Application Fuzzy for Measuring Lecturer Performance Using Matlab Software

Alwendi[1*], Andi Saputa Mandopa[2]

[1] Program Studi Ilmu Komputer, Fakultas Teknik, Universitas Graha Nusantara, Indonesia
[2] Program Studi Pend. Matematika, FKIP, Universitas Graha Nusantara, Indonesia

Abstract: Research by Lecturer, Graha University Nusantara Padangsidimpuan, Simrittabumas Data still in Guidance Category for Upgrade to Intermediate Category are required to apply. For this, we need an application that can calculate and document the lecturer's performance in the resulting research. The purpose of this study is to apply fuzzy logic with Mamdani method to evaluate the research achievements of lecturers at Graha Nusantara Padangsidimpuan University. This study uses Mamdani fuzzy logic. The fuzzy Mamdani method is a method of mapping the input space to the output space. This method is a mathematical framework for expressing uncertainty, ambiguity, inaccuracy, lack of information, and partial truth. The phase of research using the Mamdani method is to create input variables from Sinta-accredited papers, Simlitabmas Grant papers, and papers from international and national journals. Find the maximum and minimum values for each variable. Create a fuzzy set using the Mamdani method. Building assertions with defuzzification using Matlab.

Keywords: Fuzzy Logic, Lecturer, Matlab.

Introduction

To realize this vision, UGN has one of its missions, namely Organizing education, research and community service, as well as conducting studies and periodic studies. (Sadi, 2020) so that the UGN faculty can develop, dedicate and apply their knowledge in research so that it can be upgraded to the intermediate category. (Devaraj et al., 2020) For this reason, an application is needed that can be used to calculate the lecturer's (Hardianto & Nurhasanah, 2020) performance score on the research he produces (Budi Indra Gunawan & Unan Yusmaniar Oktiawati, 2020) To make it easier to see the performance of lecturers (Sofhian et al., 2016) from the research results they produce, the researchers use fuzzy logic applications. (Anisah et al., 2021) Various theories of 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 performance, researchers used 3 input variables, namely through Sinta, Simlitabmas, and the journal publication cluster.(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 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 Padangsidimpuan 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 Padangsidimpuan 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 Padangsidimpuan University using the Fuzzy Mamdani method .
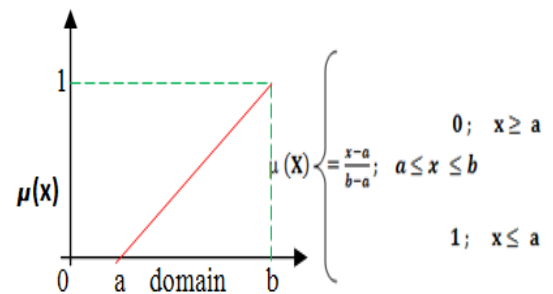

Fig 1. Linear representation

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, every element in the universe is always strictly determined whether that element is a member of that set or not. But in reality, not all sets are defined explicitly. For example, the set of clever students, in this case, cannot be stated explicitly 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 denote fuzzy sets, including Fuzzy sets are written as ordered pairs, with the first element indicating the name of the element and the second element indicating the value of its membership.

Method

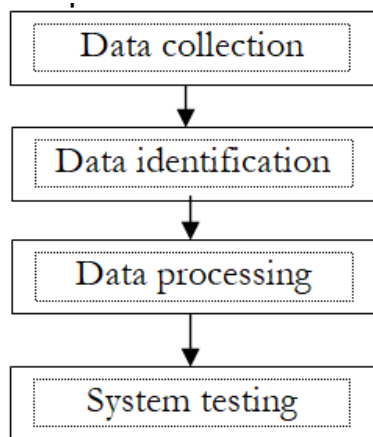The steps carried out in this study are shown in Figure 3 below.

Fig 2. Research Steps

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.

lt and Discussion
This study examines the Mamdani fuzzy method in evaluating research activities of the Faculty of Graha Nusantara Padangsidimpuan 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.

Table 1. Derivatives of Final Stage Evaluation Variables

Rule	Entrance	GO OUT		Final Score
1	A little	A little	→	A little
2	A little	Currently	→	A little
3	a little	many	→	Currently
4	Currently	a little	→	A little
5	Currently	Currently	→	Currently
6	Currently	many	→	many
7	many	a little	→	Currently
8	many	Currently	→	many
9	many	many	→	many

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. DefuzzificationThe 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 for graha nusanatara university lecturers using the mamadani method can also be done using the matlab fuzzy toolkit version R2013a. This software serves to interpret the variables of lecturer research activities
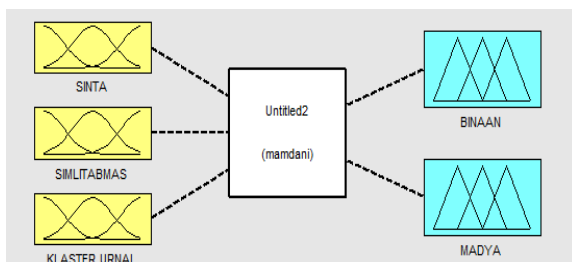

Fig 3. Input and output variables of the Mamdani method

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.
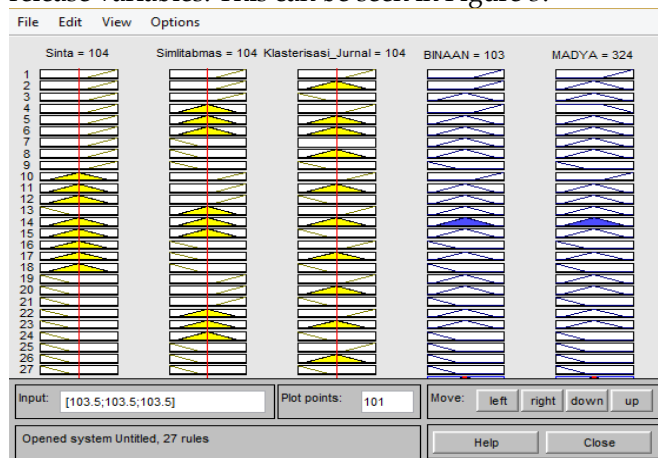

Fig 4. Defuzzification Calculation Process

Defuzzification fills the output variable with one number using the centroid or area center method. The last step in this implementation is the process of taking the input value to get the output value. In this study, the input value is 104, the initial output value is 103, and the final stage output is 324.

The definition of accuracy is how close the measurement result is to the actual number. Because this study is so precise, we start with the number of measurements, the Y value of the Mamdani method, which uses a standard set of values to give the correct result. The default value of the Mamdani method is the value of the output variable for assessing lecturer research activities, determined using 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

Based on the results of the tests and discussions that have been described, the following conclusions Fuzzy logic with the Mamdani method can be used to predict the evaluation of lecturer activities from the results of the panel research that has been carried out. There is a significant difference between the Matlab software and calculations performed manually. This system can only evaluate lecturer performance in general.

References

Ain, S. Q., Saifizi, M., Othman, S. M., Aziz, A. A., Mustafa, W. A., & Khairunizam, W. (2022). Temperature Control Using Fuzzy Controller for Variable Speed Vapor Compression Refrigerator System. *Proceedings of International Conference on Artificial Life and Robotics*. https://doi.org/10.5954/icarob.2022.os32-6

Alwendi, A. (2021). Optimalisasi Internet of Things untuk Meningkatkan Produksi pada Sektor Usaha Kecil dan Menengah di Masa Pandemi Covid-19. *Jurnal Informatika Dan Rekayasa Perangkat Lunak*. https://doi.org/10.36499/jinrpl.v3i1.3963

Alwendi, A., & Masriadi, M. (2021). APLIKASI PENGENALAN WAJAH MANUSIA PADA CITRA MENGGUNAKAN METODE FISHERFACE. *Jurnal Digit*.

https://doi.org/10.51920/jd.v11i1.174

Anisah, S., Yulianto, T., & Faisol, F. (2021). Perbandingan Fuzzy Sugeno dan Fuzzy Mamdani Pada Analisis Minat Masyarakat Terhadap Produk Air Minum Dalam Kemasan Lokal dan Nasional di Madura. *Zeta - Math Journal*. https://doi.org/10.31102/zeta.2021.6.1.29-37

Aslam, N. (2020). Sustainable processing: Examples in process intensification & commercial catalysis. *AIChE Annual Meeting, Conference Proceedings*.

Baliuta, S., Kopylova, L., Kuievda, I., Kuevda, V., & Kovalchuk, O. (2020). Fuzzy logic energy management system of food manufacturing processes. *Ukrainian Food Journal*. https://doi.org/10.24263/2304-974x-2020-9-1-19

Budi Indra Gunawan, & Unan Yusmaniar Oktiawati. (2020). Server Room Temperature and Monitoring System Using Fuzzy Based on RobotDyn Microcontroller. *Jurnal RESTI (Rekayasa Sistem Dan Teknologi Informasi)*. https://doi.org/10.29207/resti.v4i1.1207

Devaraj, R., Nasr, E. A., Esakki, B., Kasi, A., & Mohamed, H. (2020). Prediction and analysis of multi-response characteristics on plasma arc cutting of monel 400^{TM} alloy using mamdani-fuzzy logic system and sensitivity analysis. *Materials*. https://doi.org/10.3390/MA13163558

Hardianto, H., & Nurhasanah, N. (2020). Identifikasi Penyakit pada Sel Darah Menggunakan Logika Fuzzy Mamdani. *PRISMA FISIKA*. https://doi.org/10.26418/pf.v7i3.38106

Izvozchikova, V. V, Tlegenova, T. E., & Markovin, V. V. (2022). Development of an intelligent learning system based on fuzzy logic. *IOP Conference Series: Materials Science and Engineering*. https://doi.org/10.1088/1757-899x/1227/1/012007

Keviczky, L., Bars, R., Hetthéssy, J., & Bányász, C. (2019). Introduction to MATLAB. In *Advanced Textbooks in Control and Signal Processing*. https://doi.org/10.1007/978-981-10-8321-1_1

Kimura, A., Kashino, K., Kurozumi, T., & Murase, H. (2008). A quick search method for audio signals based on a piecewise linear representation of feature trajectories. *IEEE Transactions on Audio, Speech and Language Processing*. https://doi.org/10.1109/TASL.2007.912362

Li, P. cheng, Chen, G. hua, Dai, L. cao, & Li, Z. (2010). Fuzzy logic-based approach for identifying the risk importance of human error. *Safety Science*. https://doi.org/10.1016/j.ssci.2010.03.012

Mittal, K., Jain, A., Vaisla, K. S., Castillo, O., & Kacprzyk, J. (2020). A comprehensive review on type 2 fuzzy logic applications: Past, present and future. *Engineering Applications of Artificial Intelligence*. https://doi.org/10.1016/j.engappai.2020.103916

Mudia, H. (2020). Comparative Study of Mamdani-type and Sugeno-type Fuzzy Inference Systems for Coupled Water Tank. *Indonesian Journal of Artificial Intelligence and Data Mining*. https://doi.org/10.24014/ijaidm.v3i1.9309

Majid, M. A., Huneiti, Z. A., Balachandran, W., & Balarabe, Y. (2013). MATLAB as a teaching and learning tool for mathematics: a literature review. International Journal of Arts & Sciences, 6(3), 23.

Ningrum, R. F., Siregar, R. R. A., & Rusjdi, D. (2021). Fuzzy Mamdani logic inference model in the loading of distribution substation transformer SCADA system. *IAES International Journal of Artificial Intelligence*. https://doi.org/10.11591/ijai.v10.i2.pp298-305

Rani Roopha Devi, K. G., & Mahendra Chozhan, R. (2020). Prediction of Sudden Cardiac Arrest Due to Diabetes Mellitus Using Fuzzy Based Classification Approach. In *Lecture Notes on Data Engineering and Communications Technologies*. https://doi.org/10.1007/978-3-030-43192-1_46

Rodríguez, A., Carricajo, I., Manteiga, M., Dafonte, C., & Arcay, B. (2008). STARMIND: Automated classification of astronomical data based on an hybrid strategy. *Lecture Notes in Computer Science (Including*

Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics). https://doi.org/10.1007/978-3-540-87656-4_25

Rustum, R., Kurichiyanil, A. M. J., Forrest, S., Sommariva, C., Adeloye, A. J., Zounemat-Kermani, M., & Scholz, M. (2020). Sustainability ranking of desalination plants using mamdani fuzzy logic inference systems. *Sustainability (Switzerland).* https://doi.org/10.3390/su12020631

Sadi, S. (2020). DC Motor Speed Control Using Mamdani Fuzzy Logic Based on Microcontroller. *Jurnal Teknik.* https://doi.org/10.31000/jt.v9i2.3676

Sofhian, Sujaini, H., & Pratiwi, H. S. (2016). Dosen Terbaik Menggunakan Metode Promethee (Studi Kasus : Teknik Informatika Universitas Tanjungpura). *Jurnal Sistem Dan Teknologi Informasi (JUSTIN).*

Suo, M., Li, S., Chen, Y., Zhang, Z., Zhu, B., & An, R. (2018). Effectiveness evaluation of fighter using fuzzy Bayes risk weighting method. The Aeronautical Journal, 122(1254), 1275-1300.

Tahri, M., Maanan, M., Tahri, H., Kašpar, J., Chrismiari Purwestri, R., Mohammadi, Z., & Marušák, R. (2022). New Fuzzy-AHP MATLAB based graphical user interface (GUI) for a broad range of users: Sample applications in the environmental field. *Computers and Geosciences.* https://doi.org/10.1016/j.cageo.2021.104951

Tariq, M. I., Tayyaba, S., Ali Mian, N., Sarfraz, M. S., Hussain, A., Imran, M., Pricop, E., Cangea, O., & Paraschiv, N. (2020). An analysis of the application of fuzzy logic in cloud computing. *Journal of Intelligent and Fuzzy Systems.* https://doi.org/10.3233/JIFS-179680

van Krieken, E., Acar, E., & van Harmelen, F. (2022). Analyzing Differentiable Fuzzy Logic Operators. *Artificial Intelligence.* https://doi.org/10.1016/j.artint.2021.103602

Wawan, W., Zuniati, M., & Setiawan, A. (2021). Optimization of National Rice Production with Fuzzy Logic using Mamdani Method. *Journal of Multidisciplinary Applied Natural Science.*

https://doi.org/10.47352/jmans.v1i1.3

Yetilmezsoy, K., Karakaya, K., Bahramian, M., Abdul-Wahab, S. A., & Goncaloğlu, B. İ. (2021). Black-, gray-, and white-box modeling of biogas production rate from a real-scale anaerobic sludge digestion system in a biological and advanced biological treatment plant. *Neural Computing and Applications*. https://doi.org/10.1007/s00521-020-05562-7