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CENTRAL INSTITUTE OF TECHNOLOGY KOKRAJHAR
Autonomous Institute under Ministry of HRD, Government of India
TERRITORIAL AREAS DISTRICTS :: KOKRAJHAR :: ASSAM

FUZZY INFERENCE SYSTEM FOR EVALUATE OF STUDENT GRADE POINTER

A Project Work Submitted in Partial Fulfilment
of the requirements for the Degree of

BACHELOR OF TECHNOLOGY

in

INFORMATION TECHNOLOGY

By

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CERTIFICATE OF APPROVAL

This is to certify that the work embodied in this project entitled “**FUZZY INFERENCE SYSTEM FOR EVALUATE STUDENT GRADING PERFORMANCE**” submitted by Mrinal Dutta, Sansumwi Basumatary, Hareswar Swargiary and Deni Borah to the Department of INFORMATION TECHNOLOGY, is carried out under my direct supervisions and guidance.

The project work has been prepared as per the regulations of Central Institute of Technology and I strongly recommend that this project work be accepted in partial fulfilment of the requirement for the degree of B.Tech.


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Certificate by the Board of Examiners

This is to certify that the project work entitled “**FUZZY INFERENCE SYSTEM FOR EVALUATE STUDENT GRADING PERFORMANCE**” submitted by Mrinal Dutta, Sansumwi Basumatary, Hareswar Swargiary and Deni Borah to the Department of Information Technology of Central Institute of Technology, Kokrajhar has been examined and evaluated.

The project work has been prepared as per the regulations of Central Institute of Technology and qualifies to be accepted in partial fulfilment of the requirement for the degree of Bachelor of Technology.

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EXRERNAL EXAMINER





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DECLARATION

We hereby declare that the project work entitled "FUZZY INFERENCE SYSTEM FOR EVALUATE STUDENT GRADING PERFORMANCE" is an authenticated work carried out by us under the guidance of Mr. Anup Kumar Barman, Asst. Prof., Department of IT, CIT, Kokrajhar for the partial fulfilment of the award of the degree in Information Technology and this work has not been submitted for similar purpose anywhere else except to Department of IT, CIT, Kokrajhar.

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Abstract

In Educational Institutions the success is measured by academic performance, or how well a student meets standards set out by Governmental Educational policies and/or the Institutional rules and regulations. Here the Fuzzy Inference System for student grading performance evaluation is based on Fuzzy Logic Techniques (FLT).

In this report, the study proposes a new evaluation method to find the Performance of student's results based on Fuzzy Logic System (FLS) and also compared with the Institutional Method. This system evaluates the student grade point in more flexible way as comparing with institutional method. In this system the student performance depends on exam paper results. The grade pointer for a particular student is then determined based on marks.

This system helps an examiner to examine the student performance more flexible way and can provide there grade point for inspire them.

Keywords: - *Fuzzy Inference System (FIS), Performance, Evaluation, Fuzzy logic, Flexible.*

Table of Contents

<u>Chapter no.</u>	<u>Title</u>	<u>Page no.</u>
Chapter :1	Introduction	1
	1.1 Introduction.....	2
	1.2 Project objectives.....	3
	1.3 Scope of the Project.....	3
	1.4 Problem Statement.....	3
Chapter :2	Introduction to Fuzzy Logic	4
	2.1 Fuzzy logic introduction.....	5
	2.1.1 Some Application area of fuzzy logic.....	6
	2.2 Difference between fuzzy set and Classical set.....	6
	2.3 Characteristics of Fuzzy Logic.....	7
	2.4 Linguistic Variable.....	7
	2.5 Membership Function.....	7
	2.6 Fuzzy Rules.....	8
	2.7 Operation on fuzzy sets.....	8-10
	2.8 Fuzzy Logic System.....	10
	2.9 Fuzzification.....	11
2.10 Defuzzification Method.....	11-14	
Chapter :3	Design and Implementation	15
	3.1 Block diagram of fuzzy interface system.....	16
	3.2 Fuzzy Inference System (FIS) for Grading point.....	16
	3.3 Main components of a Fuzzy Inference System.....	17
	3.4 MATLAB FIS Editor.....	18
	3.5 Membership function for Input.....	19
	3.6 Input range of membership function.....	19
	3.7 Membership Functions for output.....	20
	3.7.1 Membership function for output1.....	20
	3.7.2 Output result range of output1.....	20
3.7.3 Membership function for output2.....	21	

3.7.4 Output result range of output2.....	21
3.8 Rule Editor.....	22
3.9 Rules Design for FIS.....	23
3.10 Rules viewer of FIS.....	24
3.11 Determination of performance value.....	25
3.12 Institutional method for grade point calculation.....	26
3.13 Comparison of Performance Evaluation Methods.....	27
• Chapter 4.....	28
Conclusion.....	29
Chapter 5.....	30
Reference.....	31

List of Tables

<u>Table no.</u>	<u>Title</u>	<u>Page no.</u>
3.1	Input range of membership function.....	19
3.2	Output result range of output1 variable.....	20
3.3	Output result range of output2.....	21
3.4	Rules used for FIS.....	23-24
3.5	Comparison of Performance Evaluation Methods.....	27

List of Figures

<u>Figure no.</u>	<u>Title</u>	<u>Page no.</u>
2.1	Characteristic of crisp set.....	6
2.2	Characteristic function of fuzzy set.....	6
2.3	Difference types of membership function.....	8
2.4	Intersection or minimum function.....	9
2.5	Union or maximum function.....	9
2.6	Complement function.....	10
2.7	Fuzzy logic system.....	10
3.1	Block diagram of FIS.....	16
3.2	FIS block diagram for grading point.....	16
3.3	Components of a Fuzzy Inference System.....	17
3.4	MATLAB FIS Editor.....	18
3.5	Input membership function.....	19
3.6	Membership function for output 1 variable.....	20
3.7	Membership functions for output2 variable.....	21
3.8	Rule Editor.....	22
3.9	Matlab rule viewer of FIS.....	25

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

Education Systems are very important to the growth of society. Since, their performance directly affects the social development and growth, it becomes very important to improve the quality levels of education. In order to improve the quality of educational institutions, universities and its affiliated colleges it becomes essential that their performance be evaluated, compared, analysed and improved.

Students play vital role in growth of any institute. The ranking of the institute depends on results of the students as well as their placements and quality of the faculty working with the institute. In the era of tight competitiveness among the various institutes, every college focuses on how to improve the performance of the student as well as how to evaluate the student fairly[8]. In any institutes student's performance is evaluated by different marks of subject in examination.

Our system module is developed by using MATLAB Software. This study proposes a new evaluation method to find the grading performance of student's results based on Fuzzy Logic System (FLS) and also compared with the Institutional Method.

Fuzzy Logic

A mathematical logic that attempts to solve problems by assigning values to an imprecise spectrum of data in order to arrive at the most accurate conclusion possible [10]. Fuzzy logic is designed to solve problems in the same way that humans do: by considering all available information and making the best possible decision given the input. Fuzzy logic starts with and builds on a set of user-supplied human language rules. The fuzzy systems convert these rules to their mathematical equivalents. This simplifies the job of the system designer and the computer, and results in much more accurate representations of the way systems behave in the real world. Fuzzy logic models, called fuzzy inference systems, consist of a number of conditional "if-then" rules. For the designer who understands the system, these rules are easy to write, and as many rules as necessary can be supplied to describe the system adequately. Fuzzy inference systems rely on membership functions to explain to the computer how to calculate the correct value between 0 and 1.

This development was carried out in following steps:--

- ❖ First step to develop educational based fuzzy inference system is to identify the important parameters. We have chosen such parameters where the vagueness is often encountered. The important parameters considered are mainly the marks of three subjects.
- ❖ Second step is to design the membership function of the selected parameters. Proper design of membership function gives the correct output.
- ❖ Third step is to write the rules for the fuzzy inference system.

1.2 Project objectives:

The main objective of this project is to develop a fuzzy logic based inference system to evaluate student grade point in more flexible way as comparing with institutional method. Here we have compare our institutional grading methods (CIT) with our designed Fuzzy Inference System (FIS) result (grade point). Fuzzy system is useful for evaluate the result according to human idea, how we can think or what actually we want. In our institutional method we have seen that in some cases student doesn't get proper performance result according to their obtain marks in the exam therefore we have design this fuzzy system for evaluating the result with respect to institutional methods but in more flexible way.

1.3 Scope of the project:

- Determine students' performance using a fuzzy logic model in place of classical assessment methods.
- Design a prototype Fuzzy system for evaluates student grade point.
- Evaluation of the results showed variations between the institutional and fuzzy logic methods.

1.4 Problem statement:-

In institutional grading method we have found that, sometimes student does not get proper flexibility in their result for different variation of marks they had obtained. Sometimes students are unable to achieved higher grade for only one mark.

So, our FIS system gives an opportunity to know student performance in more flexible way.

CHAPTER 2: INTRODUCTION TO FUZZY LOGIC

2.1 Fuzzy Logic Introduction

Fuzzy Logic was initiated in 1965 [1], [2], [3], by **Lotfi A. Zaideh**, professor for computer science at the University of California in Berkeley. Basically, Fuzzy Logic (FL) is a multivalued logic that allows intermediate values to be defined between conventional evaluations like true/false, yes/no, high / low, etc. Notions like rather tall or very fast can be formulated mathematically and processed by computers, in order to apply a more human-like way of thinking in the programming of computers [4]. A fuzzy system is an alternative to traditional notions of set membership and logic that has its origins in ancient Greek philosophy. The precision of mathematics owes its success in large part to the efforts of Aristotle and the philosophers who preceded him. In their efforts to devise a concise theory of logic, and later mathematics, the so-called "Laws of Thought" were posited [5]. One of these, the "Law of the Excluded Middle," states that every proposition must either be true or false. Even when Parmenides proposed the first version of this law (around 400 B.C.) there were strong and immediate objections: for example, Heraclitus proposed that things could be simultaneously true and not true. It was Plato who laid the foundation for what would become fuzzy logic, indicating that there was a third region (beyond True and False) where these opposites "tumbled about." Other, more modern philosophers echoed his sentiments, notably Hegel, Marx, and Engels. But it was Lukasiewicz who first proposed a systematic alternative to the bi-valued logic of Aristotle [6]. Even in the present time some Greeks are still outstanding examples for fussiness and fuzziness, (note: the connection to logic got lost somewhere during the last 2 millenniums [7]). Fuzzy Logic has emerged as a profitable tool for the controlling and steering of systems and complex industrial processes, as well as for household and entertainment electronics, as well as for other expert systems and applications like the classification of SAR data.

Fuzzy Logic provides a different way to approach a control or classification problem. This method focuses on what the system should do rather than trying to model how it works. One can concentrate on solving the problem rather than trying to model the system mathematically, if that is even possible. On the other hand the fuzzy approach requires a sufficient expert knowledge for the formulation of the rule base, the combination of the sets and the defuzzification. In General, the employment of fuzzy logic might be helpful, for very complex processes, when there is no simple mathematical model (e.g. Inversion problems), for highly nonlinear processes or if the processing of (linguistically formulated) expert knowledge is to be performed. According to literature the employment of fuzzy logic is not recommendable, if the conventional approach yields a satisfying result, an easily solvable and adequate mathematical model already exists, or the problem is not solvable.

2.1.1 Some Application area of fuzzy logic

- Temperature Control.
- Wind Energy Converter Control.
- Fire Zone Control.
- Biomedical Informatics.
- For developed various prediction model.

2.2 Difference between fuzzy set and classical set

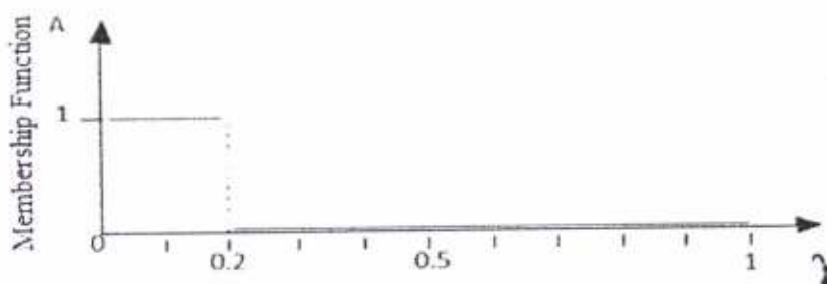


Figure 2.1: characteristic of crisp set

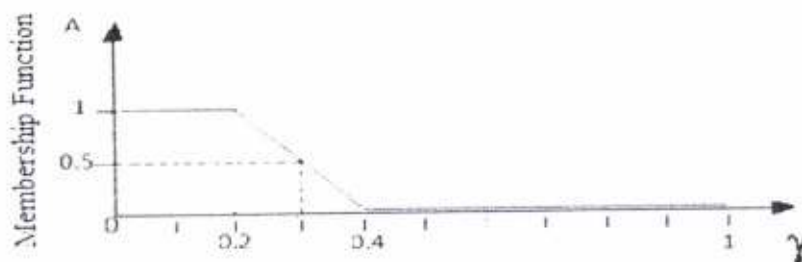


Figure 2.2: characteristic function of fuzzy set

- In classical set, an element either belongs to a set or not and nothing in between. But in fuzzy set, an element can belong to two different sets simultaneously, with different degree of belongingness.
- In classical set, membership grade is either 0 or 1.
- But in fuzzy set, membership grade lies in $[0-1]$.

2.3 Characteristic of fuzzy logic

Some of the essential characteristics of fuzzy logic relate to the following (Zadeh, 1992):

- a. In fuzzy logic, exact reasoning is viewed as a limiting case of approximate reasoning.
- b. In fuzzy logic, everything is a matter of degree.
- c. In fuzzy logic, knowledge is interpreted as a collection of elastic or, equivalently, fuzzy constraint on a collection of variables.
- d. Inference is viewed as a process of propagation of elastic constraints.

There are two main characteristics of fuzzy systems

Fuzzy systems are suitable for uncertain or approximate reasoning, especially for the system with a mathematical model that is difficult to derive.

Fuzzy logic allows decision making with estimated values under incomplete or uncertain information.

2.4 Linguistic variable:

Linguistic variables are the input or output variables of the system whose values are words or sentences from a natural language, instead of numerical values. A linguistic variable is generally decomposed into a set of linguistic terms. Examples, Let temperature (t) be the linguistic variable. Then, $T(t) = \{\text{too-cold, cold, warm, hot, too-hot}\}$ these are the linguistic values of the temperature.

2.5 Membership function:

Membership functions are used in the fuzzification and defuzzification steps of a Fuzzy Logic System, to map the non-fuzzy input values to fuzzy linguistic terms and vice versa. A membership function is used to quantify a linguistic term. There are different forms of membership functions such as triangular, trapezoidal, piecewise linear, Gaussian, or singleton (Figure 2.3). The most common types of membership functions are triangular, trapezoidal, and Gaussian shapes. The type of the membership function can be context dependent and it is generally chosen arbitrarily according to the user experience [8].

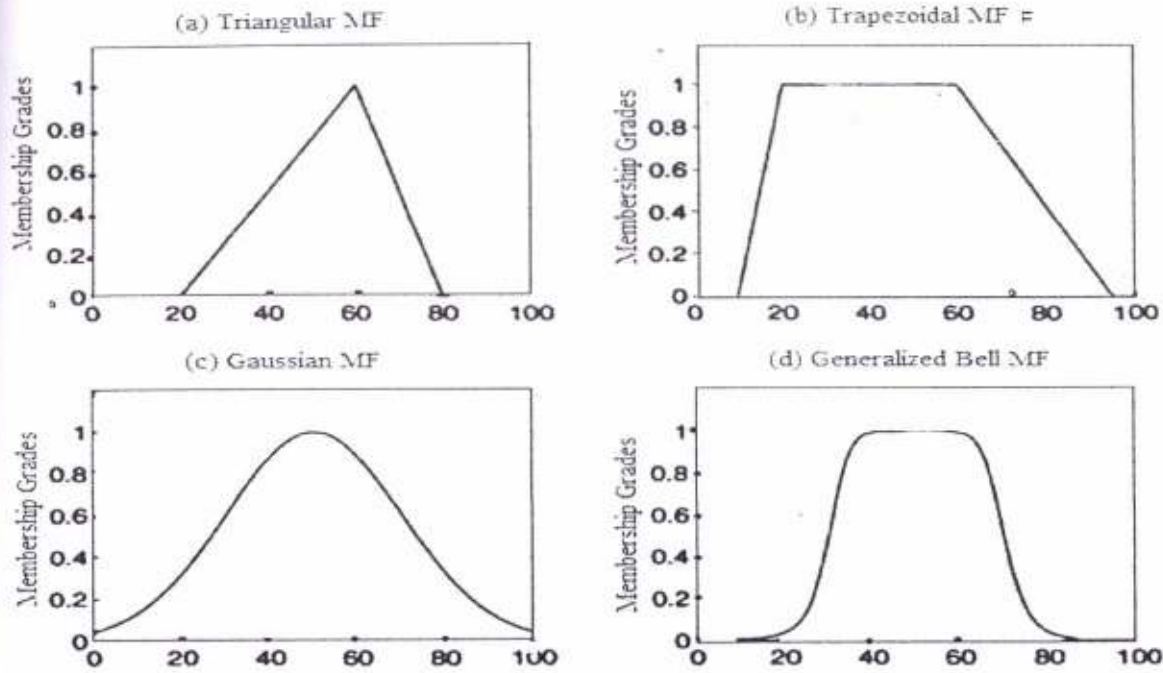


Figure 2.3: Different types of membership function

2.6 Fuzzy Rules:

In a Fuzzy Logic System, a rule base is constructed to control the output variable. A fuzzy rule is a simple IF-THEN rule with a condition and a conclusion.

2.7 OPERATIONS ON FUZZY SETS

Basic operations on fuzzy sets similar to the operations on crisp sets we also want to intersect unify and negate fuzzy sets. In his very first paper about fuzzy sets [1], L. A. Zadeh suggested the minimum operator for the intersection and the maximum operator for the union of two fuzzy sets. It can be shown that these operators coincide with the crisp unification and intersection if we only consider the membership degrees 0 and 1.

1. Intersection or minimum function:

The membership function of the intersection of two fuzzy sets \tilde{A} and \tilde{B} is defined as:

$$\mu_{\tilde{A} \cap \tilde{B}}(X) = \text{Min}(\mu_{\tilde{A}}(X), \mu_{\tilde{B}}(X)) \forall x \in X$$

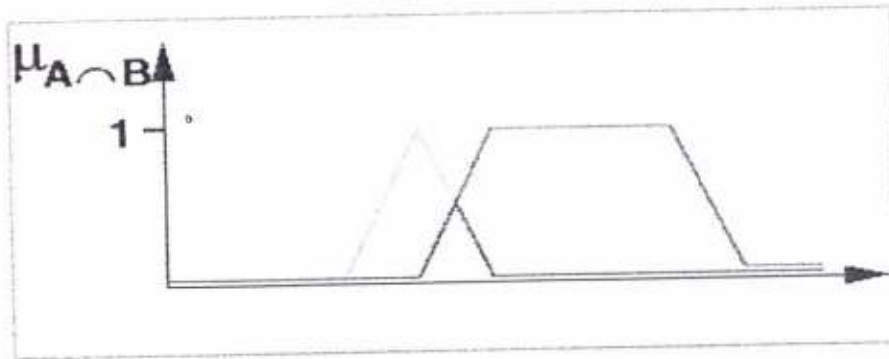


Figure 2.4: Intersection or minimum function

2. Union or maximum function:

The membership function of the union is defined as:

$$\mu_{\tilde{A} \cup \tilde{B}}(X) = \text{Max}(\mu_{\tilde{A}}(X), \mu_{\tilde{B}}(X)) \forall x \in X$$

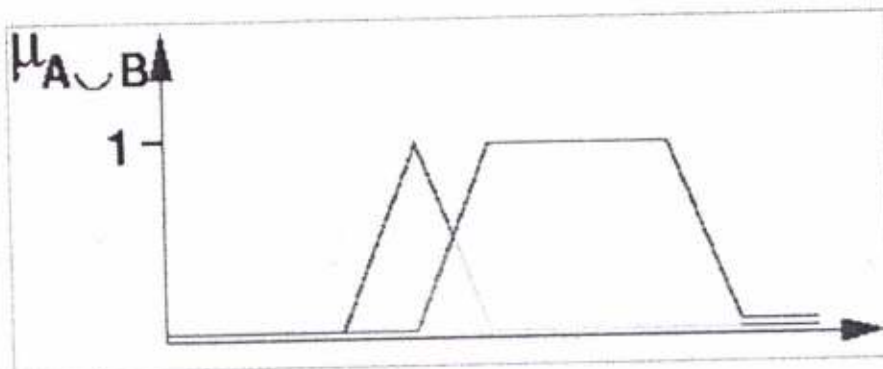


Figure 2.5: Union or maximum function

3. Complement function:

The membership function of the complement is defined as:

$$\mu_{\bar{A}}(X) = 1 - \mu_A(X) \forall x \in X$$

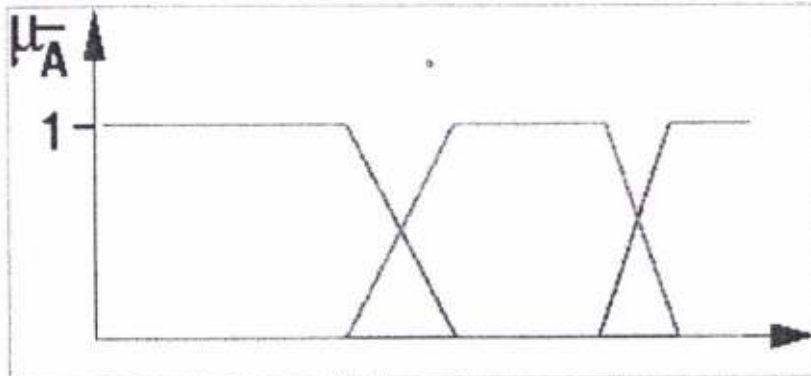


Figure 2.6: Complement function

2.8 Fuzzy Logic System

A fuzzy logic system (FLS) can be defined as the nonlinear mapping of an input data set to a scalar output data [2.2]. A FLS consists of four main parts: fuzzifier, rules, inference engine, and defuzzifier. These components and the general architecture of a FLS is shown in Figure 2.7.

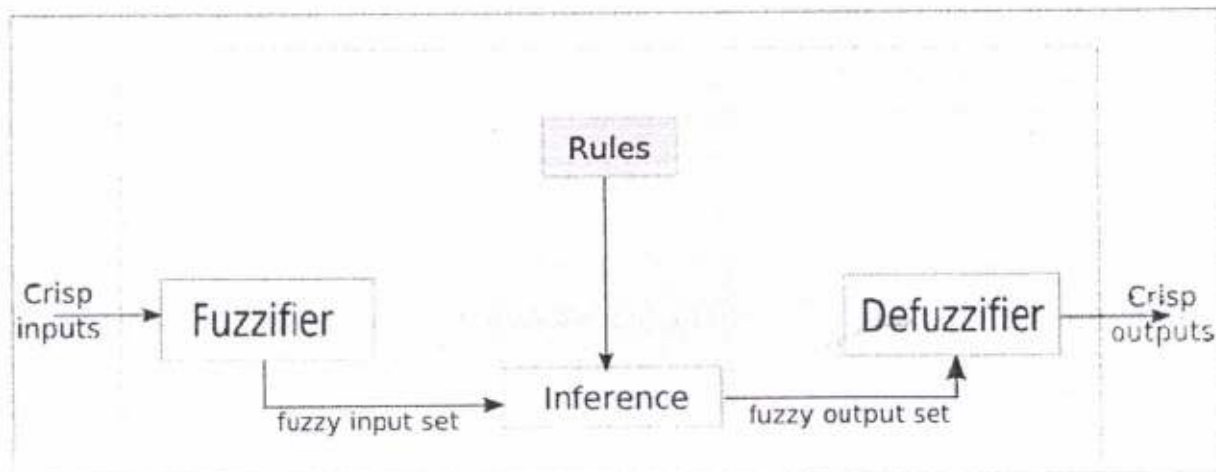


Figure 2.7: Firstly, a crisp set of input data are gathered and converted to a fuzzy set using fuzzy linguistic variables, fuzzy linguistic terms and membership functions. This step is known as fuzzification. Afterwards, an inference is made based on a set of rules. Lastly, the resulting fuzzy output is mapped to a crisp output using the membership functions, in the defuzzification step.

Steps for developing a Fuzzy Logic System:

1. Define the linguistic variables and terms (initialization)
2. Construct the membership functions (initialization)
3. Construct the rule base (initialization)
4. Convert crisp input data to fuzzy values using the membership functions (fuzzification)
5. Evaluate the rules in the rule base (inference)
6. Combine the results of each rule (inference)
7. Convert the output data to non-fuzzy values (defuzzification)

2.9 Fuzzification

Fuzzification is the process of making a crisp quantity fuzzy. Fuzzification is the process of changing a real scalar value into a fuzzy value. This is achieved with the different types of fuzzifiers (membership functions).

Fuzzy Linguistic Variables are used to represent qualities spanning a particular spectrum.

2.10 Defuzzification Method:

Defuzzification is the process of converting the degrees of membership of output linguistic variables into numerical values. Defuzzification is just the last step; it is an interface with crisp models of the world. The output of an entire fuzzy process can be union of two or more fuzzy sets. Defuzzification is a process to select a representative element from the fuzzy output inferred from the fuzzy rule-based system.

There are various methods used for Defuzzifying the fuzzy output functions:

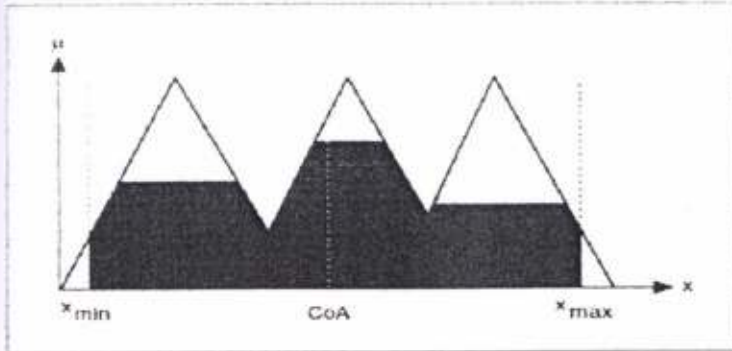
- Center of Area
- Modified Center of Area
- Center of Sums
- Center of Maximum
- Mean of Maximum

1.Center of Area:

In the Center of Area (CoA) defuzzification method, the fuzzy logic controller first calculates the area under the scaled membership functions and within the range of the output variable. The fuzzy logic controller then uses the following equation to calculate the geometric center of this area.

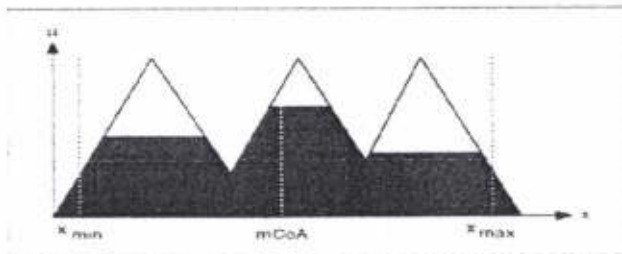
$$CoA = \frac{\int_{x_{min}}^{x_{max}} f(x) \cdot x \, dx}{\int_{x_{min}}^{x_{max}} f(x) \, dx}$$

Where CoA is the center of area, x is the value of the linguistic variable, and x_{min} and x_{max} represents the range of the linguistic variable.



2. Modified Center of Area:

The modified Center of Area defuzzification method is similar to the Center of Area defuzzification method. However, the fuzzy logic controller considers the full area under the scaled membership functions, even if this area extends beyond the range of the output variable. The fuzzy logic controller uses the following equation to calculate the geometric center of the full area under the scaled membership functions.



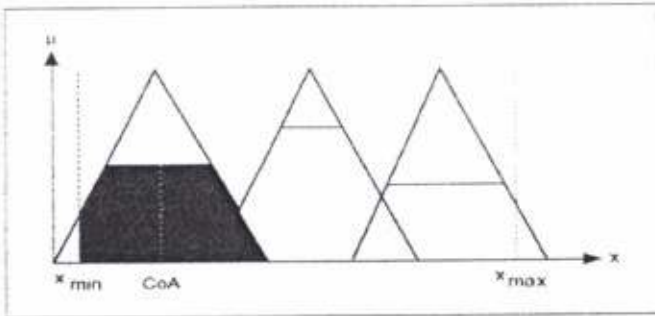
$$mCoA = \frac{\int f(x) \cdot x \, dx}{\int f(x) \, dx}$$

3.Center of Sums:

In the Center of Sums (CoS) defuzzification method, the fuzzy logic controller first calculates the geometric center of area for each membership function, as the following figure illustrates.

$$X_{final} = \frac{CoA_1 area_1 + CoA_2 area_2 + \dots + CoA_n area_n}{area_1 + area_2 + \dots + area_n}$$

Where CoA_n is the geometric center of area of the scaled membership function n and $area_n$ is the area of the scaled membership function n .

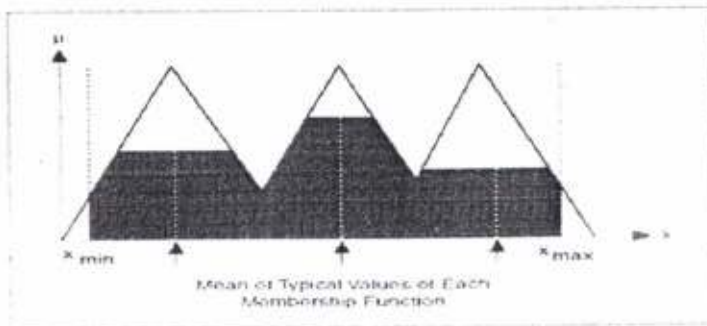


4.Center of Maximum:

In the Center of Maximum (CoM) defuzzification method, the fuzzy logic controller first determines the typical numerical value for each scaled membership function, as the following figure illustrates. The typical numerical value is the mean of the numerical values corresponding to the degree of membership at which the membership function was scaled.

$$X_{final} = \frac{X_1 \mu_1 + X_2 \mu_2 + \dots + X_n \mu_n}{\mu_1 + \mu_2 + \dots + \mu_n}$$

Where x_n is the typical numerical value for the scaled membership function n and μ_n is the degree of membership at which membership function n was scaled.

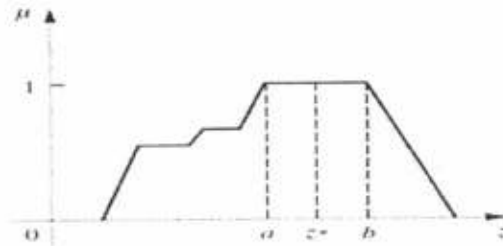


5. Mean of Maximum:

In the Mean of Maximum (MoM) defuzzification method, the fuzzy logic controller first identifies the scaled membership function with the greatest degree of membership. The fuzzy logic controller then determines the typical numerical value for that membership function. The typical numerical value is the mean of the numerical values corresponding to the degree of membership at which the membership function was scaled.

The mean of maximum takes the mean of those points where the membership function is at a maximum.

$$Z^* = (a+b)/2$$



CHAPTER3:
DESIGN AND IMPLIMENTATION

3.1 Block diagram of fuzzy inference system

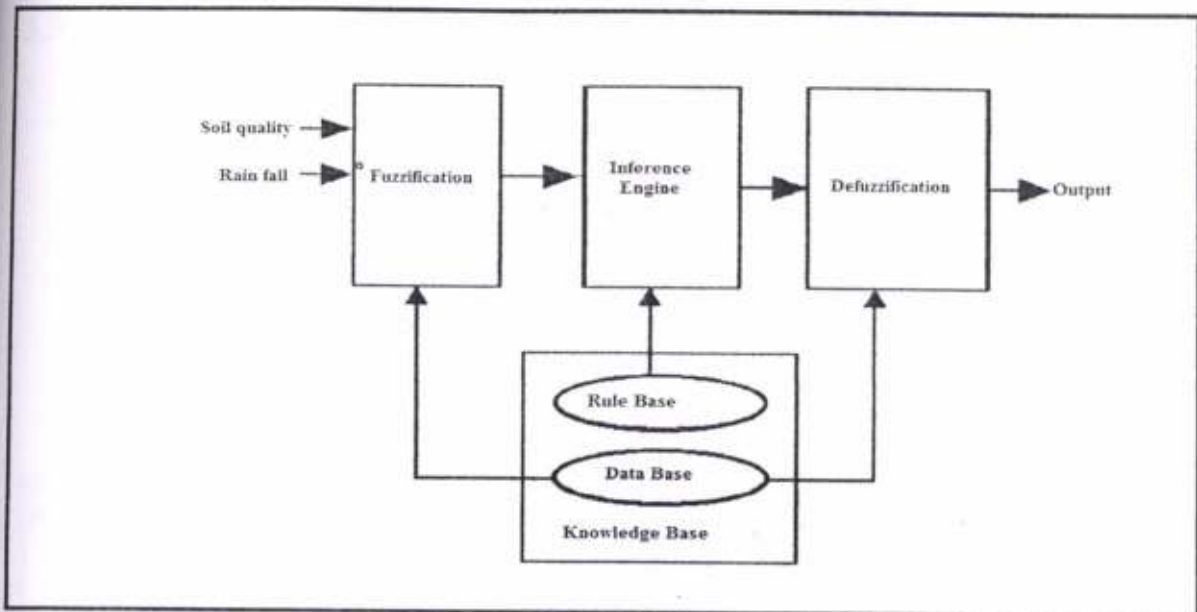


Figure 3.1:- Block diagram of FIS

The FIS designed works as per the input parameters. Once input is given by the user, appropriate rule will get fired and the output is given by the system. For designing of the fuzzy inference system the fuzzy logic tool box is used from the software MATLAB.

3.2 Fuzzy Inference System (FIS) for Grading point

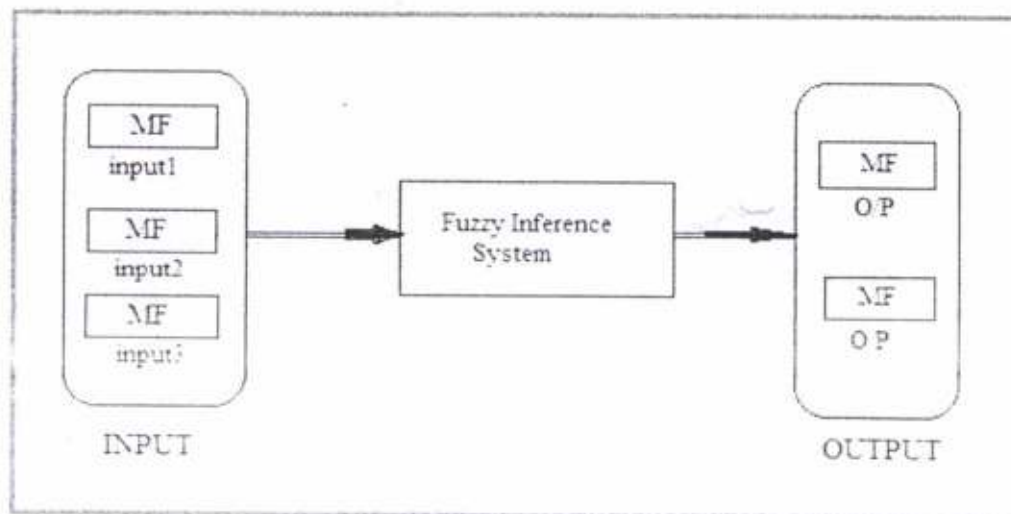


Figure 3.2:-FIS block diagram for grading point

This fuzzy inference system developed for evaluate grading point of student. There are 3 input of exam marks. The rules and membership functions designed for this FIS are as shown in below.

3.3 Main components of a Fuzzy Inference System

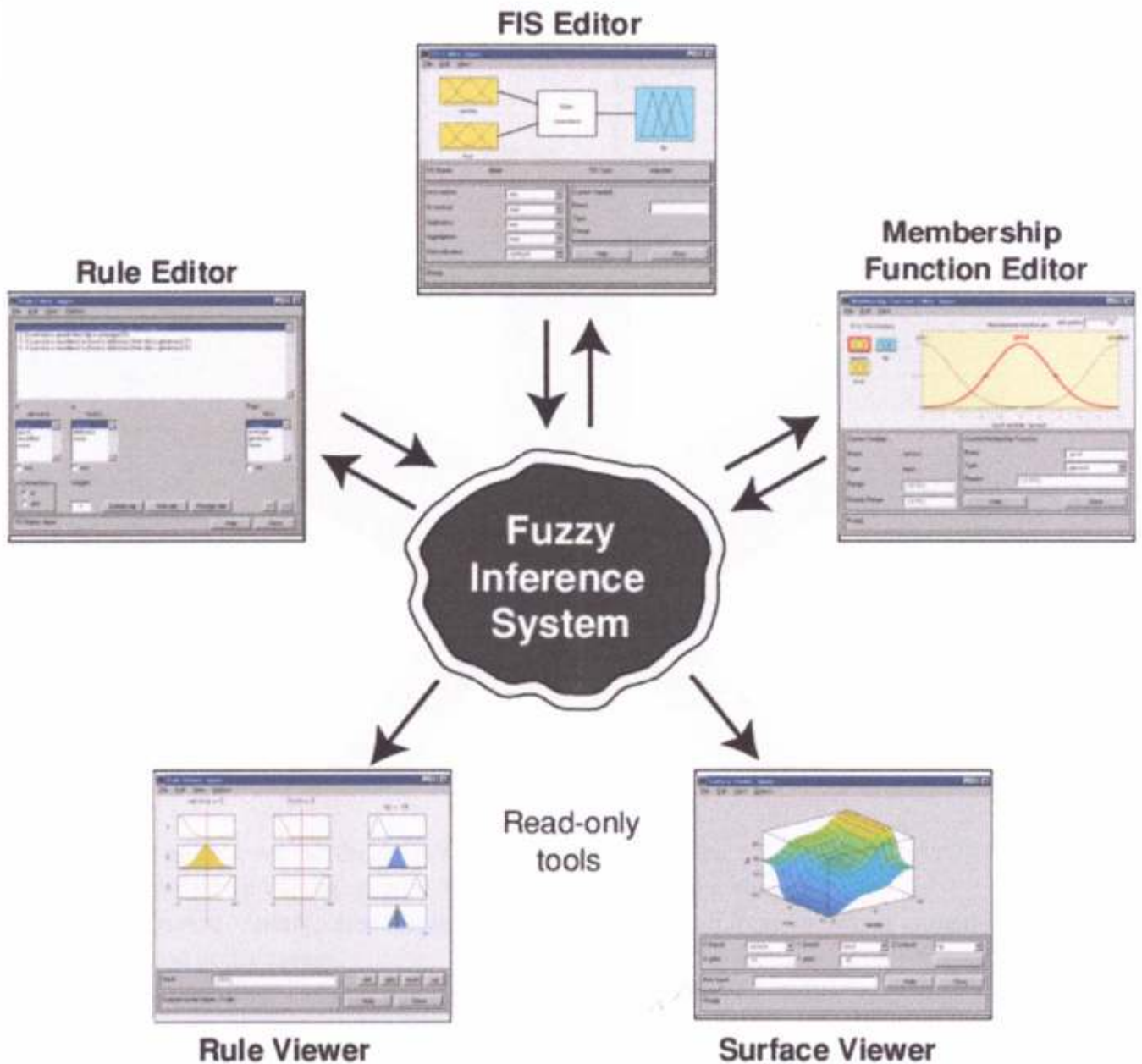


Figure 3.3:-Components of a Fuzzy Inference System

3.4 MATLAB FIS Editor

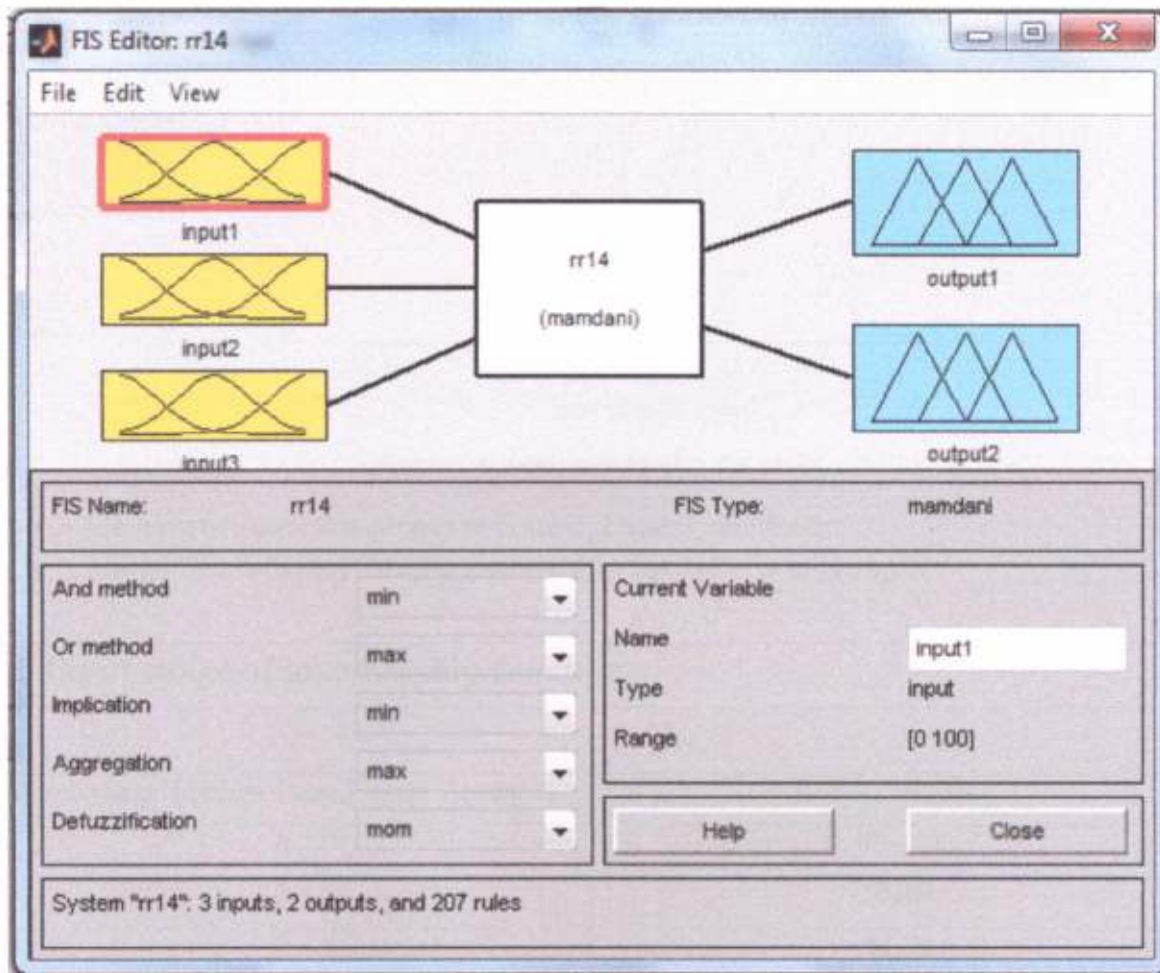


Figure 3.4: - MATLAB FIS Editor

- In this project, we use the default Mamdani-type inference.
- The drop-down lists let us modify the fuzzy inference functions.
- The Current Variable area displays the name of either an input or output variable, its type, and default range.

3.5 Membership function for Input

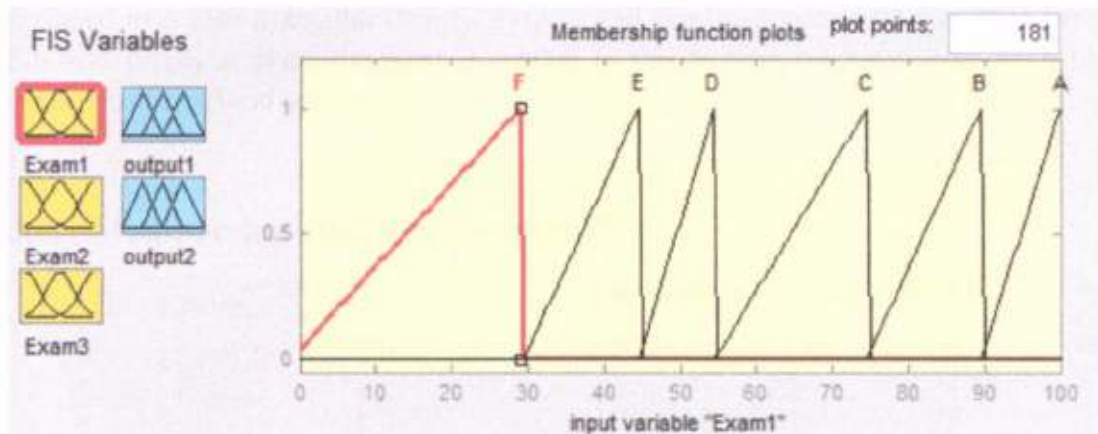


Figure 3.5: Input membership function

- We have selected three input as Exam1, Exam2, and Exam3.
- Assign five different triangle membership function for each input.

3.6 Input range of membership function

Membership function(Exam 1,exam 2,exam 3)	INPUT RANGE
A	90-100
B	75-89
C	55-74
D	45-54
E	30-44
F	0-29

Table3.1:- Input range of membership function

3.7 Membership Functions for output:

The output of this FIS is grade point (0-10) of the student. The membership function assigned to is also triangular (trimf). System will fire the appropriate rule from the particular FIS and finally it gives the desired output. In this system we have considered two output variables output1 and output2.

3.7.1 Membership function for output1

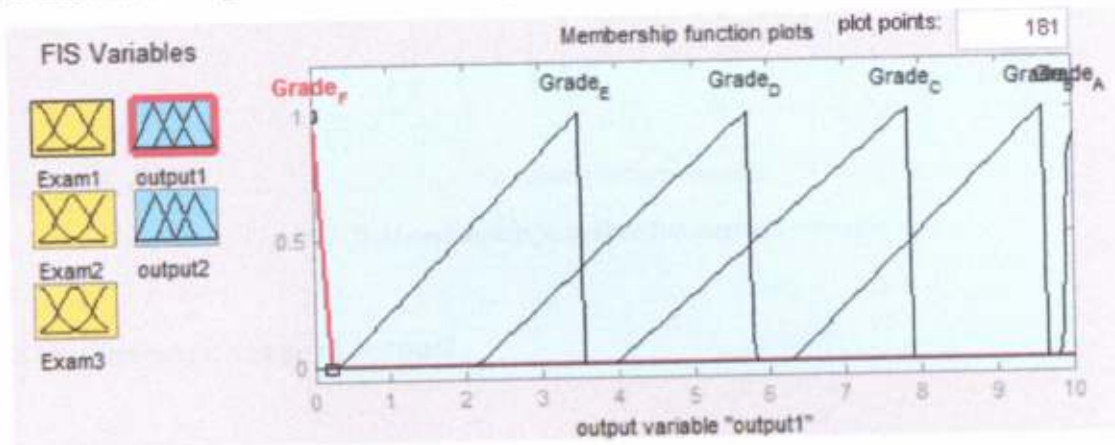


Figure 3.6: Membership function for output1 variable

3.7.2 Output result range of output1

Membership name	Output result range
Grade A	10
Grade B	8
Grade C	6
Grade D	4
Grade E	2
Grade F	0

Table 3.2:-Output result range of output1 variable

3.7.3 Membership function for output2

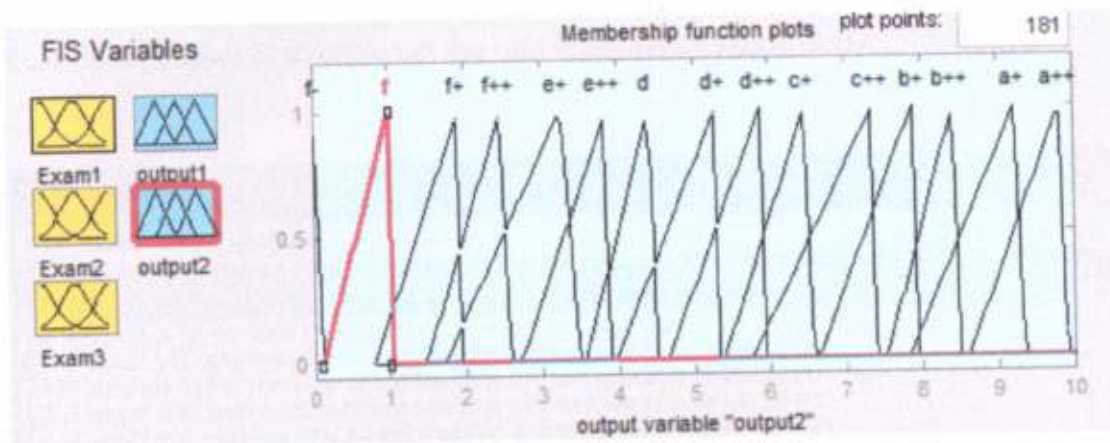


Figure 3.7: Membership function for output2 variable

3.7.4 Output result range of output2

Membership name	Output result range (grade point)
a++	9.3-10
a+	8.6-9.2
b++	8-8.4
b+	7.3-7.8
c++	6.6-7.2
c+	6-6.4
d++	5.3-5.8
d+	4.6-5.2
d	4 - 4.4
e++	3.3-3.8
e+	2.6-3.2
f++	2-2.4
f+	1.4-1.8
f	0.6-1.3
f-	0.0-0.4

Table 3.3:- Output result range of output2

3.8 Rule Editor:

Constructing rules using the graphical Rule Editor interface is fairly self-evident. Based on the descriptions of the input and output variables defined with the Fuzzy Logic Designer, the Rule Editor allows us to construct the rule statements automatically.

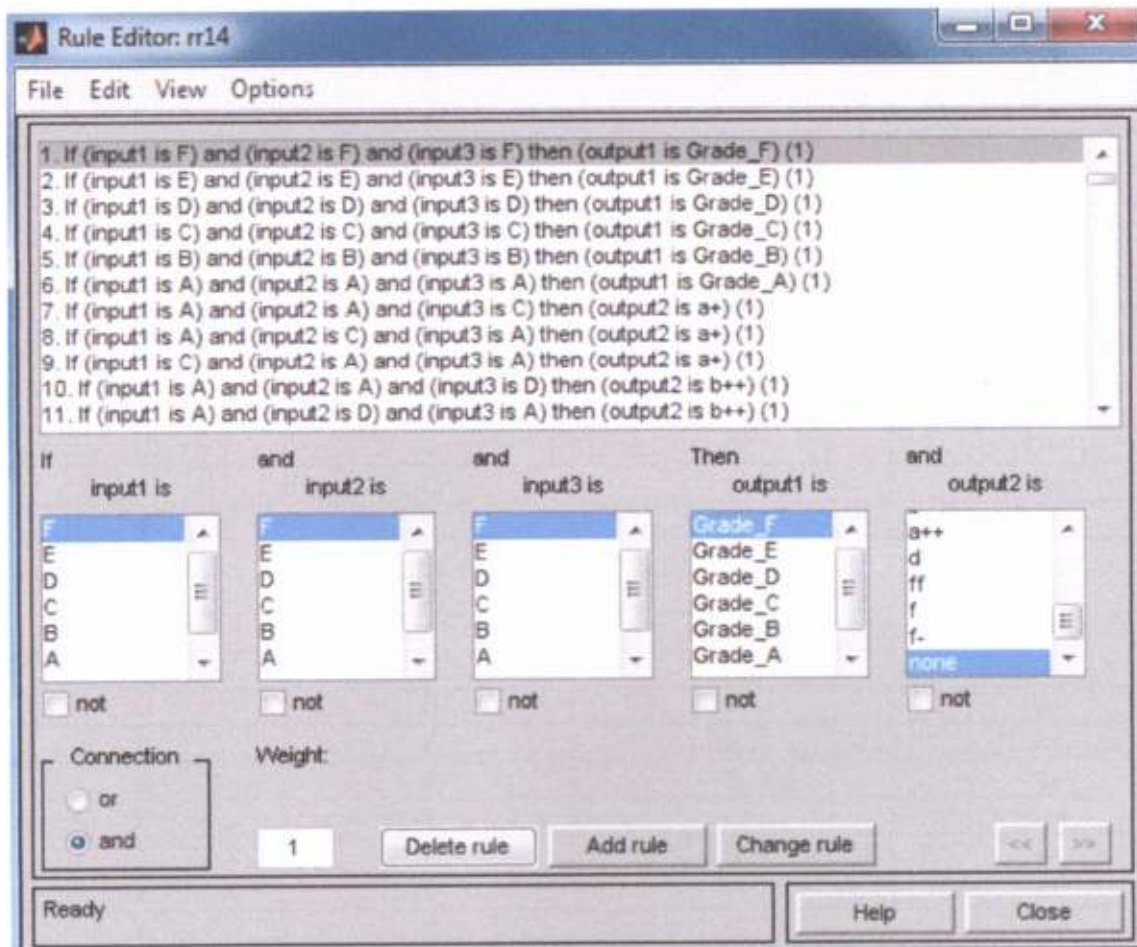


Figure 3.8:-Rule Editor

- Create rules by selecting an item in each input and output variable box, selecting one Connection item, and clicking Add Rule.
- Delete a rule by selecting the rule and clicking Delete Rule.
- Edit a rule by changing the selection in the variable box and clicking Change Rule.
- Specify weight to a rule by typing in a desired number between 0 and 1 in Weight. If you do not specify the weight, it is assumed to be unity (1).

3.9 Rules Designed for the System:-

The rules determine input and output membership functions in inference process. These rules are linguistic and also are entitled "If-Then" rules.

Example: - If Exam1 is A and Exam2 is A and Exam3 is B then Result is A++

Exam 1	Exam2	Exam3	Output2 Membership
A	A	B	A++
A	A	C	A+
A	A	D	B++
A	A	E	B+
B	B	A	A+
B	B	C	B+
B	B	D	C++
B	B	E	C+
C	C	A	B+
C	C	B	C++
C	C	D	D++
C	C	E	D+
C	C	F	D
D	D	A	C+
D	D	B	D++
D	D	C	D+
D	D	E	E++
D	D	F	E+
E	E	A	D+
E	E	B	D
E	E	C	E++
E	E	D	E+
E	E	F	FF
A	B	C	B++
A	B	D	B+
A	B	E	C++
A	B	F	C+
A	C	D	C++
A	C	E	C+
A	C	F	D++
A	D	E	D++
A	D	F	D+
A	E	F	D
B	C	D	C+
B	C	E	D++
B	C	F	D+
C	D	E	D
C	D	F	E++
D	E	F	F

Exam1	Exam2	Exam3	Output1 Membership
A	A	A	A
B	B	B	B
C	C	C	C
D	D	D	D
E	E	E	E
F	F	F	F

Table 3.4: Rules for FIS

3.10 Rules viewer of FIS:

The Rule Viewer displays the result of the whole fuzzy inference process. It is based on the fuzzy inference diagram. The variables and their current values are displayed on top of the columns. In the lower left, there is a text field Input in which we can enter specific input values. The Rule Viewer also shows how the shape of certain membership functions influences the overall result. Because it plots every part of every rule, it can become unwieldy for particularly large systems, but, for a relatively small number of inputs and outputs.

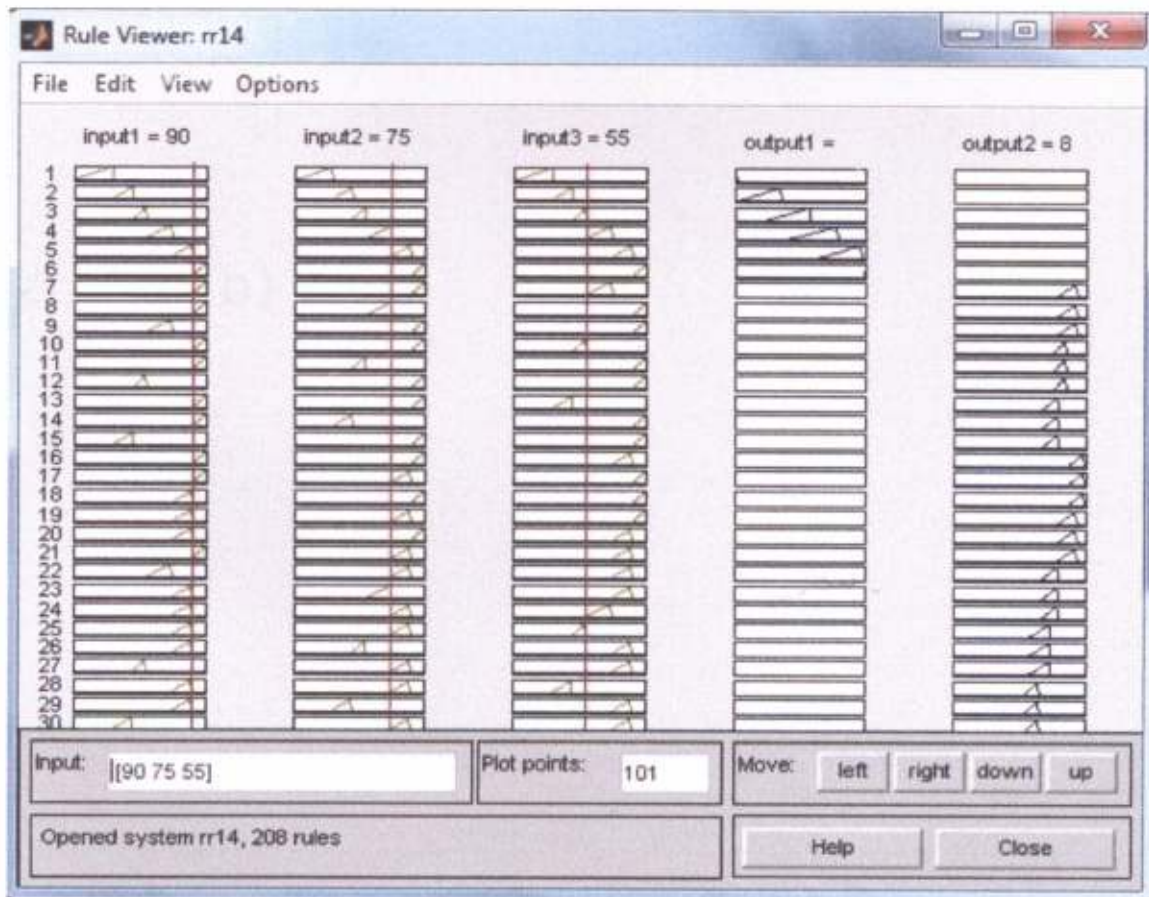
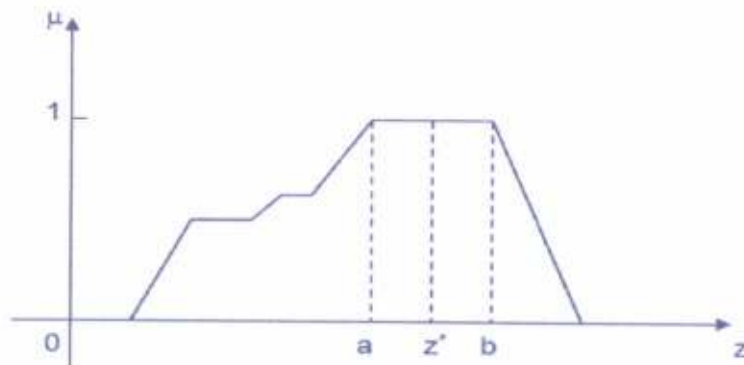


Figure 3.9:-Matlab rule viewer of FIS

In the *Figure3.9*: -Input1 is 90, Input2 is 75 and Input 3 is 55 .The rule viewer fire the appropriate rule which satisfy this combination of input and evaluate the output. Here the output of the system is 8.

3.11 DETERMINATION OF PERFORMANCE VALUE

After completing the fuzzy decision process, the fuzzy number obtained must be converted to a crisp value. This process is entitled defuzzification. Many methods have been developed for defuzzification. In this study, Mean of Maximum (MoM) technique has been applied. In the Mean of Maximum (MoM) defuzzification method, the fuzzy logic controller first identifies the scaled membership function with the greatest degree of membership. The fuzzy logic controller then determines the typical numerical value for that membership function. The typical numerical value is the mean of the numerical values corresponding to the degree of membership at which the membership function was scaled.



$$z^* = (a + b)/2$$

3.12 Institutional method for grade point calculation

Range of Marks	Letter Grades	Grade Point
90-100	A	10
75-89	B	8
55-89	C	6
45-54	D	4
30-44	E	2
0-29	F	0

- Let exam paper credit is 4

Exam Papers	Paper Credit	Grade Obtained	Grade point obtained	Honour Point
Exam 1	4	A	10	40
Exam 2	4	B	8	32
Exam 3	4	C	6	24
TOTAL	12			96

Grade Point = Total Honour Point / Total Paper Credit

$$= 96/12$$

$$= 8$$

3.12 Comparison of Performance Evaluation Methods

Exam1	Exam2	Exam3	Grade	Value in general method	Value in fuzzy logic(grade)
90	90	90	AAA	10	9.95
100	100	100	AAA	10	10
75	75	75	BBB	8	8
89	89	89	BBB	8	9.6
74	74	74	CCC	6	7.8
54	54	54	DDD	4	5.65
45	45	45	DDD	4	4.05
30	30	30	EEE	2	2
44	44	44	EEE	2	3.5
90	90	75	AAB	9.3	9.3
90	75	55	ABC	8	8
50	45	89	DDB	5.33	5.35
30	29	44	EFE	1.33	1.4
90	75	55	ABC	8	8
90	75	45	ABD	7.3	7.3
100	89	54	ABD	7.3	7.8
95	80	50	ABD	7.3	7.5
75	55	45	BCD	6	6
75	55	30	BCE	5.3	5.3
88	70	42	BCE	5.3	5.7
30	90	75	EAB	6.6	6.6
30	90	55	EAC	6	6
44	100	74	EAC	6	6.4
40	95	65	EAC	6	6.2

Table3.5:- Comparison of Performance Evaluation Methods

2.150

Exm 1

90
100
75
80
74
24
42
30
44
90
90
20
30
90
90
100
92
72
72
88
90
90
44
90

CHAPTER 4

CONCLUSION:

Fuzzy Logic provides a completely different, unorthodox way to approach a control problem. This method focuses on what the system should do rather than trying to understand how it works. One can concentrate on solving the problem rather than trying to model the system mathematically, if that is even possible. This almost invariably leads to quicker, cheaper solutions. Once understood, this technology is not difficult to apply and the results are usually quite surprising and pleasing.

When the results are evaluated, a difference in outcomes is seen between the classical method and the proposed fuzzy logic method. While the classical method adheres to a constant mathematical rule, evaluation with fuzzy logic has great flexibility. At the application stage, course-conveners can edit rules and membership functions to obtain various performance values but it is important that the same rules and membership functions are used for all students taking the same lesson. It is also important for the students to understand the assessment criteria before taking examination. For this reason, members of the educational board should communicate with each other and come to an agreement on rules, membership functions and any other criteria.

CHAPTER 5

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