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Implementation of the Forward Chaining Method in Identifying Study Programs Based on Students' Interests and Talents

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ABSTRACT

This study aims to develop a decision support system (DSS) based on the Forward Chaining method to assist prospective students in selecting a study program that aligns with their interests, talents, and abilities. The system is designed to analyze 34 facts related to the respondents' interests and talents using predefined rules, generating program recommendations in the form of rankings based on suitability weights. Testing was conducted with 100 respondents, one of whom, named Najmil Ula, was recommended to choose the Chemical Engineering program with a suitability weight of 2,3 or 26.44%, based on fulfilled facts such as an interest in understand in physics and love doing an experiment. Additionally, the system provided alternative recommendations, such as Informatics Engineering and Architecture, with lower suitability levels. These results demonstrate that the system can provide relevant and objective recommendation, making it an effective tool to support prospective students in selecting study programs that match their potential.

I. Introduction

Higher education plays a vital role in shaping competent and principled individuals with broad perspectives to achieve their aspirations and adapt to their environments. It encourages individuals to pursue a better life, serving as a key to success, particularly in the modern era that demands innovation and technological advancement. The educational process takes place in various settings such as family, school, and society, aiming to develop students' potential in aspects like spirituality, personality, intelligence, self-control, morality, and skills that benefit both themselves and society [1].

Choosing the right study program in higher education is a strategic step that significantly impacts students' career development and future success. However, many students struggle to identify their interests and talents, leading to the selection of unsuitable majors, which can result in discomfort, confusion, or even academic failure. Higher education institutions are crucial in producing a professional workforce, making it essential for students to select a field of study aligned with their interests, talents, and abilities to maximize their potential and secure promising career prospects [2].

The advancement of Artificial Intelligence (AI) technology presents new opportunities for addressing the challenges associated with identifying student interests and talents. One method that demonstrates significant potential is Forward Chaining, which constitutes a component of expert systems within the AI domain. This method can assist in identifying student interests based on their capability data through a more objective and systematic approach [3].

The superiority of the Forward Chaining method over conventional approaches lies in its capability to process large volumes of data in a consistent and objective manner [4]. To address the challenges of selecting a study program, the Forward Chaining method, a part of artificial intelligence [5], can be utilized to identify student's interests based on their ability data. This method starts with existing facts and draws relevant conclusions or recommendations using IF-THEN rules, assisting students in making more accurate decisions [6]. The author is interested in adopting the title "Implementation of the Forward Chaining Method in Identifying Interest in Study Programs Based on Students' Abilities"

for research expected to help students understand their intelligence and choose a major that matches their individual profile.

II. Method

A. Location and Time of Research

The research was conducted at Kusuma Bangsa State Senior High School (SMA) 2 in Muara Batu, North Aceh Regency. This location was chosen to facilitate the collection of data and references needed for the system to be developed. This activity was carried out to support the development of the system so that the research could proceed smoothly. The research was conducted from January 2024 until its completion.

B. Collecting Data

In the data collection process, data was gathered as needed for the research based on the issues being studied. The following are the data collection techniques used in this research:

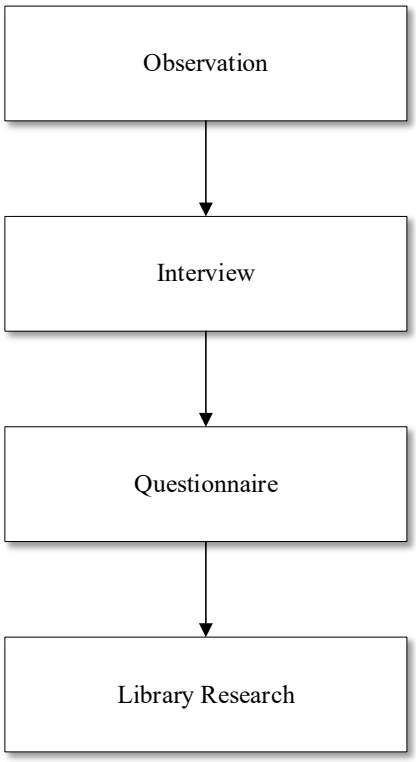

Fig 1. Collecting Data

C. Forward Chaining

Forward Chaining is a forward-run method, which means it uses condition-action rules. In this method, data is used to determine which rule should be applied, and only then is the rule executed [7]. The advantage of Forward Chaining is that it works very well when the problem starts by gathering or combining information and then finding the conclusions that can be drawn from that information. Additionally, this method can provide a large amount of information from just a small amount of data. The disadvantage of this method is that it may not have a way to recognize where some facts are more important than others [8].

Forward Chaining is a forward-looking research method and technique that begins with the available information and combines rules to form knowledge [9]. Forward Chaining is a search technique that starts with known facts, then matches those facts. When the rules are found, the decision-making machine can draw a conclusion or consequence [10].

The system's activity is carried out based on a cycle of recognition-action. First, the system will search for all the rules whose conditions are present in the working memory, then it selects one and

executes the action corresponding to that rule. The selection of which rule to execute is based on a fixed strategy called the conflict resolution strategy. This action results in a new working memory, and the cycle is repeated until no more rules can be triggered, or the desired goal has been achieved. You can see in Table 1 an example of rules using Forward Chaining.

Table 1. Example of Rules Using Forward Chaining

No	Rules
R1	*IF* A & B *THEN* C
R2	*IF* C *THEN* D
R3	*IF* A & E *THEN* F
R4	*IF* A *THEN* G
R5	*IF* F& G *THEN* D
R6	*IF* G & E *THEN* H
R7	*IF* C & H *THEN* I
R8	*IF* I & A *THEN* J
R9	*IF* G *THEN* J
R10	*IF* J *THEN* K
R8	*IF* I & A *THEN* J
R9	*IF* G *THEN* J
R10	*IF* J *THEN* K

In Table 1, an example of rules using Forward Chaining shows that there are 10 rules stored in the knowledge base. If the initial facts given are A and F (meaning A and F are true), the goal is to prove whether K is true (hypothesis: K). The inference steps are as follows:

1. Starting from R-1, A is a fact, so it is true, while B is not yet known, so C also cannot be determined as true. Therefore, no information is obtained from R1. We proceed to R2.
2. In R2, no information is known about C, so the truth of D cannot be determined. Therefore, no information is obtained from R2. We proceed to R3.
3. In R3, both A and E are facts, so they are true. Therefore, F as a consequent is also true. Now there is a new fact, which is F. Since F is not the hypothesis we want to prove (= K), we proceed to R4.
4. In R4, A is a fact, so it is true. Therefore, G as a consequent is also true. Now there is a new fact, which is G. Since G is not the hypothesis we want to prove (= K), we proceed to R5.
5. In R5, both F and G are true based on the rules from R3 and R4. Therefore, D as a consequent is also true. Now there is a new fact, which is D. Since D is not the hypothesis we want to prove, we proceed to R6.
6. In R6, both A and G are true based on the facts from R4. Therefore, H as a consequent is also true. Now there is a new fact, which is H. Since H is not the hypothesis we want to prove, we proceed to R7.
7. In R7, even though H is true based on R6, the truth of C is not known, so I also cannot be determined as true. Therefore, no information is obtained from R7. We proceed to R8.
8. In R8, even though A is true because it is a fact, the truth of I is not known, so J also cannot be determined as true. Therefore, no information is obtained from R8. We proceed to R9.
9. In R9, J is true because G is true based on R4. Since J is not the hypothesis we want to prove, we proceed to R10.

10. In R10, K is true because J is true based on R9. Since K is the hypothesis we want to prove, it is now proven that K is true.

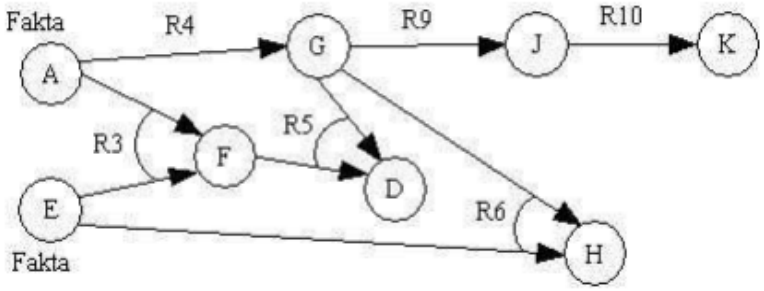

Fig 2. Example of Rules Using Forward Chaining

D. System Schema

The system schematic designed for the research using the Forward Chaining method is as follows:

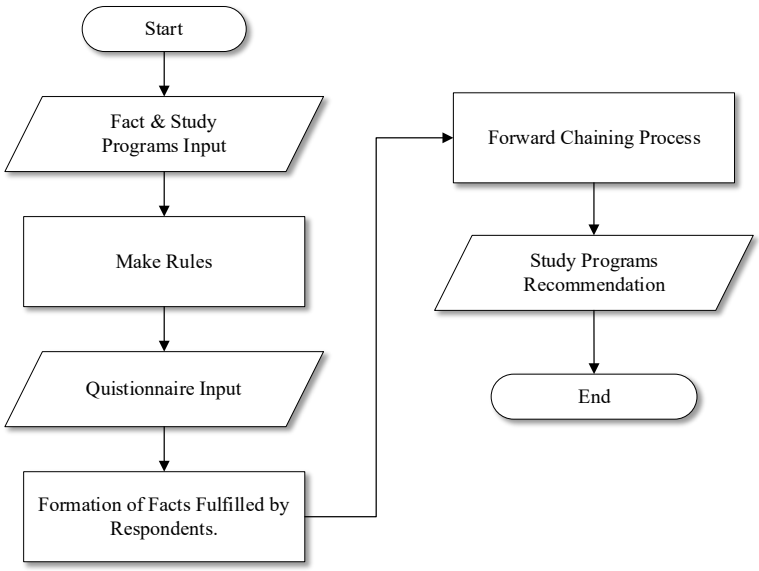

Fig 3. System Schema

The system schematic of the Decision Support System (DSS) using the Forward Chaining method illustrates the workflow in the process of identifying study program recommendations based on the facts and data obtained from respondents. Below is an explanation of each stage in the schematic:

1. Start: The process begins by determining the steps necessary to generate a study program recommendation. This stage guides users to input the required data into the system.
2. Input Facts & Study Programs Data: At this stage, initial data consisting of facts (interests, talents, and competencies) and a list of study programs are entered into the system. Facts are used to identify the characteristics of the respondents, while the study programs are the alternatives to be analyzed for generating recommendations.
3. Formation of Data Rules: Based on the facts and study program data that have been inputted, rules are formed using an IF-THEN approach. These rules link specific facts with relevant study programs and assign weights as a measure of compatibility. This stage is important for defining the inference logic in the Forward Chaining method.

4. Input Questionnaire Data: Questionnaire data from respondents, in this case, Najmil Ula's answers, are entered into the system. The answers from the questionnaire are used to match the facts that are fulfilled according to the rules previously set.
5. Formation of Facts Fulfilled by Respondents: The system processes the questionnaire data to determine which facts are fulfilled based on the respondents' answers. These facts will serve as the basis for the next inference process.
6. SPK Forward Chaining Process: At this stage, the system applies the Forward Chaining method to match the fulfilled facts with the predefined rules. Facts that match the rules will generate compatibility weights for each relevant study program. These weights are then summed up to determine the relevance level of each study program.
7. Display Study Program Recommendations: The final result of the Forward Chaining process is a list of study program recommendations, arranged based on the total weights that have been calculated. The program with the highest weight is considered the most suitable for the respondent's interests and talents.
8. Finish: The process ends after the study program recommendations are displayed to the respondent. The results can be used as a reference to determine the most suitable study program.

This schematic is designed to ensure a systematic and structured workflow in generating study program recommendations. This process not only helps respondents in selecting the appropriate program but also provides insights into the relevance between their interests and talents and the available study programs.

III. Result and Discussion

The selection of a study program is one of the most crucial decisions for students who are about to continue their education at a university, especially in determining the direction of their future careers. Identifying a study program that aligns with students' interests and talents accurately can help students make better decisions and enhance their potential for success in their studies. One method that can be used in the process of identifying the appropriate study program is the application of the Forward Chaining method.

This research focuses on the application of the Forward Chaining method to identify study programs that match students' interests and talents. The data used in this study is obtained from observations, interviews, and questionnaires from students at SMAN 2 Kusuma Bangsa Muara Batu. The aim of this research is to explore the potential of the Forward Chaining method in providing accurate and consistent study program recommendations, with the hope that it can support the study program selection process more effectively. The system developed is web-based, using PHP programming language and MySQL Database, with a focus on the study programs at the Faculty of Engineering, Malikussaleh University. This research will also evaluate the extent to which the Forward Chaining method can provide recommendations that align with students' interests and talents compared to conventional methods.

A. Problem Identify

Identifying the right study program based on students' interests and talents is a challenge due to various factors, such as academic abilities, personal tendencies, educational background, and environment. Many students face difficulties in choosing a study program because of a lack of understanding of their potential and insufficient information about the available study programs. Therefore, a method is needed that can handle the complexity of decision-making and provide reliable recommendations.

The Forward Chaining method is an appropriate choice due to its ability to process various input variables systematically, identify patterns of compatibility between interests and talents with the characteristics of study programs, and draw logical conclusions based on predefined rules. In this

research, the application of the Forward Chaining method is expected to improve the accuracy of the study program identification process and help students at SMAN 2 Kusuma Bangsa Muara Batu make better decisions in choosing a study program at the Faculty of Engineering, Malikussaleh University, compared to conventional approaches, which tend to be subjective and less structured.

B. Forward Chaining Implementation

Table 2. Forward Chaining Result

No	Ranking	Department	Total Score	Percentage
1	7	Mechanical Engineering	0.7	8.05
2	1	Chemical Engineering	2.3	26.44
3	7	Materials Engineering	0.7	8.05
4	2	Informatics Engineering	0.9	10.34
5	7	Informations System	0.7	8.05
6	5	Civil Engineering	0.8	9.20
7	5	Industrial Engineering	0.8	9.20
8	2	Architecture	0.9	10.34
9	2	Logistics Engineering	0.9	10.34
Total Score Overall			8.7	

Based on the results, the Chemical Engineering department has the highest weight, making it the most recommended study program for Najmil Ula. This Forward Chaining process shows how the facts gathered from the respondents are used to identify the relevant departments. By applying weights to each rule, the recommendation results are more directed and accurate, assisting students in choosing a study program that aligns with their interests and talents.

C. System Implementation

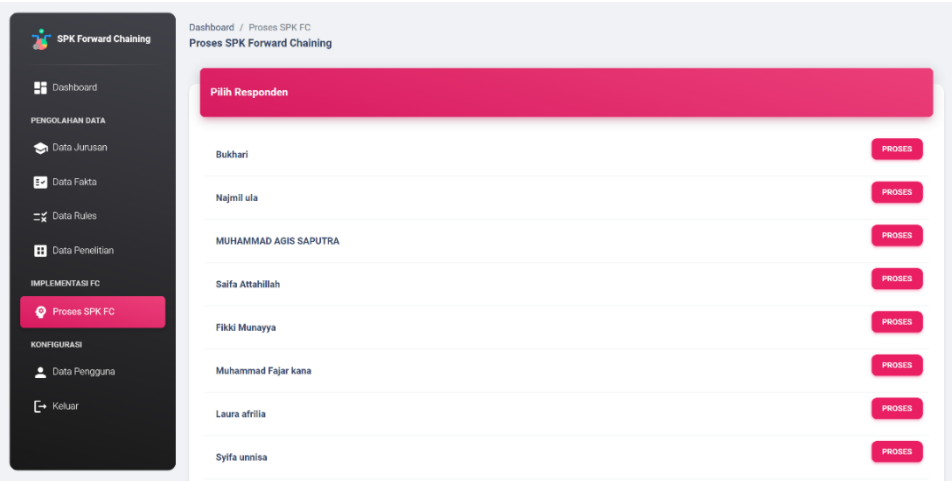

Fig 4. Forward Chaining Process Page

The Forward Chaining SPK Process page serves as a place to run the inference process based on the Forward Chaining method using the collected respondent data. On this page, the administrator or

user can select one respondent from the available list to be processed further by pressing the Process button next to the respondent's name. This process will match the respondent's answers to the facts and rules that have been defined earlier.

After the Process button is pressed, the system will run the Forward Chaining method to check the facts met (the "Yes" answers) by the respondent and match them with the relevant rules. The final result of this process is a major recommendation that fits the respondent based on the weight of the rules that were met. This page is the core of the Forward Chaining method implementation, ensuring that the system can provide accurate and relevant recommendations based on the available data.

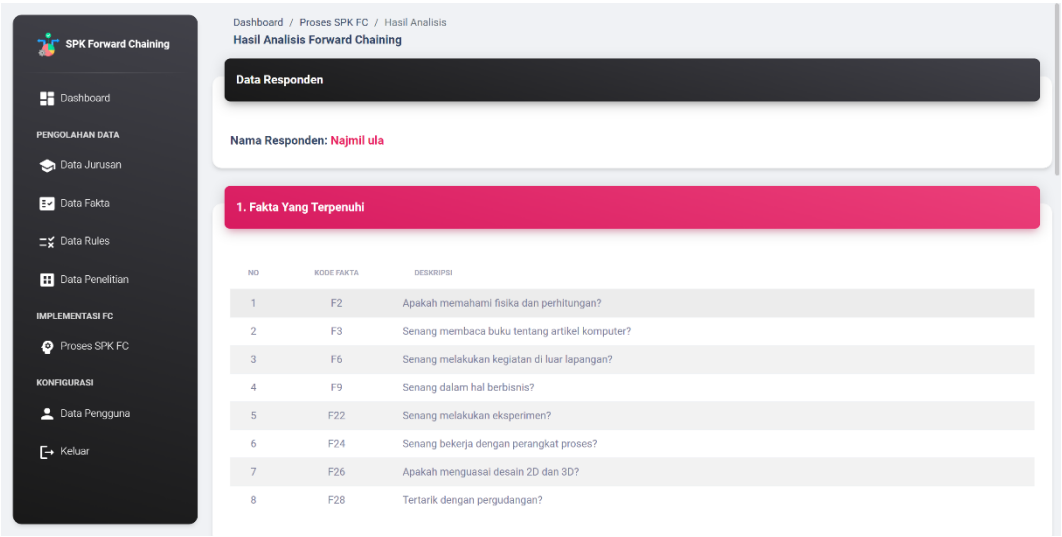

Fig 5. Analytics Result One Of Responded

This analysis results page illustrates the system process that utilizes the Forward Chaining method to generate suitable major recommendations for the respondent, in this case, named Najmil Ula. The system is divided into three main sections: fulfilled facts, the forward chaining process, and the final result, which is the major recommendation. The first section, Fulfilled Facts, records the "Yes" answers from the respondent to several statements, such as "Do you understand physics and calculations?" and "Do you enjoy reading books about computer articles?". These facts serve as the basis for matching relevant rules, reflecting the specific interests and abilities of the respondent. The analysis process continues with the application of forward chaining, where the system systematically evaluates the fulfilled facts to deduce the most suitable major. Other facts, such as "Do you enjoy conducting experiments?" and "Are you proficient in 2D and 3D design?", are also considered to enrich the decision-making database. The result of this process will be presented in the major recommendation section, providing structured guidance based on the respondent's answer patterns. The neat and organized interface design makes it easy for users to understand the system's logic flow, making it an effective tool for educational counseling.

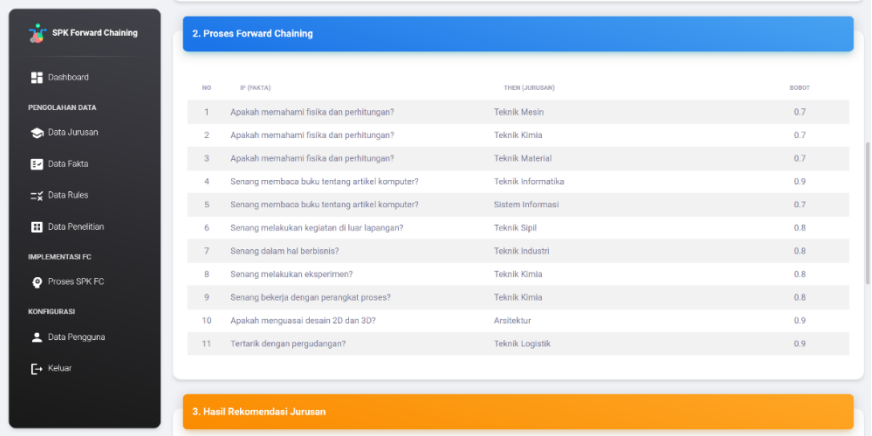

Fig 6. Second Part Analytics Result

The second section is the Forward Chaining Process, where the system checks each rule based on the fulfilled facts. These rules link facts (IF) to the recommended majors (THEN) and are accompanied by relevance weights. In this example, the system identifies the rules that match the facts fulfilled by Najmil Ula. The weight of each rule is accumulated to generate a total weight for each major.

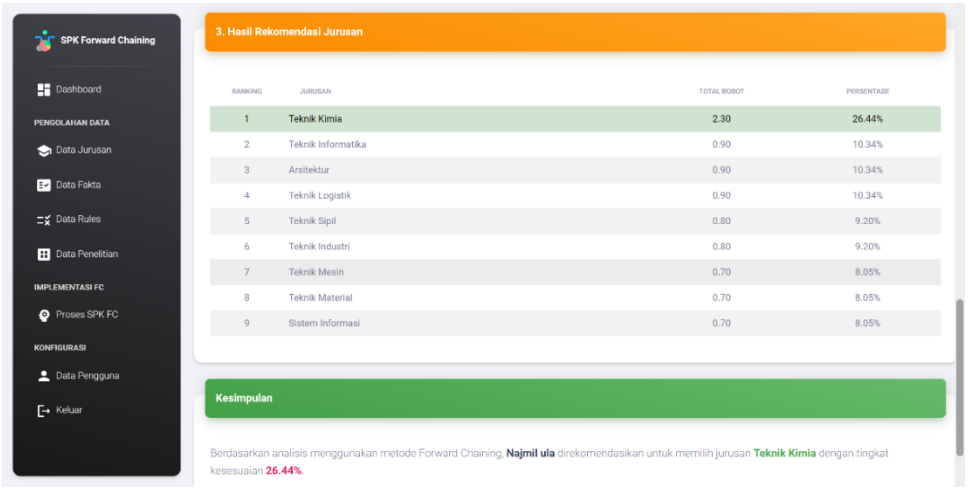

Fig 7. Third Part Analytics Result

The final section, Major Recommendation Results, displays a list of majors recommended for Najmil Ula based on the total weight and relevance percentage. The Chemical Engineering major ranks first with a total weight of 2.30 and a percentage of 26.44%, followed by other majors such as Computer Engineering and Architecture. The final conclusion states that based on the analysis using the Forward Chaining method, Najmil Ula is recommended to choose the Chemical Engineering major with the highest compatibility. This result provides clear and structured guidance for the respondent in selecting a study program that aligns with their interests and talents.

IV. Conclusion

This research successfully developed a Decision Support System (DSS) based on Forward Chaining to assist prospective students in selecting a study program that aligns with their interests and talents. The system utilizes 34 facts and rules to recommend relevant study programs. For example, Najmil Ula, one of the 100 respondents, was recommended Chemical Engineering (26.44% compatibility) based on interests in physics, experiments, and process equipment, with alternatives like Informatics Engineering. The system accurately recommends study programs based on the user's profile, processing data efficiently and without issues. The integration of facts and rules is well-executed, producing reliable recommendations, while the system's transparency in presenting fact

analysis, processes, and program rankings enhances user trust. Overall, the Forward Chaining method proves to be relevant and effective for fact-based decision-making, making it highly suitable for selecting study programs.

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