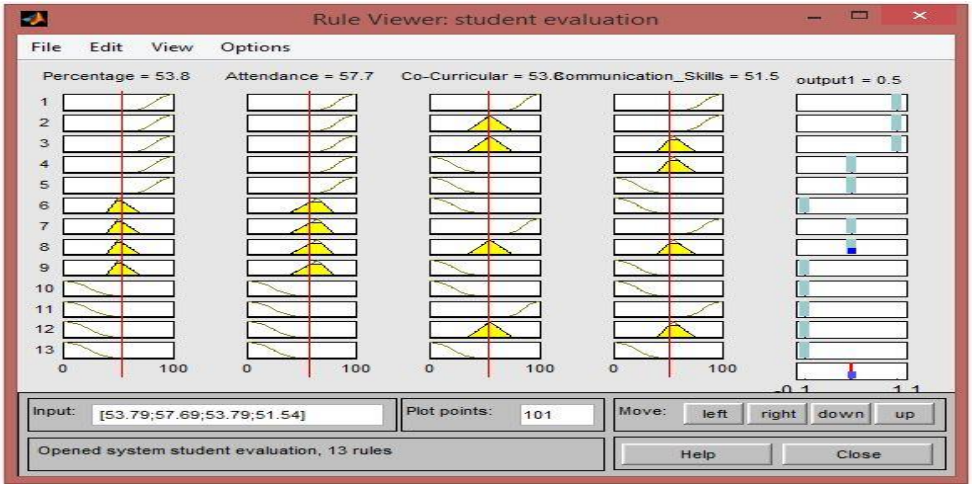


Fig. 7 Results in the rules viewer

Figure 7 demonstrate the results on the basis of input data, the range of data and the rules we have designed.

The output is going to be change as we are going to change the membership value of the input variables. The input parameters are going to evaluate the student's performance. The output value will be range from 0 to 1.

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Conclusion: - Fuzzy logic expert system is playing very important role in the field of education. One can use the fuzzy logic in education to evaluate the student's skills and can also evaluate the overall development of them. The proposed fuzzy system will help the teachers to evaluate the performance of the students on the basis of academics and co-curricular activities. In future can modify the input parameters to enhance the effectiveness of the given model.

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