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Designing A Fuzzy Rule Based System To Predict Students Academic Performance In Adamawa State University Mubi

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ABSTRACT

This research work is for the design of fuzzy logic based expert system to predict student academic performance in Adamawa State University Mubi; Fuzzy Inference System (FIS) is used in this work, Gaussian membership function is used in this research work; the described experiments were implemented on MATLAB environment 12. Some candidates were used to test the system. The results of the findings reveal that Student academic performance can be predicted based on the inputs used, the system shows 90% accuracy.

Keywords: Linguistic variables, truth values, anti-lock brakes

INTRODUCTION

The primary aim of the admission system in the university is to have candidates who would likely perform excellent or good. Hence the quality of graduates would have direct positive impact on the development of the state and/or country, since at long run these graduates eventually become key players in running the country affairs in all sector of the economy. Oladokun, Adebanjo and Charles-Owaba.

In Nigerian context, the system of education remain 9-3-4, that is Universal Basic Education (UBE) which was introduced in 2006, where a student would spend first nine (9) years of fundamental and mandatory education up to JSS III, three (3) years in the senior secondary school and four (4) years in tertiary institution (Ayeni and Dada 2011). Student takes West African Senior School certificate Examination (WASSCE)/National Examination Council (NECO) or NABTEB (for Technical Colleges), candidate is expected to register nine (9) or seven (7) subject including Mathematics and English being compulsory and other seven (7) or five subjects are combination of either Sciences or Art subjects, for these subjects three (3) categories of grade are obtainable. Distinction grades (A1, A2, A3), credits grade (C4, C5, C6), pass grade (P7, P8) and Fail grade (F9) [1].

The criteria for admission into the Nigerian Universities are contained in a brochure which provides detailed information on courses and entry requirements which include:

- Five 'O' level credit passes in relevant subjects including English and Mathematics particularly for science and social sciences while mathematics may be required at an ordinary pass level for Arts students.
- The candidates must equally score the minimum cut-off marks for the desired course of study [2].

However, despite this entry requirement some students do not perform well. It is expected that student that undergo such process would be able to graduate with either first class (excellent) or second class upper division (good) but it is not always so why? Hence there is a need to improve the quality or standard of the whole system in order to produce qualified graduates in Nigeria. This study intend to show the possibility of using fuzzy logic based expert system to predict student performance before admitting the student into the university by using the student background and their associated performance as an inputs to the fuzzy logic system to predict student class of degree upon graduation from the university.

In this research, a fuzzy logic based expert system that would predict student's performance in (Adamawa State University Mubi as a case of study) is designed to.

- Explore some factors that influence students' academic performance.
- Use these factors as inputs to the fuzzy logic based expert system.

Fuzzy logic

The seed of fuzzy logic was first planted in 1960s by Prof.Lofti A. Zadeh at University of California, Berkely, as a way of processing data based on linguistic description [3]. The mathematical foundation of fuzzy logic rest on the shoulder of fuzzy set theory (Ponce and Ramirex 2010). Fuzzy set theory provides a systematic calculus to deal with information that is imprecise or incomplete linguistically, and it performs numeric computation by using linguistic labels stipulated by membership functions (Vamsi Mohan Peri, 2002).

"Paradoxically one of the principal contributions of fuzzy logic- a contribution which is widely unrecognized is it power of precisiation of what is imprecise" [4].

Fuzzy logic may be regarded as an attempt at formalization of two important human capabilities, first the capability to think and make rational decision in an environment with incomplete information. Second the capability to carryout wide variety of physical and mental task without any dimension or computation [4]. Fuzzy logic is a superset of conventional logic that has been expanded to handle the concept of partial truth values between the Boolean dichotomy of true and false [5]. Fuzzy logic deal with knowledge representation, semantic of natural or artificial language and analysis of information [4].

The concept of fuzzy logic in a real world scenario allow imprecision to be expressed in a quantitative fashion this can be done by introducing a set of membership function represented by μA (x) which maps element X to real values between 0 and 1, the value shows the degree to which an element belong to set A [3].

Membership function

Membership functions are mathematical tools for indicating flexible membership to a set, modeling and quantifying the meaning of symbols. They can represent a subjective notion of vague class such as chairs in a room, size of people tall, short, and average, and performance such as good, very good, excellent, among others (Ponce and Ramirez 2010). Basically there are different forms or shapes of memberships function in fuzzy logic such as Gaussian, Triangular, Trapezoidal, singleton, among others. The figures below illustrate membership function.

Linguistic variables

Linguistic variables are inputs or outputs variables whose values are not numeric but wards or sentences in a natural or artificial language, the motivation behind using wards or sentence in place of numeric values is that linguistic features are in general less specific than numeric values [6]

Fuzzy system

A fuzzy is a control system that used the basic principles of fuzzy logic to deliver a definitive conclusion to a problem that has the following characteristics vague, ambiguous, imprecise, noisy, or even uncertainty [7].

Fuzzy Inference System (FIS) is the editor that shows the inputs, outputs and fuzzy logic inference engine (central fuzzy rule Processor) as shows in the Figure 1 below;

Figure 1. Fuzzy inference system editor

Fuzzy set operation

Fuzzy set operation are basically derived from classical set theory, however there are three fundamental operations used in fuzzy set theory these are intersection, Union, and complement operators. Union and intersection are often referred to as the fundamental building blocks that compute the fuzzy if-then rules. Both this operators work in the same manner as Boolean logic to perform computation, the union operator uses the Boolean term OR, intersection operator use the term AND and complement use the term NOT which are the blocks for building if-then rules in fuzzy system.

Inputs variables

The inputs are UTME Score, O'Level Result, Type of secondary school attended and age of the students were used for this experiment as shown below;

UTME SCORE

- 310 – 400
- 260- 300
- 200- 250
- 180-190

The Figure 2 below shows how UTME scores has been used as a membership functions for this experiment

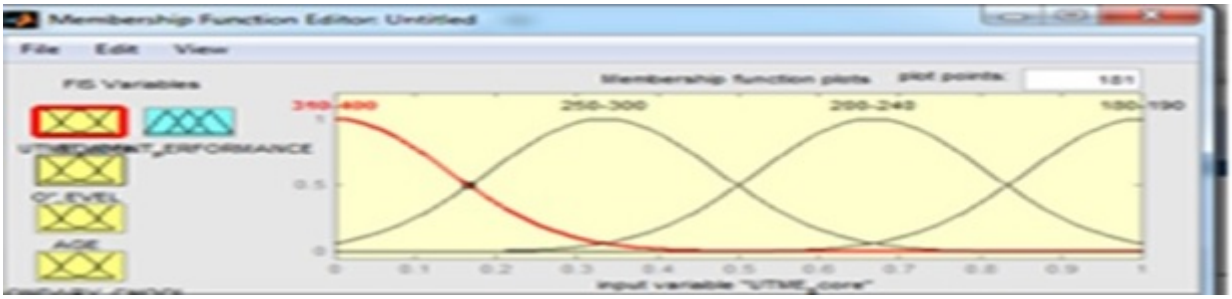

Figure 2. UTME scores as a membership functions

O'Level result

- Five distinction
- Three distinction two credits
- Five credits
- Three credits two passes
- Five passes

The Figure 3 below show how O'Level results used as a membership functions for this experiment;

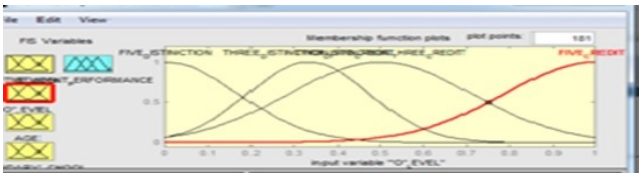

Figure 3.O'Level results as a membership functions

Types of secondary school attended

- Private
- Federal government
- State government

The Figure 4 below illustrate how the type of secondary school attended is used as a membership functions to the fuzzy system

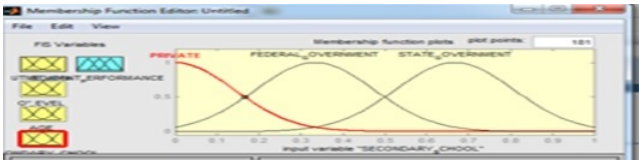

Figure 4. Type of secondary school attended as a membership functions

Age of student

- 18-22
- 23-25
- 26-30
- 31-40

The Figure 5 below depict how age of the student are used as a membership functions to the fuzzy system

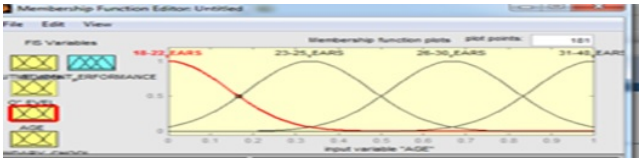

Figure 5. Age of the students as a membership function

Student performance (Predicted outputs)

- First class
- Second class upper division
- Second class lower division
- Third class
- Pass

The Figure 6 below illustrate the predicted outputs of the fuzzy system in this experiment

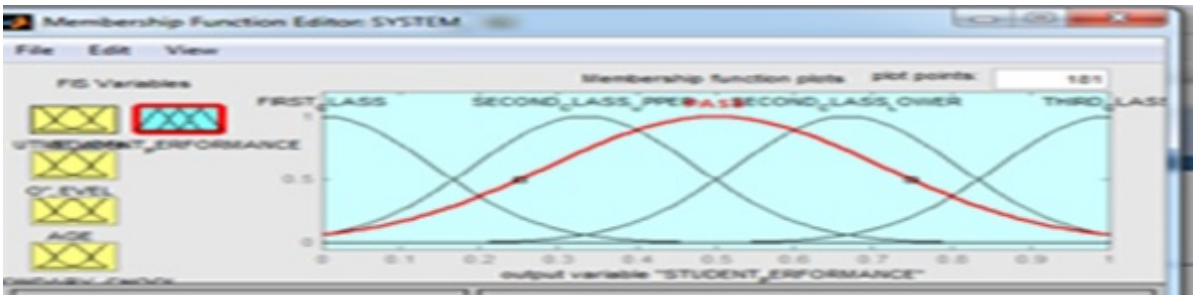

Figure 6. Student performance as a membership function

METHODOLOGY

The factors that influence the student's academic performance were studied and are inputs to the fuzzy logic based expert system and the output predicted are based on the universities standard of degree (first class, second class upper division , second class lower division, third class and Pass degree).

Fuzzy inputs

- UME scores (US)
- O'Level result (OL)
- Age of the students (AS)
- Type of secondary school attended (Private, State, Federal government) (TSS)

Implementation

In this research, MATLAB 12 fuzzy logic toolbox is used for fuzzy rule based expert system. The research work is structured on as four (4) inputs and one (1) output as stated above. The implementation has performed with the help of fuzzy rule under the following criteria as an inputs "UME score", "O' Level Result", "Type of secondary school attended", "Age of the student and "student performance" as an output. A membership function value for both inputs and output criteria is contributed using MATLAB 12 five (5) fuzzy rules has been obtained in the combination of the system now based on this system it possible to predict student academic performance.

Rule Editor is a an editor that generate rules automatically based on the description of inputs and outputs variables define with Fuzzy inference system (FIS) as shows in the figures below (Figure 7);

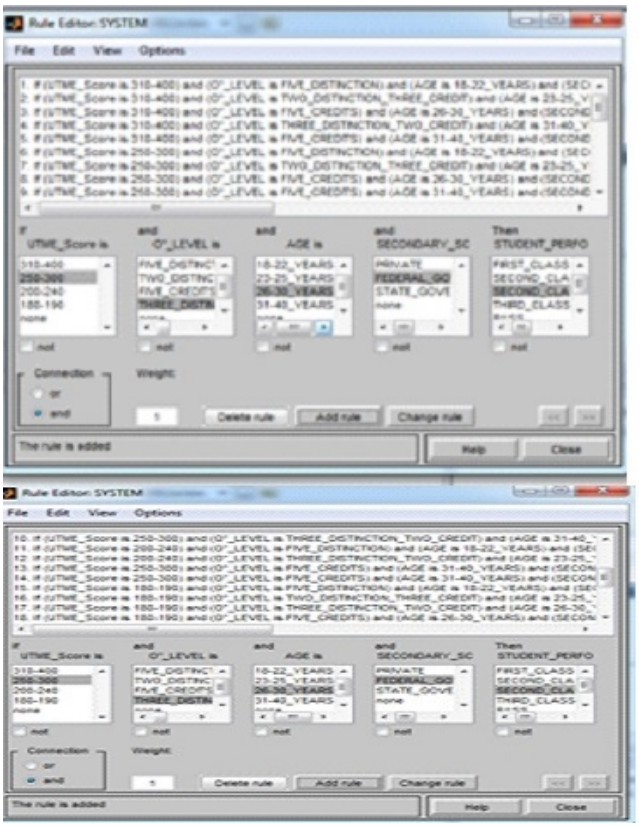

Figure 7. Rule editors

Rule viewer based on the fuzzy inference engine of the system five plots were obtained, five plots across the top of the figure below represent the antecedent and consequent of the first rule, each rule represent a row of plot and each column is a variable. First column represent UTME Score, second column represent Olevel, third column represent Age of the student, fourth column represent type of secondary school attended and the fifth column represent student performance. First four column represent inputs and fifth column is the output as shown in the Figure 8 below;

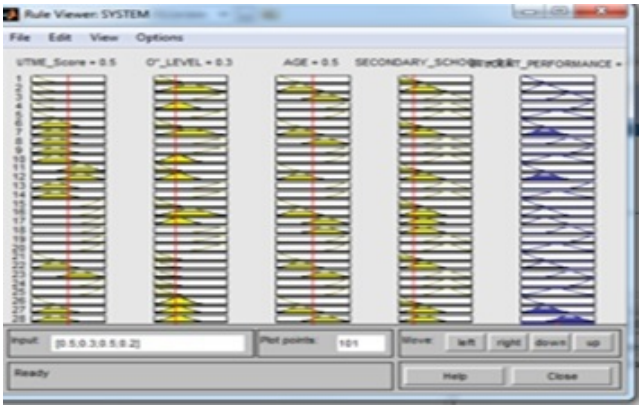

Figure 8. Rule viewer system

Based on this research work surface viewer is a three -dimension curve that represent the mapping from UTME Score and O'Level to student performance. Basically the curve represents only two inputs and one output case. But you can see the entire mapping in one plot by selecting from drop down menus labeledX(inputs), Y(inputs) and Z(outputs) as shows in the figures below (Figure 9);

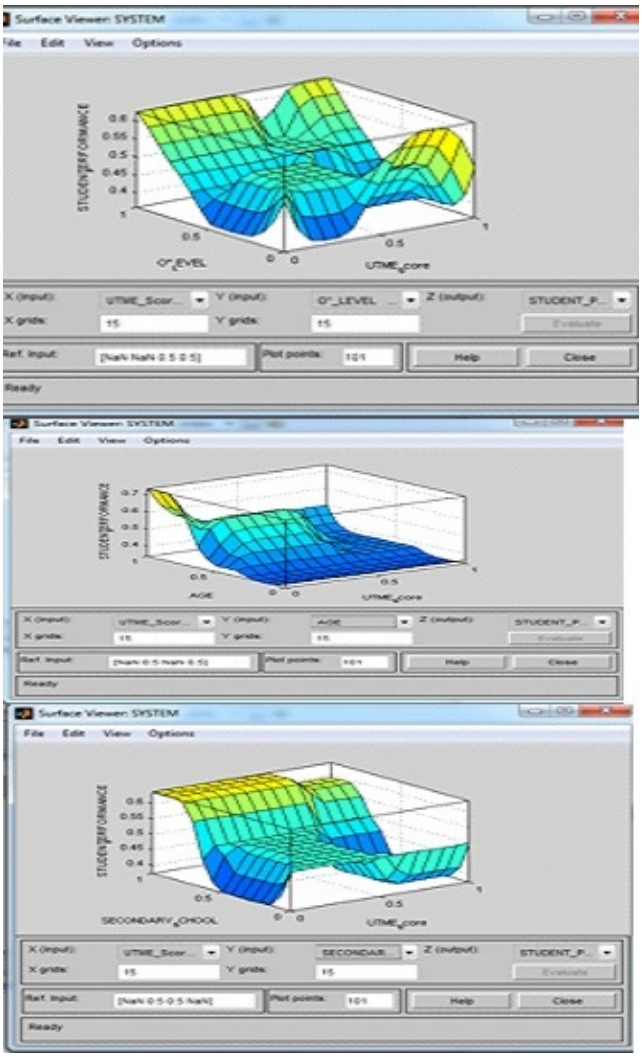

Figure 9. Surface viewer

CONCLUSION

In this research work fuzzy logic toolbox using Fuzzy inference system (FIS) has been used to design the system on MATLAB environment 12, four (4) inputs was used to feed in the system to produce one (1) output, three (3) different candidates were used to test the system and the results shows 90% accuracy.

ACKNOWLEDGEMENTS

Based on this research work we recommends that further research on this work would led to a system that would be used in Nigerian universities to predict students academic performance prior to offering them admission and also can be used oversea universities to obtained responsible, dependable and reliable graduates.

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