

Implementation Of Fuzzy Tsukamoto Algorithm for Registration Students

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Abstract

Becoming a new student in junior high school requires a registration process from the elementary level. However, information on new student admissions has been documented manually, so there are difficulties and errors in determining grade and files of student document are often lost caused by the files is not archived properly. The purpose of this research is to model a computer-based new admissions information system using the Fuzzy Logic method and this system purposed to assist officers in dealing with the obstacles faced in conducting the selection of new student admissions, however by the information system that has been made, it is expected to solve problems related to the admission of new students. The modeling of this new admissions information system uses the Fuzzy Logic method, which consists of the stages of system design, database design and fuzzy logic design. The results of the system application test can be seen that the system application on the system of implementing the Fuzzy Tsukamoto algorithm on New Student Admissions for Junior High School can carry out the process properly and correctly. Tests are also carried out on the rules of Fuzzy Logic that have been made to find out whether the system can work properly and correctly.

Keywords: *Information System, Fuzzy Logic, Database*



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INTRODUCTION

Schools or formal educational institutions regularly hold new student admissions every year. The number of new students in the new school year's admissions can increase or decrease, so predictions or forecasts are needed to find out the number of new students, so that all policies and decisions in preparing future management plans can be fulfilled properly [1] This shows that students has an important role in the success of the school, however in the selecting prospective new students of the school must really consider some of the criteria needed, because school progress depends on how good the results of student performance are accepted. To obtain quality students, most schools conduct a selection of new students. The selection process is the process of selecting students who have the ability and competence, the selection of new students is the first thing that schools must do to obtain students who have good quality and are competent to meet the requirements that exist in public schools, And there are several criteria requirements to qualify as a new student.[2] Based on this, in this study the solution used in the case of implementing the Fuzzy Tsukamoto algorithm on the acceptance of new students of Junior High School based on Android. Bu using the Fuzzy Tsukamoto method, it is expected to obtain solutions and results that are more effective and efficient than manual searches. [4] The solution required for a new student admissions information system that makes it easier to determine the passing of the test for new students is the Tsukamoto Fuzzy Logic method. With a computerized system, the stored data is easy to manage and can be displayed at any time without having to search for files, thus speeding up the process of presenting data.[5]

LITERATURE REVIEW

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[1] (Decision Support System) is a computer-based information system that provides interactive information support for managers and business practitioners during the decision-making process. DSS is built of course has a goal to be achieved by a decision maker. The purpose of DSS is as a "second opinion" or "information sources" as a consideration for a manager before deciding on certain policies. The basis of Fuzzy Logic[7] is fuzzy set theory. In fuzzy set theory, the degree of membership as a determinant of the existence of elements in a set is very important. The value of membership or the degree of membership or membership function is the main characteristic of reasoning with the fuzzy logic. Fuzzy Set In firm sets (cips), the membership value of an item x in a set A , which is often written as $\mu_A(x)$, has two possibilities[7], namely: 1. One (1), which means that an item is a member of a set, or 2. Zero (0), which means that an item is not a member of a set. There are several things that need to be known in understanding the fuzzy system, Membership Function. The membership function [7] is a curve that shows the mapping of data input points into their membership values (often referred to as membership degrees) which has an interval between 0 to 1. One way that can be used to get the membership value is through a function approach. . Zadeh Dasar Basic Operators As with conventional sets, there are several operations that are specifically defined for combining and modifying fuzzy sets. The membership value as a result of the operation of 2 sets is often known as fire strength or -predicate. There are 3 basic operators created by zadeh [7], namely: 1. AND operator 2. OR . operator 3. NOT operator Fuzzy Tsukamoto This inference method was introduced by Tsukamoto in 1979. This method is based on Ross's statement that each fuzzy rule will be represented by a fuzzy set with a monotonic membership function[8]

RESEARCH METHOD

The research methodology is to describe how to collect the necessary information or data. The research method used in completing this final project is as follows. Researchers used a prototype model as a software development model, where this model can help the development process because this model can be evaluated and changed again according to needs. In this phase the author will conduct observations and interviews. Observations and interviews are used to obtain data where the data will be used to determine the initial coverage of the system. Interviews will be obtained from interviews with PLA coordinator Wahyu Kurniawan, M.Psi and Transitional Education Service Coordinator Ratna Dewi, S.Psi In the results of the interviews obtained, the researchers got the criteria that exist in the assessment of student selection, namely Religion, Mathematics, English, and Indonesian. After obtaining the criteria, the researcher gave a questionnaire to determine the range of input values for each criterion, while the results of the interview range were obtained as follows:

Table 2.1 Range of Criteria Score

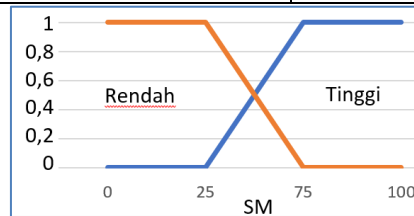
Criteria	Range Score
Religion	0 - 100
Math	0 - 100
English	0 - 100
Bahasa Indonesia	0 - 100

FINDINGS AND DISCUSSION

From the case above, it can be concluded that there are several variables that will be used as models, where these variables are the criteria listed in the case. The variables are as follows:

Table 3.1 Fuzzy Set

Variabel Input	Himpunan
Reigion	High
	Low
Math	High
	Low
English	High
	Low
Bahasa Indonesia	High
	Low
Result	Pass
	Not Pass



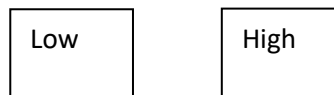
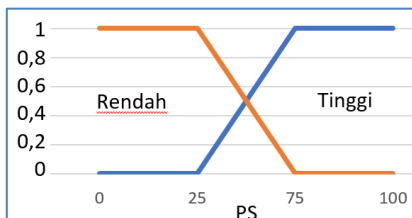
Pic. 1. Religion Variable Membership Function

Level of Membership Not Passed:

$$\mu_{SMTidakLulus}(x) = \begin{cases} 1, & ; x \leq 25 \\ \frac{75 - x}{75 - 25} & ; 25 < x < 75 \\ 0, & ; x \geq 75 \end{cases}$$

Level of Membership Pass:

$$\mu_{SMLulus}(x) = \begin{cases} 1, & ; x \geq 75 \\ \frac{x - 25}{75 - 25} & ; 25 < x < 75 \\ 0, & ; x \leq 25 \end{cases}$$



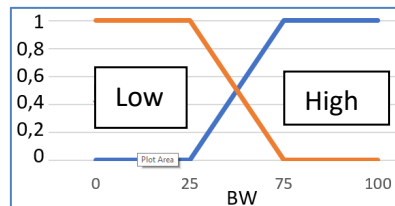
Pic. 2. Math Variable Membership Function

Level of Membership Not Passed:

$$\mu_{PSTidakLulus}(x) = \begin{cases} 1, & ; x \leq 25 \\ \frac{75 - x}{75 - 25} & ; 25 < x < 75 \\ 0, & ; x \geq 75 \end{cases}$$

Level of Membership Pass:

$$\mu_{PSLulus}(x) = \begin{cases} 1, & ; x \geq 75 \\ \frac{x - 25}{75 - 25} & ; 25 < x < 75 \\ 0, & ; x \leq 25 \end{cases}$$



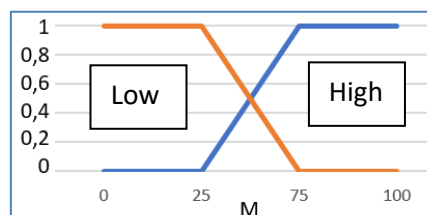
Pic. 3. English Variable Membership Function

Level of Membership Not Passed:

$$\mu_{BWTidakLulus}(x) = \begin{cases} 1, & ; x \leq 25 \\ \frac{75 - x}{75 - 25} & ; 25 < x < 75 \\ 0, & ; x \geq 75 \end{cases}$$

Level of Membership Pass:

$$\mu_{BWLulus}(x) = \begin{cases} 1, & ; x \geq 75 \\ \frac{x - 25}{75 - 25} & ; 25 < x < 75 \\ 0, & ; x \leq 25 \end{cases}$$



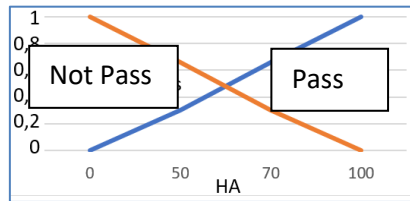
Pic. 4. Bahasa Indonesia Variable Membership Function

Level of Membership Not Passed:

$$\mu_{MTidakLulus}(x) = \begin{cases} 1, & ; x \leq 25 \\ \frac{75 - x}{75 - 25} & ; 25 < x < 75 \\ 0, & ; x \geq 75 \end{cases}$$

Level of Membership Pass:

$$\mu_{MLulus}(x) = \begin{cases} 1, & ; x \geq 75 \\ \frac{x - 25}{75 - 25}, & ; 25 < x < 75 \\ 0, & ; x \leq 25 \end{cases}$$



Pic. 5. Results Variable Membership Function

Level of Membership Not Passed:

$$\mu_{HATidakLulus}(x) = \begin{cases} 1, & ; x \leq 0 \\ \frac{100 - z}{100 - 0}, & ; 0 < x < 100 \\ 0, & ; x \geq 100 \end{cases}$$

Level of Membership Pass:

$$\mu_{HALulus}(x) = \begin{cases} 1, & ; x \geq 100 \\ \frac{z - 0}{100 - 0}, & ; 0 < x < 100 \\ 0, & ; x \leq 0 \end{cases}$$

Rule base Fuzzy

To make it easier to see the rule base, the researcher will make the rule base above in the form of a table as below:

Table 3. Rule Base

Rule	Motoric Sensor	Social Development	Language	Motoric	Results
1	High	High	High	High	Pass
2	High	High	High	Low	Pass
3	High	High	Low	High	Pass
4	High	High	Low	Low	Not Pass
5	High	Rendah	High	High	Pass
6	High	Rendah	High	Low	Not Pass
7	High	Rendah	Low	High	Not Pass
8	High	Rendah	Low	Low	Not Pass
9	Low	High	High	High	Pass
10	Low	High	High	Low	Not Pass
11	Low	High	Low	High	Not Pass
12	Low	High	Low	Low	Not Pass
13	Low	Rendah	High	High	Not Pass

14	Low	Low	High	Low	Not Pass
15	Low	Low	Low	High	Not Pass
16	Low	Low	Low	Low	Not Pass

The last step in the Fuzzy Tsukamoto method is to find the output value in the form of a crisp (z) value known as the defuzzification process. The formula used is as follows:

$$z = \frac{\sum(\alpha - \text{pre} * z)}{\sum \alpha - \text{pre}}$$

In this sub, the researcher will provide examples of input value data in the selection of transition students by applying the Fuzzy Tsukamoto method.

Table 4. Case in point Fuzzy Tsukamoto inference

Variable Input	Score Input
Religion	75
Math	65
English	55
Bahasa Indonesia	80

Fuzzy Set Value

This fuzzy set is calculated based on the provisions of the fuzzy set above.

a. Rreligion

$$\begin{aligned} \mu_{\text{AgmTidakLulus}}(75) &= (75-75)/(75-25) \\ &= 0/50 \\ &= 0 \end{aligned}$$

$$\begin{aligned} \mu_{\text{AgmLulus}}(75) &= (75-25)/(75-25) \\ &= 50/50 \\ &= 1 \end{aligned}$$

b. Math

$$\begin{aligned} \mu_{\text{MtkTidakLulus}}(65) &= (75-65)/(75-25) \\ &= 10/50 \\ &= 0,2 \end{aligned}$$

$$\begin{aligned} \mu_{\text{MtkLulus}}(65) &= (65-25)/(75-25) \\ &= 40/50 \\ &= 0,8 \end{aligned}$$

c. English

$$\begin{aligned} \mu_{\text{BingTidakLulus}}(55) &= (75-55)/(75-25) \\ &= 20/50 \\ &= 0,4 \end{aligned}$$

$$\begin{aligned} \mu_{\text{BingLulus}}(55) &= (55-25)/(75-25) \\ &= 30/50 \end{aligned}$$

$$= 0,6$$

d. Bahasa Indonesia
 $\mu_{\text{BindTidakLulus}}(80) = 0$

$$\mu_{\text{BinflLulus}}(80) = 1$$

Rule base

This rule base will use the Rule table that has been created by the researcher, where each rule will get a set value according to the set calculation above.

Table 5. Score Input of Rule Base

Rule	Religion	Math	English	B.Indonesia	Results
1	1	0,8	0,6	1	+
2	1	0,8	0,6	0	+
3	1	0,8	0,4	1	+
4	1	0,8	0,4	0	-
5	1	0,2	0,6	1	+
6	1	0,2	0,6	0	-
7	1	0,2	0,4	1	-
8	1	0,2	0,4	0	-
9	0	0,8	0,6	1	+
10	0	0,8	0,6	0	-
11	0	0,8	0,4	1	-
12	0	0,8	0,4	0	-
13	0	0,2	0,6	1	-
14	0	0,2	0,6	0	-
15	0	0,2	0,4	1	-
16	0	0,2	0,4	0	-

α -pre

Determine the value of α -pre, where the value of α -pre is obtained by determining the minimum value from the results of the rule calculation from the 4 criteria in the rule base table.

Table 6. Score Input α -pre

Rule	Rreligion	Math	English	B.Indonesia	α -pre
1	1	0,8	0,6	1	0,6
2	1	0,8	0,6	0	0
3	1	0,8	0,4	1	0,4
4	1	0,8	0,4	0	0
5	1	0,2	0,6	1	0,2
6	1	0,2	0,6	0	0
7	1	0,2	0,4	1	0,2
8	1	0,2	0,4	0	0
9	0	0,8	0,6	1	0
10	0	0,8	0,6	0	0

11	0	0,8	0,4	1	0
12	0	0,8	0,4	0	0
13	0	0,2	0,6	1	0
14	0	0,2	0,6	0	0
15	0	0,2	0,4	1	0
16	0	0,2	0,4	0	0

Determine the Z

Value The z value is obtained from α -pre which is calculated through the formula for the set of Assessment Results through the Rule base where the set of Assessment Results that say Pass/Fail, the following formula will be used: Membership Degree Not Passed: In the Rule base of Dismissed Assessment Results there is 1 set obtained through the calculation of the set of criteria, which is 0.3, so in determining the z value, the researcher will determine through the following formula: $Z = 100 - (x.100)$ $Z = 100 - (0.3 \times 100)$ $Z = 100 - 30$ $Z = 70$ Degree of Membership Passed: In the Rule base of the Passed Assessment Results there are 2 sets obtained through the calculation of the set of criteria, namely 0.7 and 0.3, so in determining the z value, the researcher will determine through the following formula: $Z = (x.100)+0$ $z = (x.100)+0$ $Z = (0.3 \times 100)+0$ $z = (0.7 \times 100)+0$ $Z = 30$ $z = 70$ It can be seen from the above formula, the z value is obtained by using the Assessment Results formula which has been described in point 1. The value of the fuzzy set which focuses on subpoint e. Assessment Results. Researchers will not take all existing formulas because in this z calculation, researchers only need the final formula, namely: $z = (x.100)+0$ or $z = 100-(x.100)$ Where if the rule base states that the assessment results do not pass, the researcher will use the formula on the right and if the assessment results pass, the researcher will use the formula on the left. The following is a table of the results of the calculation of the z value:

Table 7. Input Score Z

Rule	Religion	Math	English	B.Indonesia	α-pre	Z
1	1	0,8	0,6	1	0,6	60
2	1	0,8	0,6	0	0	0
3	1	0,8	0,4	1	0,4	40
4	1	0,8	0,4	0	0	100
5	1	0,2	0,6	1	0,2	20
6	1	0,2	0,6	0	0	100
7	1	0,2	0,4	1	0,2	80
8	1	0,2	0,4	0	0	100
9	0	0,8	0,6	1	0	0
10	0	0,8	0,6	0	0	100
11	0	0,8	0,4	1	0	100
12	0	0,8	0,4	0	0	100
13	0	0,2	0,6	1	0	100
14	0	0,2	0,6	0	0	100
15	0	0,2	0,4	1	0	100
16	0	0,2	0,4	0	0	100

Determine the Value of α -pre*z

The value of α -pre*z is obtained from -pre multiplied by z like the following table:

Table 8. Score Input α -pre*z

Rule	Religion	Math	English	B.Indonesia	α -pre	Z	α -pre * z
1	1	0,8	0,6	1	0,6	60	36
2	1	0,8	0,6	0	0	0	0
3	1	0,8	0,4	1	0,4	40	16
4	1	0,8	0,4	0	0	100	0
5	1	0,2	0,6	1	0,2	20	4
6	1	0,2	0,6	0	0	100	0
7	1	0,2	0,4	1	0,2	80	16
8	1	0,2	0,4	0	0	100	0
9	0	0,8	0,6	1	0	0	0
10	0	0,8	0,6	0	0	100	0
11	0	0,8	0,4	1	0	100	0
12	0	0,8	0,4	0	0	100	0
13	0	0,2	0,6	1	0	100	0
14	0	0,2	0,6	0	0	100	0
15	0	0,2	0,4	1	0	100	0
16	0	0,2	0,4	0	0	100	0

It can be seen in the table above, the multiplication value between α -pre and z produces different values according to the value in each Rule base. The next step is defuzzification.

DeFuzzification

The last step in the Fuzzy Tsukamoto method is to find the output value in the form of a crisp (Z) value known as the defuzzification process. The formula used is:

$$Z = \frac{\sum(\alpha - \text{pre} * z)}{\sum \alpha - \text{pre}}$$

$$Z = \frac{72}{1,4} = 51,43$$

Then the final result obtained from the Fuzzy Tsukamoto logic based on the given input value is 51.43. In accordance with the results of interviews obtained from the Transitional Education Service, 51.43 means that students are declared FAILED.

CONCLUSION

The results of this study use the Tsukamoto fuzzy method so that it can be implemented in the Transitional Education Service to determine the selection of students. The data used is sample data used by researchers to determine the output value of fuzzification and defuzzification which is calculated manually. From the output data obtained from the Fuzzy Tsukamoto implementation process, the results can be used to determine whether students are accepted or not.

It is hoped that further research will be carried out on the accuracy of the system that has been made by this study with a running system. By using student data to determine the accuracy of the system after using the data. Accuracy is the formation of very influential fuzzy rules. In this study, the determination of fuzzy rules is done manually based on expert opinion and if the fuzzy rules are determined manually and only to be tested, the determination will be far closer to the results. With the implementation of genetic algorithms in further research is needed to optimize fuzzy rules. Optimization of fuzzy rules also aims to improve the accuracy of the system which is much better. Therefore, it can combine Genetic algorithms for further research which has been widely used to solve problems related to optimization.

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