

Simulation of Determining Outstanding Lecturers Using the Fuzzy Logic

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Abstract: In the learning process, lecturers have quite an important role because a lecturer is required to manage or organize so that the learning process can run well. The objectives of writing this article are Determine the category of outstanding lecturers by applying fuzzy logic with the mamdani method. Produce a matlab program developed using the mamdani method to determine outstanding lecturers at Graha Nusantara University. Today, information technology, especially soft computing technology, is developing very quickly. One of the most developed software computing technologies is fuzzy logic, as it can be used to measure various ambiguous, camouflaged or fuzzy phenomena. One of the research topics applying fuzzy logic is the evaluation system in the research field. Research conducted by professors from Graha Nusantara Padangsidimpuan University in Simlitabmas data Still in the category of orientation to move to intermediate level, professors from UGN Padangsidimpuan are challenged to be able to develop, contribute and apply knowledge required for research. To do this, we needed an application that could be used to calculate and record teacher performance in outcomes research. The purpose of this study is to apply fuzzy logic with Mamdani method to evaluate the research efficiency of professors at Graha Nusantara Padangsidimpuan University this study uses Mamdani fuzzy logic.

Keywords: Development, Mamdani, Fuzzy Logic

Introduction

In the learning process, lecturers have quite an important role because a lecturer is required to manage or organize so that the learning process can run well. The objectives of writing this article are Determine the category of outstanding lecturers by applying fuzzy logic with the mamdani method. To realize this vision, UGN has as one of its missions, which is to organize teaching, research and serve the community, as well as conduct periodic studies and research. (Sadi, 2020) so that UGN professors can develop, contribute and apply their knowledge in research so that they can be promoted to the intermediate level. (Devaraj et al., 2020) For this reason, there is a need for an application that can be used to score a speaker's performance (Hardianto & Nurhasanah, 2020) based on the research they put forth (Budi Indra Gunawan & Unan Yusmanian Oktiawati, 2020) helps to better visualize

teachers' performance (Sofhian et al., 2016) from the research results they produced, the researchers used the application of fuzzy logic. (Anisah et al., 2021) Various theories on the development of fuzzy logic show that fuzzy logic can be used to model various systems in general. (Rodríguez et al., 2008) To evaluate research efficiency, researchers used three input variables: through Sinta, Simlitabmas and journal publishing clusters. (Izvozchikova et al., 2022). To get these results, we need to go through the stages of fuzzy set construction, application of implication functions, and compilation of rules. (Acosta-Prado et al., 2021) The results obtained indicate that the evaluation of academic results using fuzzy logic (Abbasipayam & Makrova, 2022) can show differences in the final value of lecturer research activities. (Ain et al., 2022) To obtain these results, it is necessary to carry out the stages of forming a fuzzy set, applying the implication function

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and compiling rules (Li et al., 2010). The results obtained indicate that the assessment of academic (Alwendi, 2021) performance using fuzzy logic can show differences (Baliuta et al., 2020) in the final value of lecturer research activities. (Tariq et al., 2020) Based on the explanation contained in the background (Tahri et al., 2022) a problem can be formulated, namely, (Aslam, 2020) how to determine the value of lecturer research (Alwendi & Masriadi, 2021). using the Fuzzy Mamdani (Yetilmezsoy et al., 2021) method as an alternative tool to calculate the value of lecturer research (Keviczky et al., 2019) at Graha Nusantara Padangsidempuan University. (Ningrum et al., 2021) 1. Knowing the results obtained from the results of calculations using fuzzy logic to assess the performance of lecturers 3. Knowing the use of the Mamdani fuzzy logic method in evaluating the research (van Krieken et al., 2022) activities of lecturers at Graha Nusantara Padangsidempuan University in 2020-2021. Provide knowledge about how to determine the evaluation of research activities A lot of research has demonstrated the ability of fuzzy logic (Mudia, 2020) in dealing with vague and uncertain linguistic information. For the purpose of representing human perception, fuzzy logic (Rani Roopha Devi & Mahendra Chozhan, 2020) has been employed as an effective tool in intelligent decision making. Due to the emergence of various studies (Ain et al., 2022) on fuzzy logic-based decision-making methods (Mittal et al., 2020)

Kazimovich et al (2012) illustrated the capabilities of the applications of symbolic computation techniques of MATLAB for engineering students. The capabilities of MuPAD and its combination with MATLAB were described for writing formulas, factorizing an expression, solving equations, solving systems of equations and differential equations, finding derivatives and antiderivatives as well as plotting functions. In addition, some of the useful functions like computing Fourier transforms and their inverses have also been given. The paper also provided sketches of the transfer between MuPAD and MATLAB. Tahir et al (2010) proposed the integration of MATLAB into science, technology and engineering disciplines as a teaching and learning tool for undergraduate studies to the Ministry of Science and Technology, Iraq. The graphical user interface programs created for Math 1 and Math 2 courses were proposed to be used in teaching linear algebra, graphing, Laplace Transform, differential and integral calculus courses. The proposed programs were aimed at motivating students and demonstrating the relationships between pure mathematical concepts to the real world. The authors planned to develop a supplemental booklet for using computer programs in tutorial sessions. The authors also recommended the use of the software throughout

the science and engineering institutions in the country and also emphasized the need for providing necessary training on the use of MATLAB to the teaching faculty. The keywords used for the search were "CAS and mathematics education", and "CAS/MATLAB as a teaching & learning tool for math", "CAS/MATLAB as a visualization tool for math", "CAS/MATLAB as problem-solving tool in math" etc. Our primary focus was the empirical studies based on classroom and computer-lab where MATLAB was used as a pedagogical tool for mathematics of the Faculty of Graha Nusantara Padangsidempuan University using the Fuzzy Mamdani method .

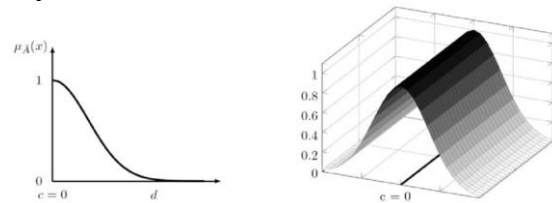


Fig 1. Linear representation

An ascending linear representation that represents the increase in the set, starting from the domain value which has zero membership degree (Wu & Xu, 2021), moving to the right to the domain value which has the same higher degree of membership.

Fuzzy Logic

The concept of fuzzy logic was first introduced by Professor Lotfi A. Zadeh from the University of California, in June 1965. Fuzzy is linguistically defined as blurry or vague. According to Setiadji (2009: 174), fuzzy is a value that can be true or false simultaneously. But how much the value of truth and error depends on the degree of membership it has. The degree of membership in fuzzy has a value range of 0 (zero) to 1 (one). This is different from the strict set which has a value of 1 or 0 (yes or no). Fuzzy logic is used to translate a quantity that is expressed using language (linguistics), for example the speed of a vehicle which is expressed slowly, quite fast, fast, and very fast. And fuzzy logic shows how far a value is true and how far a value is wrong. Unlike strict logic, a value only has 2 possibilities, namely whether it is a member of the set or not.

Fuzzy Collection

In a strict set, each element in the universe is always strictly determined as to whether it is a member of that set or not. But in reality, not all sets are clearly defined. For example, the set of smart students, in this case, cannot be clearly stated because there is nothing

to measure a person's level of intelligence. Therefore, it is necessary to define a fuzzy set that can represent the event. There are several ways to refer to fuzzy sets, where fuzzy sets are written as ordered pairs, with the first element indicating the element name and the second element indicating its membership value.

Methodology

In the fuzzy logic calculation process, there are three stages that must be passed, namely: (a) fuzzyfication, (b) inference engine, and (c) defuzzyfication [4].

Fuzzyfication is the process of mapping input values (crisp input) originating from a controlled system (non-fuzzy quantities) into fuzzy sets according to their membership function. The fuzzy set is fuzzy input which will be processed fuzzy in the next process. To change crisp input to fuzzy input, you must first determine the membership function for each crisp input, then the fuzzyfication process will take the crisp input and compare it with the existing membership function to produce a fuzzy input price. At this stage, the crisp input is teacher performance, creative or innovative work, and outstanding teachers.

Based on the research steps in Figure 2, each step can be explained as follows:

1. Data collection The data needed for this research is research data from the Faculty of Graha Nusantara University in 2020 and 2021 which is taken from data from the Sinta cluster, Simlitabmas and journal publications.
2. Data identification Data identification is done to select the variables needed to perform calculations and analyze the problem.
3. Data processing The data processing stage is to create a Mamdani fuzzy system using Matlab software.
4. System test At the system testing stage, testing and simulation will be carried out to evaluate lecturer research activities using fuzzy logic.

The positive impact of computer technology on students' learning and performance has also been examined and reported, Abdul Majid et al (2012), Strayhorn (2006), Kulik & Kulik (1991). Abdul Majid et al (2012) have used MATLAB as a supplement for teaching Integral Calculus course to 77 engineering students at the University of Ha'il. The study aimed at firstly, to enhance

students' conceptual understanding, their performance in mathematics and secondly, to foster positive attitudes towards mathematics and attitudes toward the computer technology. The case study involved an experimental group and a control group. Among the important objectives of incorporating the software were to address the declining mathematical skills of students needed for their core engineering courses as well as establishing a smooth transition to the upper level courses.

Result and Discussion

This study examines the Mamdani fuzzy method in evaluating research activities of the Faculty of Graha Nusantara Padangsidempuan University using an application built with Matlab R2013a software. In this study, it consists of 3 input variables, namely the variables that are used as evaluation materials, which include variables from Sinta, Simlitabmas at bima and Klater Jurnal. The comparison results between tests using Mamdani and Sugeno fuzzy logic methods obtained clear quantitative differences, both tests using Mamdani method or Sugeno method, these two methods have been tested and produces new data so users can easily check. Which direction to use during data checking. To identify outstanding students of Southern Aceh Polytechnic University. The following tables and graphs illustrate the comparison results obtained after testing. For more details, see the following tables and charts. (Yunan, A., & Ali, M. 2020)

Table 1. Derivatives of Final Stage Evaluation Variables

Rule	Input	Output		Nilai Akhir
1	Sedikit	Sedikit	→	Sedikit
2	Sedikit	sedang	→	Sedikit
3	sedikit	banyak	→	sedang
4	sedang	sedikit	→	Sedikit
5	sedang	sedang	→	sedang
6	sedang	banyak	→	banyak
7	banyak	sedikit	→	sedang
8	banyak	sedang	→	banyak
9	banyak	banyak	→	banyak

In this study, the discussion process was carried out in several stages, namely:

1. Determine the input variables taken from the lecturer's research assessment data, where the variables used are the sinta variable, the simlitabmas variable, and the journal cluster variable.

2. Fuzzification: determining the degree of membership of the input and output variables.
3. Fuzzy logic operations must be performed if the previous part of more than one statement performs fuzzy logic operations. The final result of this operation is the degree of truth of the antecedent, which is a single number. Fuzzy operators to perform operations and and or can be made independently.
4. Implication: Apply the implication method to determine the final form of fuzzy set output. The consequence or inference of a fuzzy rule is determined by filling the output of the fuzzy set with the output variable. The implication function used is Min.
5. Aggregation: The process of combining the outputs of all if-then rules into one fuzzy set using the Max function.
6. Defuzzification The inference process in the application of fuzzy statements uses the MIN implication function. In addition, the composition of all fuzzy outputs is done using max. Then do validation or called defuzzification using Centroid. In this method, a crisp solution is obtained by taking the center point of the fuzzy area as follows :

Fuzzy Statement Analysis Using Matlab

The validation of research evaluation data by Graha Nusanatara University professors using the mamadani method can also be performed using the matlab fuzzy toolbox version R2013a. This software is used to interpret variables in teachers' research activities

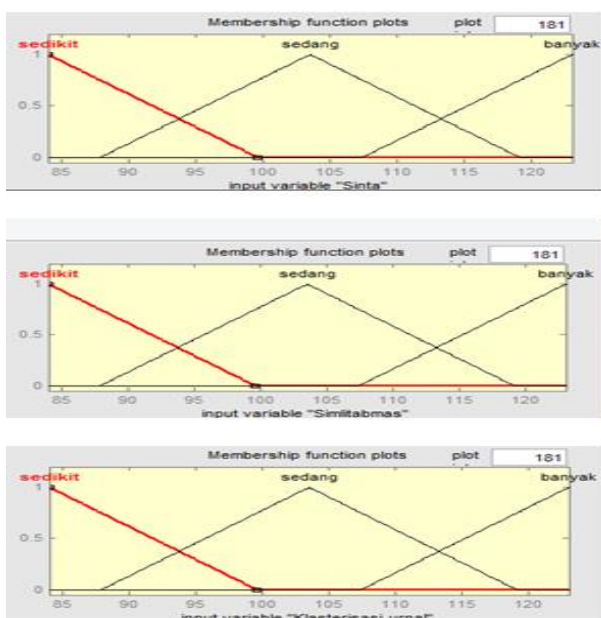


Fig 3. Input and output variables of the Mamdani method

This study has 3 input variables and 2 output variables. The input variables consist of Sinta, Simlitabmas, and cluster. 2020 and 2021. While the minor and interim release variables. This can be seen in Figure 3.

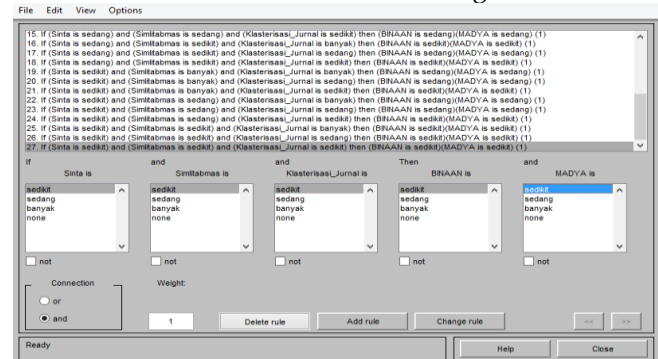


Fig 4. Implication Function

The defuzzification process fills the output variable with a number using the centroid or area centroid method. The final step of this implementation is the process of taking the input value to get the output value. In this study, the input value is , the initial output value is and the output at the final stage is The definition of accuracy is how close the measurement result is to the actual number. Because this study is very precise, we started with the number of measurements, the Y value of the Mamdani method, using a set of standard values to give accurate results. The default value of the Mamdani method is the value of the output variable used to evaluate teachers' research activities, determined by the membership function.

1. If the conclusion is the result of a fuzzy assessment, and the final assessment results are the same, then it is declared accurate.
2. If not, then the result is NOT ACCURATE
3. The result of the accuracy of the Mamdani method is 9 and the value of the fuzzy calculation is 16. Thus, the percentage of accuracy of the Mamdani method can be calculated.

Conclusion

This system can only evaluate lecturer performance in general. Based on the research results of implementing the decision-making process for selecting excellent students at South Aceh Polytechnic using the Mamdani and Sugeno fuzzy logic method, it can be concluded that: The steps to select excellent students begin with defining the fuzzy set, determining the application of the implicit function, synthesizing the rules used in the fuzzification calculation process,

determining the defuzzification to obtain the certainty value of decision outcomes, methods of ranking and selecting from lists. The names with the highest scores are excellent students. The test process can be presented as a graphical user interface (GUI) screen in Matlab 2013a so that the user or administrator can input data into the system that has been built for the output process.

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