



# Student Score Evaluation Using Simulink and Fuzzy Logic

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## Abstract

Student Evaluation is an assessment by teachers in the institution of learning where solely depends on classroom experience or of all aspects of the learning experience. This research work proposes a modern approach for exam evaluations. Student performance of twenty-five students of National diploma, Agricultural Engineering at Ahmadu Bello University, Zaria. The study carried out, with fuzzy logic and compared with the simulation evaluation method. The two methods were applied on only one subject, whereas the simulation evaluation method gave the exact students score without truncation or approximation in their performance while the fuzzy logic evaluation method truncates the result, which short assessment, their performances.

**Keywords:** Simulink; Fuzzy logic; Membership Function; Student Scores; Exam; Evaluation; Performance;

## 1. Introduction

Student result evaluation is the most important part of the educational process. It is good, students get exactly what he or she has in their exams. Many methods adopted to express student scores; the measurement evaluation is to identify numerically. Gokmenet al (2010), said there are various methods to evaluate student exam scores. Many researchers work on classical method and fuzzy logic (In which the result was shown by active rule graphically) to determine the Student scores is carried out by many researchers, while in this paper Simulink where used, to set rules fuzzy controller, and determined much better measurement for accurate exams evaluation. This research will help institutions of learning to improve the method of students' scores evaluation and to give the students the exact marks gets in each subject without shortfall or increment in their performances. This paper provides more insight on Simulink and fuzzy logic in particular

which first discovered in 1965 by LotfiZadeh [1].

## 1. Literature Review

Fuzzy logic is a way of reasoning that is similar to human reasoning. The come up, of fuzzy logic Imitates the way of decision-making in human that includes all the intermediates possibilities between digitals values YES (1) and NO (0). The fuzzy logic work on the levels of possibly of input to achieve the desired output. The Fuzzy Logic tool is introduce in 1965, also by LotfiZadeh, and is a mathematical tool for dealing with uncertainty[2]. It offers a soft computing partnership with the important concept of computing with words'. It provides a technique to deal with imprecision and information granularity. The fuzzy theory provides a mechanism for representing linguistic constructs such as "many," "low," "medium," "often," "few." Fuzzy logic is a very useful way in problem solving-decision. In addition, fuzzy logic used to deal with perpetual data and find out a precise conclusion. Chaudhari et al

(2012) discovered evaluation is very important in tertiary education for a teacher in order to meet the teaching quality, satisfaction, efficiency and innovation in the institutions[3]. Fuzzy logic seems closer to the way our brains work, this made fuzzy logic become prominent in wide applications such as aerospace, automotive, defence, medical, psychology, transportation, securities, and Business and finance, etc. This is the reasons why fuzzy logic is very useful for commercial and practical purposes, it can control machines and consumer products, it may not give accurate reasoning, but acceptable reasoning and Fuzzy logic helps to deal with the uncertainty in engineering. Fuzzy classified into; type-1 fuzzy sets used in conventional fuzzy systems cannot fully handle the uncertainties present in control systems. Recent developments in fuzzy logic have presented new theories, concepts, and algorithms, extending the original ideas of the pioneering work of Zadeh and type-2 fuzzy. Sets systems can handle uncertainties in a better way [4] because they provide us with more parameters and more design degrees of freedom. One of the applications of fuzzy logic is the measurement and evaluation in education but simulation of the fuzzy logic controller provides more effective student performance. A lot of research discovered the classical method gives less performance value as compared to fuzzy logic[5].But the simulation method is much more accurate than classical and fuzzy logic membership, in this paper triangular is used. A triangular membership function (MF) is defined by its parameter (a, b, c) which are express in equation 1, which is our main concern in this paper.

$$F(x) = \begin{cases} \frac{x-a}{b-a} & a \leq x \leq b \\ \frac{c-x}{c-b} & b \leq x \leq c \\ 0 & x \leq a \vee x \geq c \end{cases} \quad (1)$$

### 3. Methodology

The student exams evaluation in fuzzy must include three different stages, fuzzification of examinations result (the student performance) that is the inputs,

resolution of rules and inferences and defuzzification of the examinations (Score) which is the desired output. As shown below in figure 1.



Figure 1. Stages in an examinations evaluation fuzzy model

### 3.1 Fuzzification of Student Examination Evaluation (Input)

Fuzzification of student examination evaluation (Input). For fuzzification here, the numerical variable (real number) is converting into a linguistic variable (fuzzy number); the input is a crisp numerical value and their membership function of a fuzzy set. Fuzzy set and crisp set are the part of the distinct set theories, where the fuzzy set implements infinite-valued logic while the crisp set employs bi-valued logic [6].

Crisp Set;

$$(\forall x \in A)(x \in A \vee x \notin A) \quad (2)$$

Fuzzy Set;

$$\begin{aligned} \mu_{\underline{X}}(a) &= \in [0; 1] \\ \underline{X} &= \left\{ \frac{\mu_A(a_1)}{a_1} + \frac{\mu_A(a_1)}{a_1} + \dots \right\} \\ &= \left\{ \sum_i \frac{\mu_x(a_i)}{a_i} \right\} \end{aligned} \quad (3)$$

The membership function modelling is very vital in the fuzzy set, in this paper as mention earlier the triangular membership function (MF) were used, because triangular membership functions in fuzzy logic are recommended for student exams results in evaluation by many researchers. In this paper, simulation been employed for much better results by using Simulink blocks to clarify the result in a better way than usual. There are two input variables, which are Middle term Examination and Final Semester Examination for twenty-five (25) all in order to have equalled weighted. The linguistic expression for a fuzzy set of exam result variables shown in Table 1

Table 1: Fuzzy set of exam result variables.

S/no	Range	Interval	Linguistic Variables
1	0 to 35	(0 0 35)	Poor (P)
2	0 to 70	(0 35 70)	Satisfied (S)
3	35 to 100	(35 70 100)	Good (G)
4	70 to 100	(70 100 100)	Excellent (Ex)

The membership functions of Mid. Exam and Final Exam given in Figure 2.

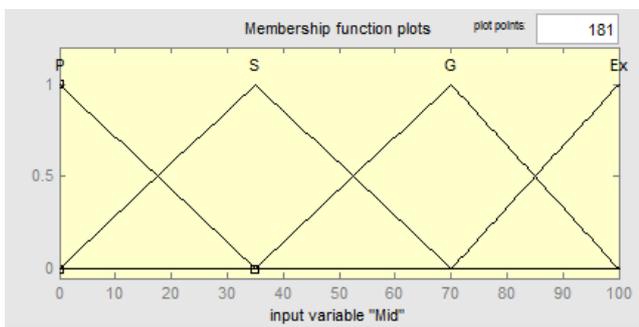
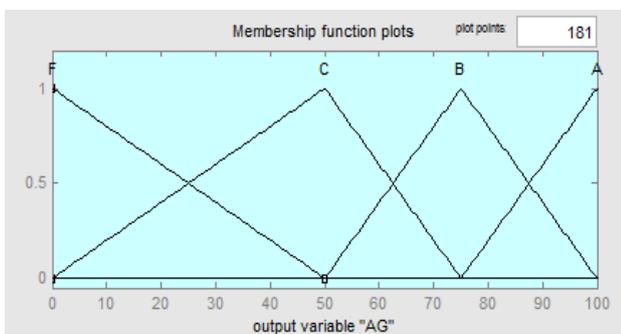


Figure 2. Graphical representation of input variables membership functions

For output variables, the result classified into four levels of performance or four-membership function. Table 2 shows the linguistic expression in student performance.

Table 2: Fuzzy set of Student Performance output.

S/no	Range	Interval	Linguistic Variables
1	0 to 50	(0 0 50)	F
2	0 to 70	(0 0 50)	C



3	50 to 100	(50 75 100)	B
4	75 to 100	(75 100 100)	A

Figure 3 the membership function of student scored

### 3.2 Resolution of Rules and Inferences Methods.

1. If (midterm is p) and (final Exam is P) then (AG is F).
  2. If (mid-term is p) and (final Exam is S) then (AG is F).
  3. If (mid-term is p) and (final Exam is G) then (AG is C).
  4. If (mid-term is p) and (final Exam is Ex) then (AG is C).
  5. If (mid-term is s) and (final Exam is P) then (AG is F).
  6. If (mid-term is s) and (final Exam is S) then (AG is C).
  7. If (mid-term is s) and (final Exam is G) then (AG is B).
  8. If (mid-term is s) and (final Exam is Ex) then (AG is B).
  9. If (mid-term is g) and (final Exam is P) then (AG is F).
  10. If (mid-term is g) and (final Exam is S) then (AG is C).
  11. If (mid-term is g) and (final Exam is G) then (AG is B).
  12. If (mid-term is g) and (final Exam is Ex) then (AG is A).
  13. If (mid-term is Ex) and (final Exam is P) then (AG is C).
  14. If (mid-term Ex) and (final Exam is S) then (AG is B).
  15. If (mid-term is Ex) and (final Exam is G) then (AG is B).
  16. If (mid-term is Ex) and (final Exam is Ex) then (AG is A).
- Graphical presentation in the MATLAB R2014A rule viewer. The active rules and result of a student with Mid-term is 90 marks and Final Exam is 95 marks shown is Figure 4.

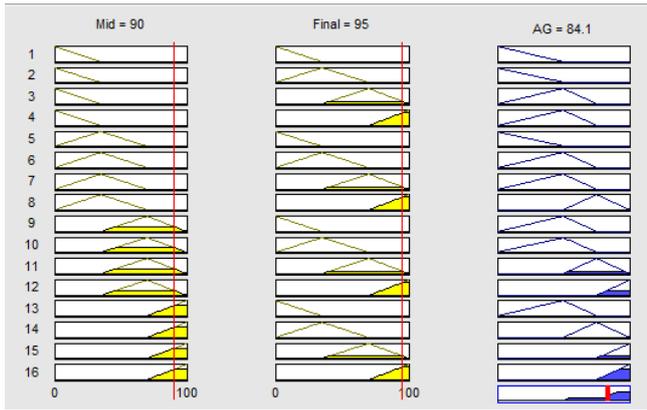


Figure 4 Active rules and result with Mid-term 90 marks and final Exam is 95 marks graphically.

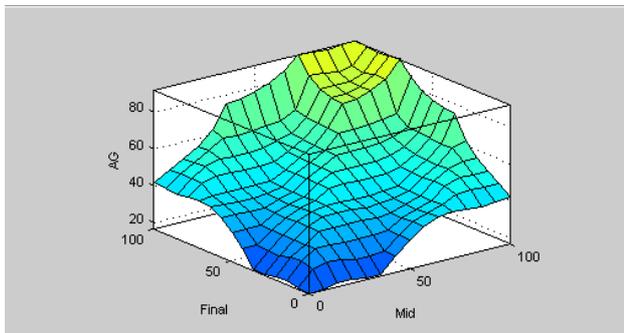


Figure 5 Surface viewer for student Scores evaluation

### 3.3 Simulation Set Up

Simulink is a simulation and model-based design environment for dynamic and embedded systems integrated with MATLAB Simulink, the simulation used, to evaluate a new design. In this research study, MATLAB2014a Simulink library is used. Whereas the fuzzy logic FIS file uploaded into fuzzy controller blocks, constant blocks serve as an input of mid-term and final exam, Mux and display block to show the exact performance value of the student. Student result with Mid-term is 90 marks and the final exam is 95 marks is shown in Figure 6

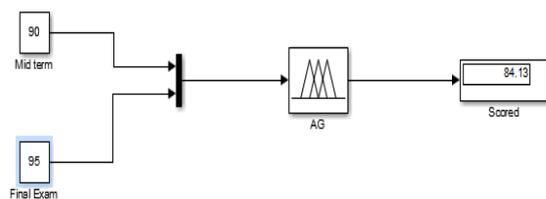


Figure 6 Simulation result with Mid-term is 90 marks and final exam is 95 marks

### 3.4 Defuzification of Examinations Score

Defuzzification is the method of producing a quantifiable result in crisp logic, its process that map fuzzy set to a crisp set. There are many types of defuzzification but in this paper, the centre of area (COA) where used. The crisp values calculated by equation 4.

$$Z = \frac{\int \mu_c(z) \times x \times dz}{\int \mu_c(z) \times dz} \quad (4)$$

## 4. Result

The students score evaluation of both fuzzy logic and simulation of twenty-five students (25) given in Table 3.

Table 3: Students Score and Performance Value

Students	Mid-term	Final-Exam	Fuzzy Logic	Simulink
1	90	95	84.1	84.13
2	78	95	84.5	84.54
3	89	75	80.3	80.27
4	47	90	58.7	58.73
5	69	63	63.6	61.87
6	28	86	53.6	53.63
7	57	50	51.4	51.36
8	95	55	65.2	65.24
9	64	55	54.5	54.54
10	64	78	63.9	63.89
11	47	59	49.6	49.63
12	68	56	55.3	55.25
13	95	78	84.5	84.54
14	57	50	51.4	51.36
15	78	57	57.1	57.11
16	66	64	63.2	63.17
17	88	56	57.7	57.57
18	57	22	37.3	37.29
19	59	50	51.4	51.36
20	57	35	40.8	40.83
21	80	44	50.5	50.54
22	35	86	53.6	53.63
23	100	99	92	91.98
24	45	50	48.8	48.79

25	67	66	66.2	66.21
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The membership function of the students' scores evaluation uses triangular membership function in order to find the actual performance value. All results above found that the Simulink method is more justice and fairness than the fuzzy logic method; it gives the exact value of students' score. Student number 1 that has 90 and 95 in Mid-term and Final exam respectively the result shows some alteration between the two methods whereas the number behind the decimal point truncated in fuzzy methods while the Simulink methods provide the actual performance. Likewise, student of number 10 the numbers behind the decimal were increase in the fuzzy method. This shows that the Simulink method is much better in students' assessment it provides actual performance without favour.

## 5. Conclusion

The objective was to give a good exams evaluation approach to determine the best method. The result is evaluated there is a disparity in the outcome between the fuzzy logic (Active Rule) and Simulation blocks method. From the result in Table 3. It seen that the Simulink method has greater flexibility, compatibility, and accuracy than the fuzzy logic method (Active Rule). Whereas the simulation result gave the exact students score without any truncation or approximation. The main aim of this research

is to come out with a better method for student score evaluation in order to determine the student exact performance in the subject. In this research, only one course for National Diploma Students in Agricultural Engineering applied in both different methods fuzzy logic and simulations method.

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