

AI-Based Decision Support System for Personalized Student Academic Advising

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Abstract: ***Background:** Academic advising plays an important role in helping students choose suitable academic specializations according to their abilities, interests, and academic performance. However, students may face difficulties in selecting the most appropriate specialization due to the availability of multiple academic tracks and limited access to academic advisors. **Objectives:** The main objective of this research is to develop a Student Academic Advisor Expert System that assists students in selecting the most suitable academic specialization based on their Grade Point Average (GPA) and personal interests. **Methods:** The proposed expert system was designed and implemented using SL5 Object Expert System Language. The system uses a rule-based knowledge base that contains a set of IF–THEN rules representing academic advising knowledge. Students are asked a series of questions related to their GPA and interests in areas such as programming, databases, artificial intelligence, networking, and cyber security. The inference engine analyzes the provided information and generates an appropriate recommendation. **Results:** The proposed system was able to provide specialization recommendations that match the academic profile and interests of students. The system offers a simple and interactive environment that facilitates the academic decision-making process. **Conclusions:** The Student Academic Advisor Expert System provides an effective tool for supporting students in choosing academic specializations. The use of expert system technologies and knowledge representation techniques demonstrates the applicability of Knowledge-Based Systems in the educational domain and contributes to improving the quality of academic guidance.*

Keywords: Artificial Intelligence, Expert Systems, Knowledge-Based Systems, Academic Advising, Rule-Based System, SL5 Object, Knowledge Representation.

1. INTRODUCTION

Academic advising is an essential process in higher education institutions. It helps students make informed decisions regarding their academic future and guides them toward selecting the most appropriate specialization according to their interests, skills, and academic performance. Choosing an unsuitable specialization may negatively affect student achievement, motivation, and future career opportunities. Therefore, providing accurate academic guidance is an important factor in improving educational outcomes.

Nowadays, universities offer a wide variety of academic specializations such as Software Engineering, Artificial Intelligence, Cyber Security, Database Systems, and Network Engineering. Many students face difficulties when selecting one of these specializations because they may not fully understand their strengths, interests, or the requirements of each field. As a result, students often require assistance from academic advisors to support their decision-making process.

Expert Systems are one of the most successful applications of Artificial Intelligence (AI). An Expert System is a computer program designed to simulate the decision-making abilities of a human expert in a specific domain. It uses stored knowledge and reasoning mechanisms to provide recommendations and solutions for particular problems. Expert systems have been successfully applied in various domains including medicine, agriculture, engineering, education, and business.

An Expert System usually consists of two main components: the Knowledge Base and the Inference Engine. The Knowledge Base contains facts, rules, and expert knowledge, while the Inference Engine applies reasoning techniques to derive conclusions from the available knowledge.

This research presents a Student Academic Advisor Expert System that assists students in selecting a suitable academic specialization based on their Grade Point Average (GPA) and personal interests. The proposed system uses a rule-based approach and applies knowledge representation techniques to model academic advising knowledge. The system asks students a series of questions related to their academic preferences and then provides recommendations for specializations that best match their profiles.

The proposed system was implemented using SL5 Object, which is a forward-chaining expert system language that supports rule-based reasoning and knowledge representation. The system demonstrates how Expert System technologies can be applied in the educational domain to support students and improve academic advising services.



Figure 1: Major academic specializations that can be recommended by the proposed expert system.

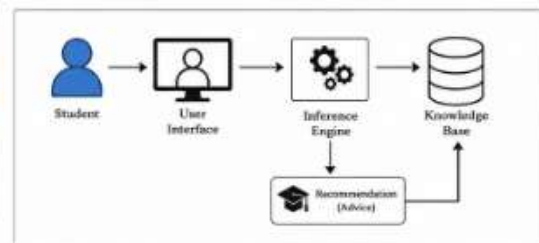


Figure 2: Architecture of the proposed Student Academic Advisor Expert System.

Figure 3: GPA selection screen.

Figure 4: Student interests collection screen.

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IF GPA = High
AND Programming = Yes
THEN Recommend Software Engineering
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IF GPA = High
AND AI Interest = Yes
THEN Recommend Artificial Intelligence
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IF Networks Interest = Yes
THEN Recommend Network Engineering
    
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Figure 5: Sample rules from the knowledge base.

Figure 6: Recommendation generated by the expert system.

Test Case	GPA	Main Interests	Recommended Specialization
1	92 (High)	Programming, Databases	Software Engineering
2	88 (High)	Artificial Intelligence, Machine Learning	Artificial Intelligence
3	80 (Medium)	Networks, Systems	Network Engineering
4	78 (Medium)	Cyber Security, Networks	Cyber Security
5	70 (Medium)	Databases	Database Systems

Figure 7: Sample test cases and system recommendations.

Overview of the proposed Student Academic Advisor Expert System.

2. MATERIALS AND METHODS

The proposed Student Academic Advisor Expert System was developed to assist students in selecting the most suitable academic specialization according to their academic performance and personal interests. The system was implemented using SL5 Object, a forward-chaining expert system language that supports rule-based reasoning and knowledge representation.

The proposed system collects information from students through a series of questions. These questions focus on the student's Grade Point Average (GPA) and interests in different computing fields such as Programming, Artificial Intelligence, Cyber Security, Database Systems, and Computer Networks. Based on the provided answers, the system analyzes the available information and generates a recommendation for the most appropriate academic specialization.

The knowledge of the system was acquired from academic advisors, university specialization requirements, and educational guidelines related to computing and information technology programs. This knowledge was transformed into a set of IF-THEN rules stored in the knowledge base.

The system follows a simple dialogue process. First, the student enters the required information and answers the questions presented by the system. Then, the inference engine evaluates the collected facts against the rules stored in the knowledge base. Finally, the system produces a recommendation accompanied by a brief explanation of the reasons behind the selected specialization.

The proposed expert system provides recommendations for several academic specializations including Software Engineering, Artificial Intelligence, Cyber Security, Database Systems, and Network Engineering. The purpose of the system is to support students during the academic decision-making process and provide an initial advising service in an organized and efficient manner.

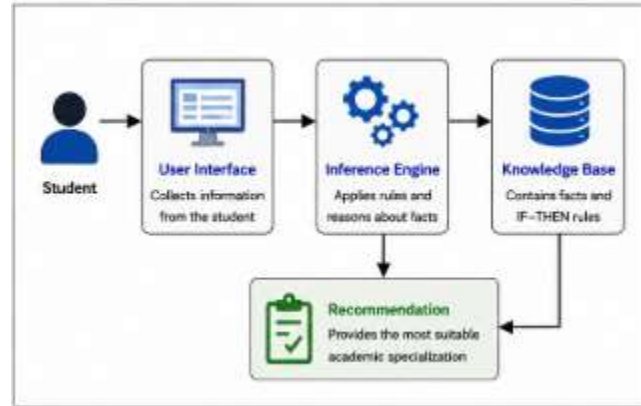


Figure 2: Architecture of the proposed Student Academic Advisor Expert System.

Student Academic Advisor Expert System

What is your Grade Point Average (GPA)?

☐ A) Above 90

☐ B) 80 – 89

☐ C) 70 – 79

☐ D) Below 70

Back Next Exit

Figure 3: GPA selection screen used by the expert system.

Student Academic Advisor Expert System

Please answer the following questions about your interests:

Do you like Programming?	☐ Yes	☐ No
Do you like Artificial Intelligence?	☐ Yes	☐ No
Do you like Cyber Security?	☐ Yes	☐ No
Do you like Database Systems?	☐ Yes	☐ No
Do you like Computer Networks?	☐ Yes	☐ No

Back Next Exit

Figure 4: Student interests collection screen.



Figure 5: Recommendation generated by the proposed expert system.

3. LITERATURE REVIEW

Expert systems have been widely used in many domains including medicine, agriculture, engineering, and education. These systems aim to simulate the decision-making capabilities of human experts by utilizing knowledge bases and inference engines. Expert systems are particularly useful in situations where expert knowledge is limited or not always available.

Several expert systems have been developed to assist users in diagnosis, recommendation, and decision support. Medical expert systems such as MYCIN were designed to diagnose diseases and recommend treatments based on patient symptoms. Other expert systems have been applied in agriculture for diagnosing plant diseases and recommending appropriate treatments. These systems demonstrated the effectiveness of rule-based reasoning in solving real-world problems.

In the educational domain, expert systems can be used to support students and academic advisors in making informed decisions. Academic advising requires analyzing several factors including academic performance, interests, skills, and future goals. Expert systems provide a structured mechanism for evaluating these factors and generating recommendations based on predefined rules.

Previous research has shown that knowledge-based systems can improve decision-making processes by providing consistent recommendations and reducing dependency on human experts. The use of rule-based systems in educational environments can enhance academic guidance services and assist students in selecting suitable academic specializations.

Unlike many existing expert systems that focus on medical or agricultural diagnosis, the proposed Student Academic Advisor Expert System focuses on educational decision support. The system utilizes academic advising knowledge to recommend suitable specializations based on students' GPA and personal interests.

4. KNOWLEDGE REPRESENTATION

The knowledge representation process is considered one of the most important stages in developing an expert system. The effectiveness of the proposed Student Academic Advisor Expert System depends on the quality of the knowledge acquired and the rules stored in the knowledge base.

The knowledge used in this system was obtained from academic advising practices, university specialization requirements, and common recommendations provided by academic advisors. This knowledge was converted into a rule-based format and stored in the knowledge base using IF–THEN rules.

The proposed system uses several attributes to describe the student's academic profile. These attributes include:

- Grade Point Average (GPA)
- Programming Interest
- Artificial Intelligence Interest
- Cyber Security Interest
- Database Systems Interest
- Computer Networks Interest

The inference engine analyzes the values of these attributes and matches them with the available rules in the knowledge base. Once a rule is satisfied, the system generates the corresponding recommendation.

Examples of the rules used in the proposed system are shown below:

Rule 1:

IF GPA = High

AND Programming Interest = Yes

THEN Recommend Software Engineering

Rule 2:

IF GPA = High

AND Artificial Intelligence Interest = Yes

THEN Recommend Artificial Intelligence

Rule 3:

IF Cyber Security Interest = Yes

THEN Recommend Cyber Security

Rule 4:

IF Database Systems Interest = Yes

THEN Recommend Database Systems

Rule 5:

IF Computer Networks Interest = Yes

THEN Recommend Network Engineering

The proposed expert system currently contains a set of rules that cover the most common academic specializations in computing and information technology fields. The rules are processed using a forward-chaining reasoning strategy, where the system starts with the facts provided by the student and then searches for applicable rules until a suitable recommendation is produced.

This rule-based representation allows the system to provide clear, understandable, and consistent recommendations while maintaining the flexibility required for future expansion and modification.

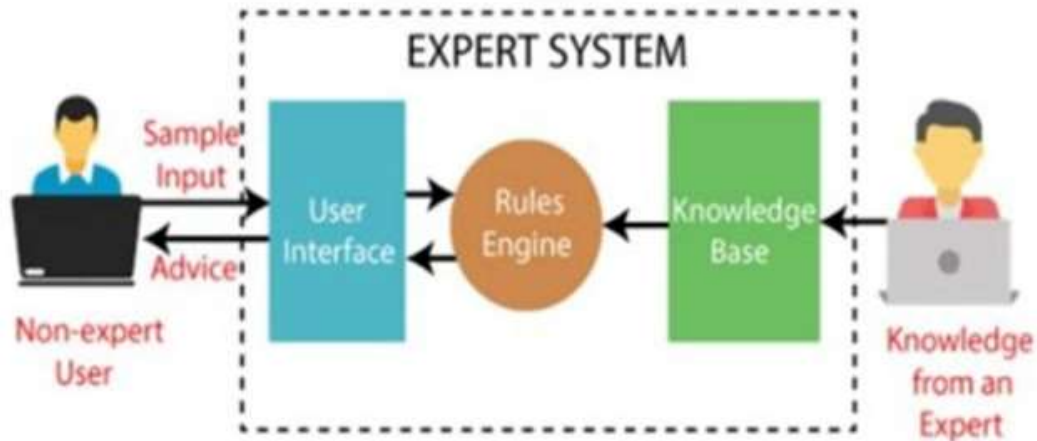


Figure 6: The figure presents the main components of an Expert System.

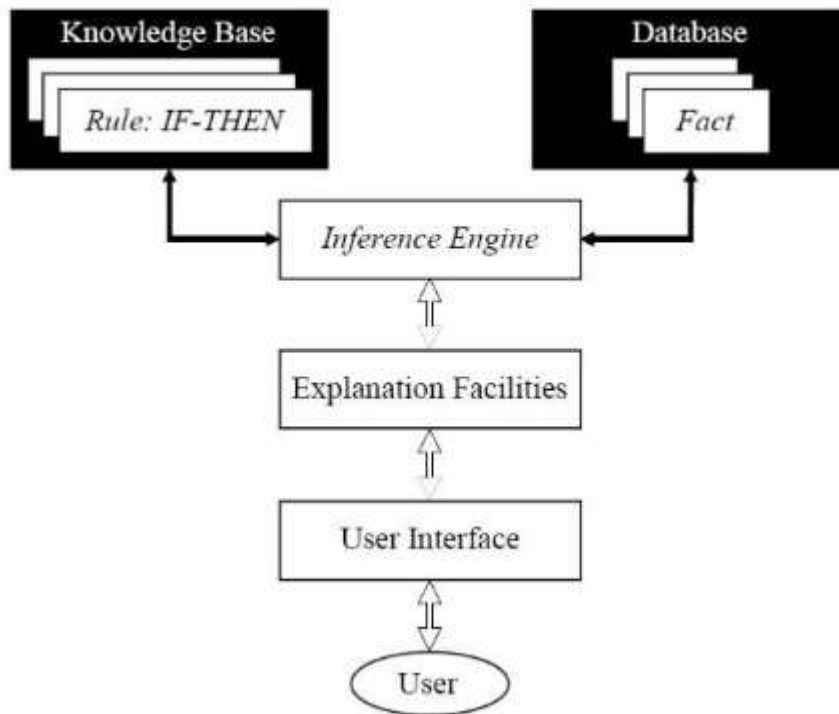


Figure 7: The architecture of an Expert System and its main components.

5. SYSTEM EVALUATION

The proposed Student Academic Advisor Expert System was evaluated using a set of test cases representing different academic profiles and interests. The purpose of the evaluation was to verify the accuracy and consistency of the recommendations generated by the system.

Several students with different Grade Point Averages (GPA) and academic interests were considered during the evaluation process. The system successfully analyzed the provided information and generated recommendations that matched the students' interests and academic performance.

Test Case	GPA	Main Interests	Recommended Specialization
1	92	Programming, Databases	Software Engineering
2	88	Artificial Intelligence	Artificial Intelligence
3	82	Computer Networks	Network Engineering
4	78	Cyber Security	Cyber Security
5	75	Databases	Database Systems

Table 1: presents sample test cases used to evaluate the proposed expert system.

The obtained results demonstrate that the proposed system is capable of providing appropriate recommendations based on predefined rules stored in the knowledge base. The use of rule-based reasoning allows the system to maintain consistency in the advising process and reduce subjective decision-making.

The evaluation results indicate that the proposed Student Academic Advisor Expert System can serve as a useful decision-support tool for students who need assistance in selecting suitable academic specializations. The system provides recommendations in a simple, fast, and organized manner.

6. CONCLUSION

This research presented a Student Academic Advisor Expert System designed to assist students in selecting suitable academic specializations based on their academic performance and personal interests. The system was developed using SL5 Object and implemented as a rule-based expert system that utilizes a knowledge base and an inference engine to generate recommendations.

The proposed system collects information about students, including their GPA and interests in different computing fields such as Programming, Artificial Intelligence, Cyber Security, Database Systems, and Computer Networks. Based on predefined IF–THEN rules, the system analyzes the available information and recommends the most appropriate academic specialization.

The evaluation results demonstrated that the system can provide consistent and reasonable recommendations that support the academic decision-making process. The use of expert system technologies in the educational domain can improve academic advising services and provide students with an accessible decision-support tool.

Future improvements may include adding more academic specializations, increasing the number of rules in the knowledge base, and integrating the system with university information systems to provide more personalized recommendations.

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