

# Fuzzy Logic: A Technique for Assessing Students' Learning Performance

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## Abstract

Learning assessments of students are very vital in assessing the overall learning performance of students. Knowing the learners capabilities are always part of a teacher's job to fully understand the learner's need. Hence, the researchers were motivated to conduct this study on the purpose of evaluating and identifying the performance of students using the fuzzy inference. The research is focused on the private university students. Results of examinations from both the lecture and laboratory classes are evaluated to determine how the student performs in a class. The exam scores of lecture and laboratory class serve as input to the fuzzification technique to determine which among the two class types would the students perform well. In this paper, fuzzy logic basic concepts are applied on the exam results. The authors then concluded that students are performing better during laboratory examinations.

**Keywords:** *learning performance, examinations, fuzzy logic, fuzzification.*

## I. INTRODUCTION

Most evaluations measure quantitative performance of a person be it an employee staff, faculty and even students. In the academic setting, it is very important to evaluate the learners' acquisition of knowledge and skills. There are several assessment techniques that could be applied to validate students' performance and these could be through written and practical (hands-on) application. In educational system, particularly at DLSU-Dasmariñas, students are evaluated based on lecture and hands-on performance. These student performance plays significant role for professors as these would give them an idea on how students are coping with their lessons. Hence, evaluation tool should be used to evaluate these student performance.

It is worth nothing that fuzzy logic tools are applied by most researchers in the academic area. Although the term was first introduced in 1965 there has been studied since the 1920s known as infinite-valued logic. Since then, it has been applied to several fields[1]. Solution to problems that involves absence of sharply defined criteria is through the application of Fuzzy set theory[2]. Rajiv Bhatt and Dr. Darshana Bhatt (2011) have evaluated the flexibility and reliability of fuzzy logic in the field of engineering. G.A. Bhosale and R. S Kamath (2013) have evaluated the effectiveness and accuracy of the teaching staff in performance appraisal. James R. Norlan (1998) has developed an expert fuzzy classification. The function of the system is to support teachers for evaluating student writing. The system increased the consistency of the scoring for individual and group assessment.

Mamatha S. Upadhaya (2012) have evaluated the performance of students of Higher Education on the foundation of fuzzy inference system. Taking non-precise input factors serves a basis for this process.

Students' performance is usually evaluated through their examinations given by the schools. Since the demand professionals under Information Technology are too high, it is but fitting that we have to evaluate the performance of computer science students as well as students from other IT related courses. The evaluation is understandable as a measure of aptitudes, views and principle describing what a learner has learned or can do. This can be assess through applying fuzzy logic technique.

Hence, the researchers used fuzzy logic in evaluating the performance of IT students. The aim of this research is to identify the successfulness of students' performance in lecture and laboratory assessment.

## II. RELATED LITERATURE

There are a lot of researches that uses fuzzy logic in various fields. Some uses it in traffic management, motors, and most commonly to performance evaluations of employees. Further, Fuzzy logic concepts can be applied to performance evaluation in the academe.

In terms of application in traffic lights, authors in their research study cited that in most cities in the entire world, the congestion problem in the traffic is considered a major issue. They have developed an effective advanced traffic monitoring and control system using fuzzy logic controller. The researchers have used VB6 and Matlab for their prototype. VB6 was uswd to simulate traffic intersections while Matlab was used on giving decisions of extensions. Both fixed and fuzzy traffic controls are used to compare the effectiveness[3].

In the articles of Zhao and Bose, the fuzzy controller sensitivity are being used, analyzed it and evaluated the different membership functions for speed controlled induction motor drive[4].

Further, N. Arbay and Z. Suradi proved that fuzzy logic is used as a tool to measure performance appraisal of the staff. The study proved that fuzzy logic approach can handle the imprecision and uncertainty information. The way people think and make judgements are imprecise data and they have proved that through fuzzy models it can handling these kind of data[5].

According to these another set of authors, they created a Fuzzy Expert System that will evaluate the overall performance of teachers. These researchers based their study on fuzzy logic. They further shows how the principles of fuzzy logic be implemented in the academe to evaluate performance of teachers Their system can further help all educators in an organization in their annual reports [6].

According to the study of Sirigiri Pavani, Kajal Kiran Gulhare and Gangadhar, there are many reasons attributed to the need for evaluating the performance of a teacher. Students improvement, students' monitoring, and students betterment. The researchers consider some of the most relevant factors and develop rules will be fuzzified. They concluded that in evaluating the performance whether positive or negative direction, the shape of membership function is not playing much rule[7].

Another study was conducted on Fuzzy Expert System with the goal of evaluating academically the performance of students using fuzzy logic methods. They concluded that using fuzzy logic is not only appropriate for student performance evaluation but also laboratory application [8].

Further, Khairul A. Rasmani and Qiang Shen discuss the use of fuzzy techniques in

several approach. They have introduced a practical technique for the evaluation of learners' performance which uses data-driven fuzzy rule induction. Norm-Referenced Evaluation (NRE) has been performed in applying this new method [9].

Another study conducted by Shilpa et al. proposed an approach that is useful for both subjective and objective type of questions. The said method considered the complexity of questions that makes fuzzy logic and inference system [10].

Another study conducted by Shilpa et al. used the fuzzy logic to improve statistics on the assessment of teaching. Authors concluded that their proposed method is very helpful in assessing subjective answers. The improved system will become transparent, fairer and beneficial to all students [11].

In terms of E-Learning, M. A. Hogo used the fuzzy clustering techniques that discovers the category of learners and predict their profiles. He used fuzzy c-means and kernelized to classify behaviour of e-learners. He compared the two techniques and as a result the study proved that the use of FCM is much better in predicting the learner's behaviour [12].

Further, Suvarna et al. uses the following modules: Fuzzification, IF-THEN rules knowledge-base, inference engine and defuzzification [13].

According to N. Macwan and Dr. P. S. Sajja (2013) the fuzzy evaluation technique allow the reviewers to draw the conclusion from ambiguous information. The study discussed the factors that effects the performance evaluation and methodology based on performance appraisal [14].

Further, Ashwani Kharola, Swarnima Kunwar and Gopa B. Choudhury, made

a comparison of traditional average technique versus fuzzy system for evaluating the learner's performance. The study considers the personality traits and academics of students for further evaluation. Matlab-Simulink model has been built for better result of the study [15].

### III. METHODS

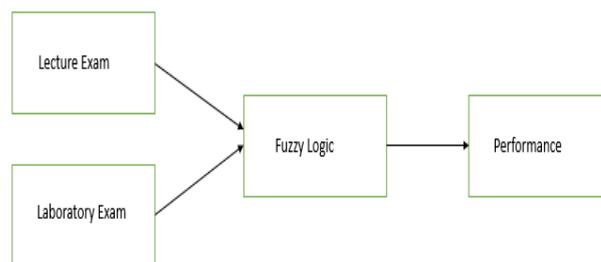


Figure 1. Determination of Students' Performance

The figure 1 shows the diagram of determining the students' performance with fuzzy logic. There are two inputs namely lecture and laboratory examinations. This two inputs are used in fuzzification which in the end determines the relevance rules and inference method.

### IV. RESULT AND DISCUSSION

Input variables and the fuzzy set membership functions was used to conduct the fuzzification of inputs examinations outcomes. The examination results from lecture and laboratory will serves as inputs of the fuzzy logic.

Using these membership functions and input variables, fuzzification of the results of lecture and laboratory examinations was brought out. Originally, membership functions have an interval for the two exams and have an equal weighted comfortable. The fuzzy set of input variables for both lecture exam and laboratory exam are shown in Table 1a and Table 1b. It is seen that the exams in lecture and laboratory can belong to one another. Conversely, there could be difference in the two memberships. In lecture, while the score of 10 belongs to "Low membership function", and both lecture and

laboratory has scored 30 in an expression of “Comfortable”, but weighted more heavily within the “High membership function”. On the other hand, in laboratory, the score of 5 belongs to “Low membership function”, a score of 15 belongs to both “Comfortable” but weighted more heavily within the “High” membership function. It is seen that both lecture and laboratory exams can belong to one or two membership functions thoughts membership weights can be different.

Table 1a.Lecture exam fuzzy set

Linguistic Expression	Symbol	Interval
Low	L	(0,0,10)
Comfortable	C	(10,20,30)
High	H	(30,40,50)

Table 1b.Laboratory exam fuzzy set

Linguistic Expression	Symbol	Interval
Low	L	(0,0,5)
Comfortable	C	(5,10,15)
High	H	(15,20,20)

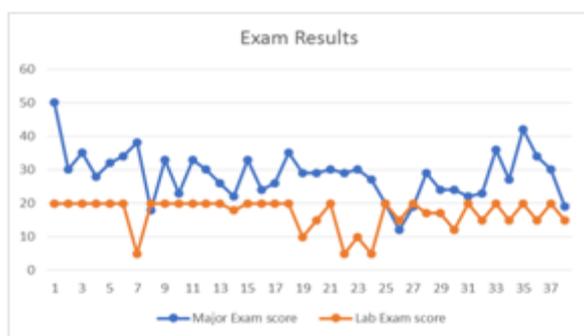


Figure 2. Visualization of the Student’s Performance

Image above shows the visualization of the performance of the students for both lecture and laboratory exams. It is seen that the performance

of the students in laboratory is more successful than in lecture exam. Also, less number of students got failed performance in laboratory examination. It is proved that most number of students who were taking laboratory exams are successful.

## V. CONCLUSION

In this paper, the researchers have appreciated the great role of fuzzy logic in the academic area. Fuzzy logic offers a wider and richer field of resources in assessing the learners’ performance. The researchers concluded that the students from a private university in Cavite who were taking BSIT perform well in the laboratory assessment compared to assessments in lecture. Thus, this may conclude that students appreciate and absorb more of the knowledge by applying the learned theoretical concepts and skills in the laboratory.

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