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Predicting Student Graduation Using The Fuzzy Tsukamoto Method In Computer Science Study Program Students Class of 2022

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ABSTRACT

This study aims to help optimize resources by designing a system that can be used to help predict student graduation at Pattimura University. The system method used is the fuzzy tsukamoto method. The Tsukamoto method is an extension of monotone reasoning. In the Tsukamoto method, each consequence of the rule in the form of IF-THEN must be presented with a fuzzy set with a monotone membership function. As a result, the inference output of each rule is given crisply based on α-predicate (fire strength). The final result is obtained using a weighted average. The result of this study is a student graduation prediction system to optimize good results and avoid errors that occur when predicting student graduation. It can be seen that out of 38 students who graduated on time, 10 students with GPA input variables of more than 3.00, for attendance input variables of more than 80%, and the total number of credits is 64 credits. Meanwhile, the output variable for Results (not on time and on time) obtains the results of students graduating from the Communication Studies Study Program who graduated on time.

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I. Introduction

Based on data from student survey results, the Computer Science Study Program Class of 2022 at Pattimura University has a total of 38 active students. The survey sample taken to predict the graduation results of Computer Science students in the Class of 2022 is 10 students. This is also shown by the number of students who are still following the lecture process in the Computer

Science study program. With so many active students in the Computer Science study program, management needs predictions for the graduation of students in the 2022 computer science study program.

In the Computer Science Study Program, Pattimura University, one of the challenges faced by management is the daunting task of predicting the rate of student graduation on time. This is due to various factors that influence graduation, such as academic achievement, attendance rate, student participation in lecture activities, and external factors such as financial problems or family support. As the number of active students in the study program increases, it becomes increasingly difficult for management and academics to manually distribute and predict admissions based on historical data. In addition, the absence of an effective prediction system makes it difficult to plan strategies to improve the quality of education and support students who have the potential to experience delays in admission.

Conventional prediction methods, such as calculating average values and basic statistical analysis, are often unable to meet the complexity of various dynamic and ambiguous factors. Therefore, a more adaptive method is needed that is able to capture signals to predict student admissions. In an effort to overcome this problem, the use of the Fuzzy Tsukamoto method is the right choice[1]. This method allows handling fuzzy data (uncertain or ambiguous), so that it is able to provide more accurate predictions by considering various interacting factors. With this method, study programs can make better and more proactive decisions in managing students who have the potential to not graduate on time.

2. Research Methods

The research method explains the activity design, scope or object, main materials and tools, place, data collection techniques, operational definitions of research variables, and analysis techniques.

Research methods are a process or scientific way to obtain data that will be used for research purposes. Research is carried out in stages starting from planning, determining research focus, research time, data collection, analysis, and presenting research results. The method used is a quantitative method which is carried out systematically and focuses on the use of numbers, tables, graphs and diagrams to display the results of the data/information obtained.

2.1. Research Location and Time

The author conducted research at the Pattimura University Campus on Jalan. Ir. M. Putuhena, Poka, District. Tlk. Ambon, Ambon City, Maluku. This research was conducted in June 2024

2.2. Data collection technique

Data collection techniques are the most important step in research, because the main goal of research is to obtain and obtain data. Several types of data collection methods that the author uses include:

1. Observation Method
   This technique is used to obtain real facts, namely by collecting data directly from the research object using Google Forms. In this case the author took sample data from students at the Pattimura University Campus.
2. Literature Study
   This method was carried out to obtain additional literature data from reference books regarding data mining and the Fuzzy Tsukamoto method, the sources used were books, scientific works, and supporting sites that could assist in completing research articles.

2.3. Analysis and Design

1. Fuzzy Tsukamoto Method

Predictions for graduating students from the Class of 2022 for the Computer Science Study Program at Pattimura University are carried out periodically. At this stage, the author will describe the process of using the fuzzy Tsukamoto method in predicting student graduation. Based on the data obtained from the survey results, the input criteria/variables can be seen in Table 1.

Table 1. Variable use in survey

Code	Criteria/Variables	Value Range
C01	IPK	1.00 – 4.00
C02	SKS	24 – 144
C03	Presence	1 – 100
C04	Organizational	1 – 100

Information:

IPK

1. 3.41 - 4.00 = 85
2. 2.76 – 3.40 = 70
3. 2.10 – 2.75 = 60
4. 1.00 – 2.09 = 30

SKS

1. 60 - 69 credits = 85
2. 50 – 59 credits = 70
3. 30 – 49 credits = 60
4. 0 – 29 credits = 30

Presence

1. >80% = 85
2. 60 – 79% = 70
3. 40 – 59% = 60
4. 0 – 39% = 30

Organizational

1. Registered with the organization and active in the organization = 80
2. Registered with the organization but not/less active = 60

Not registered with organization = 25

2. Fuzzification

The fuzzyfication stage carried out is the calculation process to change the crisp/classic value into a fuzzy membership degree. The calculation in the fuzzyfication process is described based on the limits of the fuzzy membership function of each variable[2]–[5]. The following is the membership function of the fuzzy set for four input variables, namely IPK, SKS, Presence, and Organization and one output variable, namely the Result Variable.

a. Fuzzy IPK Set

The membership function for the IPK variable can be shown in Figure 1 below:

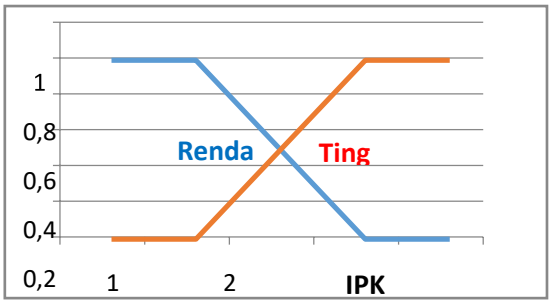

Fig.1. Membership Function for IPK

Association Low membership function:

$$\mu_{Low}(X) = \begin{cases} 1, & 1 \le x \le 2 \\ \dfrac{3-x}{3-2}, & 2 \le x \le 3 \\ 0, & 3 \le x \le 4 \end{cases}$$

High membership function :

$$\mu_{High}(X) = \begin{cases} 0, & 1 \le x \le 2 \\ \dfrac{x-2}{3-2}, & 2 \le x \le 3 \\ 1, & 3 \le x \le 4 \end{cases}$$

b. Membership function for SKS

The membership function on the SKS variable can be seen in Figure 2 below:

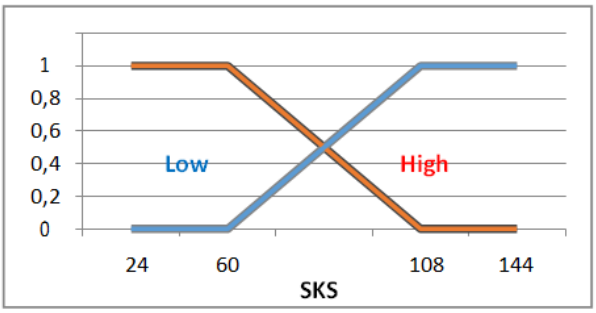

Fig.2. Membership Function for SKS

low degree of membership :

$$\mu_{Low}(Y) = \begin{cases} 1, & 24 \le y \le 60 \\ \dfrac{60-y}{108-60}, & 60 \le y \le 108 \\ 0, & 108 \le y \le 144 \end{cases}$$

high degree of membership :

$$\mu_{High}(Y) = \begin{cases} 0, & 24 \le y \le 60 \\ \dfrac{x-60}{108-60}, & 60 \le y \le 108 \\ 1, & 108 \le y \le 144 \end{cases}$$

c. Membership Function For Presence

The membership function on the Presence variable can be seen in Figure 3 below:

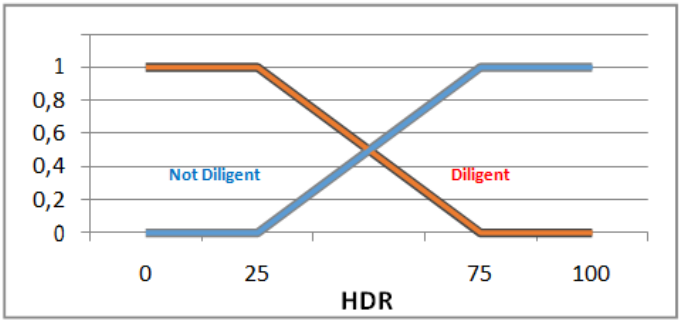

Fig.3. Membership Function for Presence

Not Diligent degree of membership :

$$\mu_{Not\_Diligent}(Z) = \begin{cases} 1, & 0 \le z \le 25 \\ \dfrac{75 - z}{75 - 25}, & 25 \le z \le 75 \\ 0, & 75 \le z \le 100 \end{cases}$$

Diligent degree of membership :

$$\mu_{Diligent}(Z) = \begin{cases} 0, & 0 \le z \le 25 \\ \dfrac{z - 25}{75 - 25}, & 25 \le z \le 75 \\ 1, & 75 \le z \le 100 \end{cases}$$

d. Membership Function for organizational
The membership function on the organizational variable can be seen in Figure 4 below:

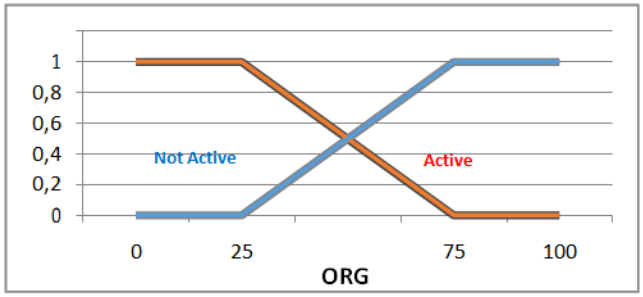

Fig.4. Membership Function for organizational

Not Active degree of membership :

$$\mu_{Not\_Diligent}(W) = \begin{cases} 1, & 0 \le w \le 25 \\ \dfrac{75 - w}{75 - 25}, & 25 \le w \le 75 \\ 0, & 75 \le w \le 100 \end{cases}$$

Active degree of membership :

$$\mu_{Diligent}(W) = \begin{cases} 0, & 0 \le w \le 25 \\ \dfrac{w - 25}{75 - 25}, & 25 \le w \le 75 \\ 1, & 75 \le w \le 100 \end{cases}$$

e. Membership Function for Result
The membership function on the Result variable can be seen in Figure 5 below:

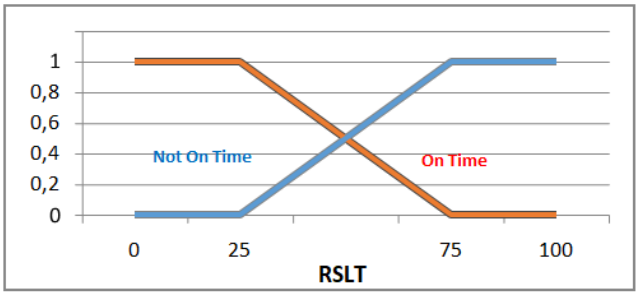

Fig.5. Membership Function for Result

Not On Time degree of membership :

$$\mu_{Not\_Diligent}(H) = \begin{cases} 1, & 0 \le h \le 25 \\ \dfrac{75-h}{75-25}, & 25 \le h \le 75 \\ 0, & 75 \le h \le 100 \end{cases}$$

On Time degree of membership :

$$\mu_{Diligent}(H) = \begin{cases} 0, & 0 \le h \le 25 \\ \dfrac{h-25}{75-25}, & 25 \le h \le 75 \\ 1, & 75 \le h \le 100 \end{cases}$$

3. Fuzzy Inference Systems

The system that performs calculations is based on the concept of fuzzy set theory, fuzzy rules, and fuzzy logic concepts, namely the Fuzzy Inference System (FIS) [6], [7]. In a fuzzy inference system, there is a fuzzy input in the form of crisp values. The crisp value will be calculated based on the rules that have been created to produce a fuzzy quantity called the fuzzification process. The Tsukamoto fuzzy method inference system forms a rules-based or rule base in the form of "cause-effect" or "if-then".[8], [9]

The first step in calculating the Tsukamoto fuzzy method is to create a fuzzy rule. The next step is to calculate the degree of membership according to the rules that have been created. Once the membership degree value of each fuzzy rule is known, the predicate alpha value can be determined by using fuzzy set operations [10], [11].

Table 2. Rules Base

Rules	IPK	SKS	Presence	Organization	Results
1	TALL	TALL	DILIGENT	ACTIVE	ON TIME
2	TALL	TALL	DILIGENT	NOT ACTIVE	ON TIME
3	TALL	TALL	NOT DILIGENT	ACTIVE	ON TIME
4	TALL	TALL	NOT DILIGENT	NOT ACTIVE	ON TIME
5	TALL	LOW	DILIGENT	ACTIVE	ON TIME
6	TALL	LOW	DILIGENT	NOT ACTIVE	NOT ON TIME
7	TALL	LOW	NOT DILIGENT	ACTIVE	NOT ON TIME
8	TALL	LOW	NOT DILIGENT	NOT ACTIVE	NOT ON TIME
9	LOW	TALL	DILIGENT	ACTIVE	ON TIME
10	LOW	TALL	DILIGENT	NOT ACTIVE	NOT ON TIME
11	LOW	TALL	NOT DILIGENT	ACTIVE	NOT ON TIME
12	LOW	TALL	NOT DILIGENT	NOT ACTIVE	NOT ON TIME
13	LOW	LOW	DILIGENT	ACTIVE	NOT ON TIME
14	LOW	LOW	DILIGENT	NOT ACTIVE	NOT ON TIME
15	LOW	LOW	NOT DILIGENT	ACTIVE	NOT ON TIME
16	LOW	LOW	NOT DILIGENT	NOT ACTIVE	NOT ON TIME

4. Defuzzification

The final step in the Fuzzy Tsukamoto method is to look for the output value in the form of a crisp (z) value which is known as the defuzzification process. The method used in this process is the Center Average Defuzzyfier method.

5. Context Diagram

Context diagrams are a form of data flow that shows that the system is a process.

3. Results and Discussion

The student assessment process is carried out through the student assessment input page. The assessment input consists of the range of values that have been determined in the process of determining the set of each criterion. The results can be seen in Figure 5.

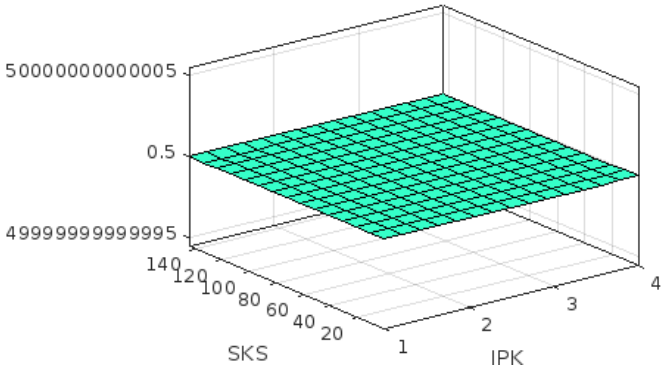

Fig. 7. Student Assessment Results

Student Calculation Page

The calculation process carried out on the student calculation page is used to calculate the total score obtained for each student based on the criteria. The calculation results for each student can be seen in Table 3.

Table 3. Student Calculations

NAMA LENGKAP	IPK	JUMLAH SKS	KEHADIRAN	IKUT ORGANISAS	HASIL
ASKIN SYAFIYAH SUHARDIN	3,75	64	> 80%	YA	TEPAT WAKTU
ISMU IQBAL SAPRI	3,27	64	> 80%	YA	TEPAT WAKTU
CHRISYA TEKLA MAITALE	3,38	64	> 80%	YA	TEPAT WAKTU
LEA SIDA LESBASSA	3,28	64	> 80%	YA	TEPAT WAKTU
VYARLITA FATARUBA	3,2	64	> 80%	YA	TEPAT WAKTU
RUSNIAN SAIDU	3,08	64	> 80%	TIDAK	TEPAT WAKTU
JEAN LESNUSSA	3,3	64	> 80%	TIDAK	TEPAT WAKTU
MAGDALENA	3,38	64	> 80%	YA	TEPAT WAKTU
AFNAN EMAN OPIER	3,35	64	> 80%	YA	TEPAT WAKTU
SRI MBOITI KUBANGUN	3,15	64	> 80%	YA	TEPAT WAKTU

Based on the prediction rules used in this research, each decision result will refer to the rule as a knowledge representation technique. In general, a rule has more than one piece of evidence which is connected by the conjunction AND. In making decisions about the rules first, which are owned by the students, the set of each rule is then arranged between the rules to find the α value of the predicate for each rule α^1. Rule evaluation is a process of reasoning on fuzzy input, namely GPA, SKS, Attendance, and Organization, which is produced by the fuzzification process based on the fuzzy rules that have been created and produces a fuzzy output, namely on time or not on time for student graduation.

4. Conclusion

The 2022 batch of 38 students in completing their studies can be predicted using fuzzy tsukamoto. It can be seen that out of 38 students who graduated on time, 10 students had an input variable GPA of more than 3.00, for the input variable attendance of more than 80%, and the total number of credits was 64 credits. While the output variable for Results (not on time and on time) obtained the results of the graduation of students from the Communication Studies Study Program graduating on time

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