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Decision Support System for Major Determination in Madrasah Aliyah

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***Abstract*—During this time, process of major determination in MAN Gondangrejo is based on value, interests, and the results of psychological tests. Interest derived from questionnaires, which gathered information about student interest on a particular subject. While the results of psychological tests are only taken from the results of the largest majors, so the decision is less than the maximum. It is because the results ignore other majors. There is no consideration of class quota of each major. Therefore, to obtain the right decision, this senior high school needs a decision support system that can help the team as the decision maker to determine of students majoring in accordance with the values, interests, intelligence / IQ, personality and skills of students. Moreover, it considers also the class quota of each major. One of application logic fuzzy is support system with *Fuzzy Inference System* (FIS) Mamdani. There are four stages to get output in FIS Mamdani: formation of a collection of fuzzy, formation of rules, application of function of implications and rules of inferences, and defuzzyfication. The method for developing system that used in this research is waterfall method. There are 5 steps to developing system. They are required analysis of system, interface design of system, implementation of system, testing of system and maintenance of system. This system is capable to display the rank of recommendation to all students for x class based on FIS Mamdani. The ranks are sorted from the highest to the lowest recommendation and quota of majors. This system is useful to give the right determination for majoring in senior high schools. Based on the result of system testing, 100% major decision makers in MAN Gondangrejo totally agree about this decision support system.**

Keywords-Decision Support System; Fuzzy Inference System; Mamdani Method; Waterfall Method.

I. INTRODUCTION

A. Background

Educational institutions at the level of Madrasah Aliyah or Senior High School need a standard assessment system to help students choosing the right majors. This system can help school to obtain decisions. Decisions taken in determining student majors are expected to be in accordance with academic grades, psychological test results, student interest and quota provided. Decision makers shall really consider the appropriate options for these majors. Therefore, it is needed a decision support system that could process major data and produce appropriate majors.

Fuzzy logic is an appropriate way to map an input space into an output space. This technique uses the mathematical theory of fuzzy sets. Fuzzy logic is related to the uncertainty that has become human nature. Fuzzy logic can be useful because it is an effective and accurate way to describe human perception of the problem of decision making.

Therefore, this research takes a case study in the Gondangrejo Madrasah Aliyah with the title "Decision Support System uses Mamdani Method for Major Determination in Madrasah Aliyah". The object-based system will be built using the Java programming language and MySQL database.

B. Research purposes

The objectives of this research is creating an object-based decision support system that allows users to determine majors at the Madrasah Aliyah level by using Fuzzy Inference System Mamdani method.

II. THEORY

A. Literature Review

Research related to this case includes a study entitled "Determination of Majors in Surakarta N 8 High School with the Fuzzy Inference System (FIS) Mamdani"[1]. The study discusses the determination of majors in SMA N 8 Surakarta using FIS Mamdani. The FIS was built using five input variables, there are NIPA, NIPS, IQ, Interest and class capacity. The output variables are IPA and IPS.

Other research that is also related is "Decision Support Systems for Major Determination in 10 High Schools Yogyakarta"[2]. The research was made with the aim of making a decision support system to help students decide which majors in accordance with their abilities and interests.

In addition to the two studies above, the research entitled "Employee Assessment Decision Support System for Occupying a Position Based on the Five-Fold Grading System Specifications (Case Study of PT. Aneka Tara)"[3]. In this study, a decision support system was built with the Java programming language with the Netbeans 5.5 editor and the MySQL database. The method implemented in this decision support system is the profile matching method with the Five-Fold Grading System specification.

Other research that is also related is "Decision Support System for Toddler Health Handling Uses Fuzzy Mamdani Reasoning"[4]. This research builds a decision support system by implementing Mamdani fuzzy logic reasoning in the processing of input and output data.

B. Decision Support Systems

The concept of Decision Support Systems (DSS) was first revealed in the early 1970s by Morton with a term Management Decision Systems. Morton defines DSS as "Interactive Computer-Based System, which helps decision makers to solve unstructured problems using data and various models "[5]. According to William and Sawyer[6], a decision support system is a computer-based information system that provides flexibility in analyzing and helps managers to stay focused in the future.

C. Purpose of Decision Support Systems

According to Turban[7], the objectives of DSS are as follows:

1) Assist in making decisions on structured problems.
2) Providing support for the manager's consideration and not intended to replace the manager's function.
3) Increasing the effectiveness of decisions taken rather than improving efficiency.
4) Computational speed, computers allow decision makers to do a lot of computing quickly at a low cost.
5) Increased productivity.
6) Quality support.
7) Competitive.
8) Overcoming cognitive limitations in processing and storage.

D. Fuzzy Logic

The concept of fuzzy logic was first introduced by Professor Lotfi A. Zadeh of the University of California, in June 1965. Fuzzy logic is a generalization of classical logic that has only two membership values between 0 and 1. In fuzzy logic, the truth value of a range statements from completely right to completely wrong. With fuzzy set theory, an object can be a member of many sets with different degrees of membership in each set. This concept is different from classical set theory (crisp).

The reasons for using fuzzy logic according to Kusumadewi and Purnomo[8] include:

1) The concept of fuzzy logic is easy to understand. The mathematical concept underlying fuzzy reasoning is very simple and easy to understand.
2) Fuzzy logic is very flexible.
3) Fuzzy logic has a tolerance for incorrect data.
4) Fuzzy logic is able to model nonlinear functions that are very complex.
5) Fuzzy logic could build and apply the experiences of experts directly without having to go through a training process.
6) Fuzzy logic could work with conventional control techniques.
7) Fuzzy logic is based on natural language.

E. Mamdani Method

The Mamdani method is often known as the Max-Min method. This method was introduced by Ebrahim Mamdani in 1975. To get the output, it takes 4 stages:

1) Formation of fuzzy sets.
In this method, both input and output variables are divided into one or more fuzzy sets.

2) Application function implications.
In this method, the implication function used is Min.

3) The composition of the rules.
Unlike monotonous reasoning, in this method, the system consists of several rules; inference is obtained from the collection and correlation between rules.

4) Defuzzyfication

III. METODOLOGIES

This research was conducted to produce recommendations from a decision support system related to the process of major determination at the Madrasah Aliyah in Gondangrejo Karanganyar. This system implements one of the fuzzy inference system methods, Mamdani method, in carrying out the process of the variables that are required in the process of major determination. The variables are student grades, intelligence / IQ, special abilities, personality and student interest in the major and class quota. Mamdani method was chosen because this method is considered to have similarities with the pattern of human thinking compared to other fuzzy inference system methods. This research sampled students in grade X MAN Gondangrejo 2012 with three majors as their choice, Natural Sciences Program, Social Sciences Program and Religious Programs.

IV. SYSTEM ANALYSIS AND DESIGN

A. System Requirements Analysis

System analysis is used as a decomposition of a whole information system into several sections with aims to identifying and evaluating problems, obstacles that occur and the needs that are expected, therefore, a better system could be proposed. Fig. 1 shows system overview.

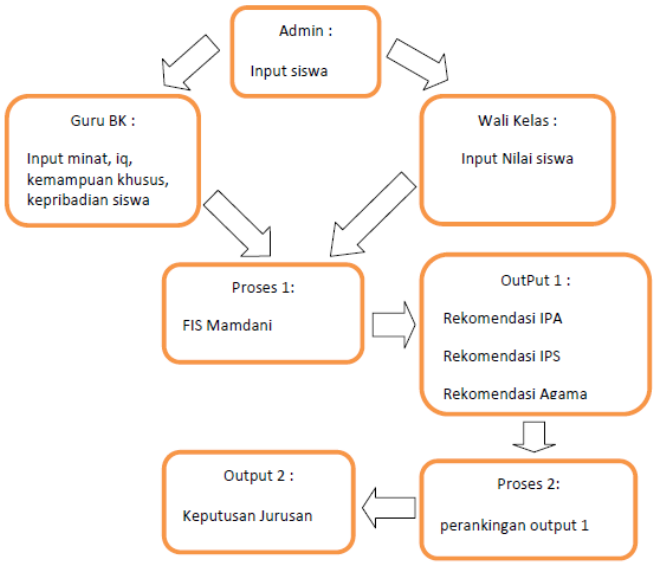

Figure 1. System Overview

B. Fuzzy Inference System Mamdani Method

The decision support system for major determination of Madrasah Aliyah uses Mamdani method of fuzzy inference system. To get a decision in determining the right direction, fuzzy inference system method will process the input data calculation and determine the membership function which will affect the outcome of the decision.

The membership function is a curve shows the mapping of data input points into its membership which has an interval between 0 to 1. Mamdani method processes a set through four stages; there are the formation of a set, application of function implications, composition of rules and defuzzyfication.

C. UML (Unified Modelling Language)

Use case of this system is shown in Fig. 2. As can be seen, there are three actors to this system. There are several processes that those actors can do.

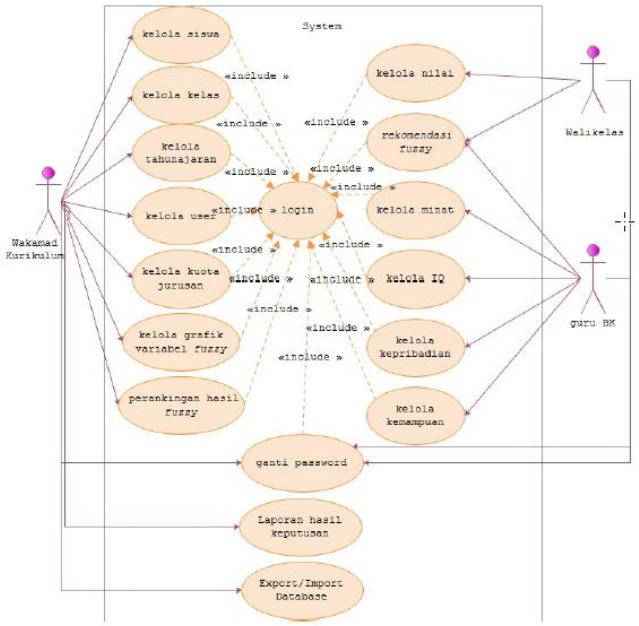

Figure 2. Use case of DSS

V. IMPLEMENTATION AND TESTING

A. *Implementation*

Implementation is a translator stage of the design of object-based decision support systems with the Mamdani method for major determination in the form of program code lines. Object-based decision support system uses Mamdani method is a desktop-based system that is implemented using the Java programming language and MySQL as the database.

B. *Testing*

System testing is the final stage in this research, which is carried out using a system test that tests the overall capabilities provided by the decision support system. the system testing uses black box method. Black box technique is a testing method by focusing on the functional system that has been built and pay attention to the results of the system if it has been running as expected.

VI. RESULT

A. *Results of the Fuzzy Inference System Mamdani Method*

The case that will be calculated in the Fuzzy Inference System Mamdani method accordance with the method used to build a decision support system for the decision making. This case was taken and modified from one of class X MAN Gondangrejo students in the 2010/2011 school year.

A student has an IQ of 113, the value of interest in entering into a natural science 80, an interest in entering a 50 social studies major, and an interest in entering a religious major 60.

B. *System Calculation Result*

The steps in completing case examples 6-1 with the system are:

1) Homeroom teachers enter student grades

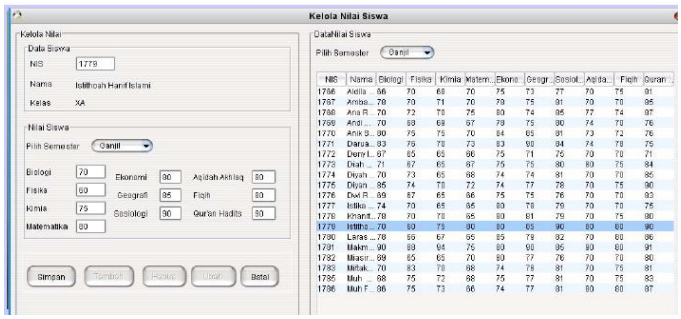

Figure 3. Input Value

Fig. 3 is a form provided by the system for entering student grade data. The results of calculating the degree of membership by the system are shown in Fig. 4.

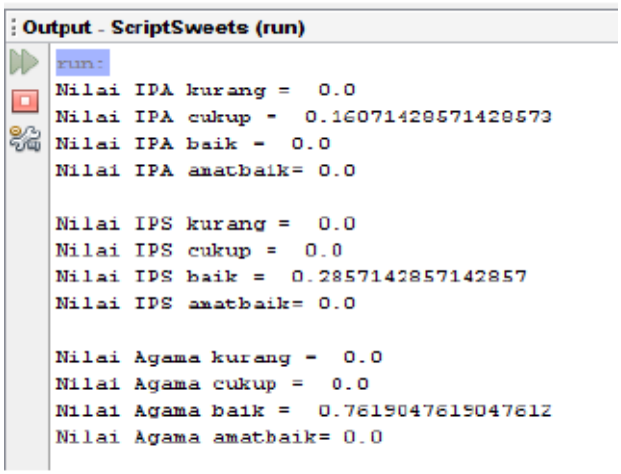

Figure 4. Degree of Membership of Value Variables

2) Teachers enter student IQ scores.

Figure 5. IQ Input

Fig. 5 is a form provided by the system to enter student IQ data. The results of the calculation of the degree of membership for the IQ variable processed by the system can be seen in Fig. 6 below.

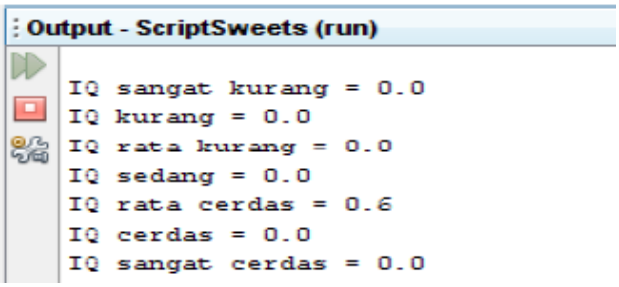

Figure 6. Degree of IQ Variable Membership

3) BK teachers enter student interest data into the system

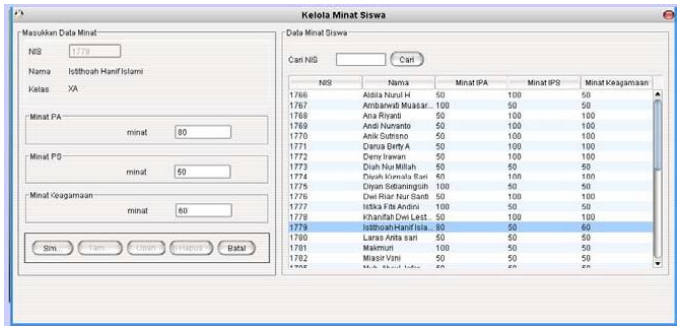

Figure 7. Input Interests

Fig. 7 is a form provided by the system to enter student interest data. The results of the calculation of the degree of membership for the variable of interest processed by the system can be seen in the following Fig. 8.

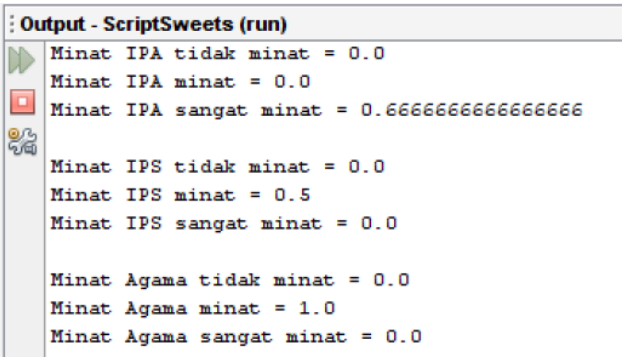

Figure 8. Degree of Interest Variable Membership

4) BK teachers enter student ability data into the system
Fig. 8 Input Special Capabilities

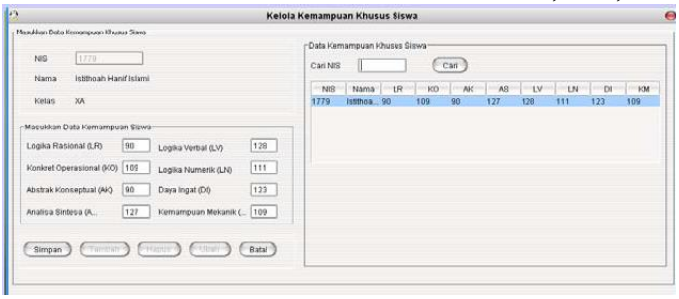

Figure 9. Input Special Capabilities

Fig. 8 is a form provided by the system for entering data on special abilities of students. The results of the calculation of the degree of membership for special ability variables that are processed by the system can be seen in Fig. 9.

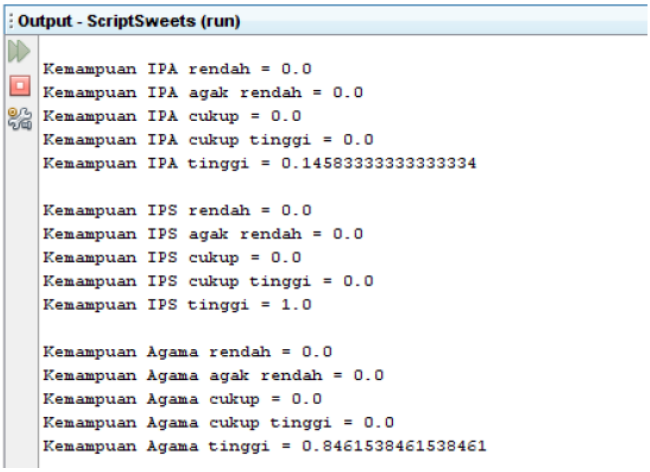

Figure 10. Degree of Membership of Special Ability Variables

5) BK teachers enter student personality data into the system

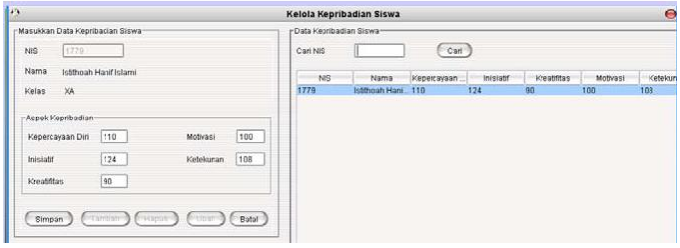

Figure 11. Personality Input

Fig. 10 is a form provided by the system to enter student personality data. The results of the calculation of the degree of membership for personality variables that are processed by the system can be seen in the following Fig. 11.

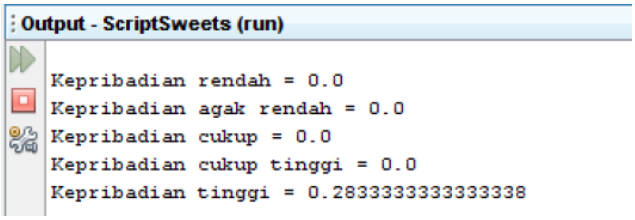

Figure 12. Degree of Membership of Personality Variables

6) The BK teacher opens the Recommendation Results submenu in the Majors Results menu. Then the BK teacher enters the student's NIS to calculate the results of his recommendation as shown in Fig. 12.

Figure 13. Calculation of recommendation results

When the BK teacher clicks the process button, the system will display the results of recommendations which are the result of defuzzification of the input variables that have been previously entered.

VII. CONCLUSION

According to the results of tests that have been done, it can be drawn some conclusions as follows:

1) This research succeeded in designing and implementing an object-based decision support system using the Mamdani method to determine the majors of Madrasah Aliyah students.

2) This research successfully applied Mamdani method in determining the results of major's recommendations and the quota to determine the outcome of the decision.

3) The system is able to provide recommendations to the Wakamad Curriculum, BK and Homeroom teachers to determine the majors of Madrasah Aliyah students.

4) From the trial case that have been carried out, it can be concluded that the results of calculations by system is same with the results of calculations that done manually.

5) Based on the test results, it can be concluded that 100% of system functionality is fulfilled. For the results of interface and access testing, there are 62.5% of respondents who strongly agree and 37.5% of respondents agree while the decision-making team or decision holder strongly agrees 100% with the majors content contained in this decision support system of majors determination.

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