Department of Computer Engineering

T.E. (Computer Sem VI) **Assignment -2** **Artificial Intelligence (CSC604)**

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Assignment 2:

Considering the following objectives :

CSC604.1: To grasp the fundamental concepts and methods involved in creating intelligent systems.

1. CSC604.2: Ability to choose an appropriate problem solving method and knowledge representation technique.
2. CSC604.3: Ability to analyze the strength and weaknesses of AI approaches to knowledge–intensive problem solving.
3. CSC604.4: Ability to design models for reasoning with uncertainty as well as the use of unreliable information.
4. CSC604.5: Ability to design and develop AI applications in real world scenarios.

A) What are the key considerations in designing an expert system that effectively utilizes knowledge representation techniques to handle uncertainty and unreliable information, while ensuring practicality in real-world applications?

B) Additionally, how do these considerations align with the strengths and weaknesses of various AI approaches to knowledge-intensive problem solving?

1. Rubrics for the Assignment:

Indicator	**Average**	**Good**	**Excellent**	**Marks**
Organization (2)	Readable with some missing points and structured (1)	Readable with improved points coverage and structured (1)	Very well written and fully structured	
Level of content(4)	All major topics are covered, the information is accurate (2)	Most major and some minor criteria are included. Information is accurate (3)	All major and minor criteria are covered and are accurate (4)	
Depth and breadth of discussion and representation(4)	Minor points/information maybe missing and representation isminimal (1)	Discussion focused on some points and covers themadequately (2)	Information is presented indepth and is accurate (4)	
Total				

Signature of the Teacher

A)

Following are the key considerations in designing an expert system that effectively utilizes knowledge representation techniques to handle uncertainty and unreliable information, while ensuring practicality in real-world applications:

Knowledge Representation:

Choice of Technique: Select a knowledge representation technique that can capture the nuances of the domain and express uncertainty. This could include:

1. Probabilistic reasoning: Assigning probabilities to facts and rules to represent the likelihood of their occurrence. (e.g., Bayesian networks)
2. Fuzzy logic: Representing values and relationships with degrees of truth rather than strict true/false values.

Levels of Certainty: Incorporate mechanisms to represent the confidence level associated with each piece of knowledge. This allows the system to reason with incomplete or contradictory information.

Explanation Facilities: Build in the ability to explain the reasoning process and the basis for recommendations. This transparency is crucial for user trust and real-world adoption.

Handling Uncertainty and Unreliable Information:

Develop mechanisms to propagate uncertainty through the reasoning process. The system's confidence in the final recommendation should reflect the confidence in the underlying knowledge. Implement routines to identify and address errors or inconsistencies in the data used by the system. Design the system to learn and adapt over time. This could involve incorporating new data, feedback from users, or integration with external knowledge sources.

Practicality and Real-World Use:

To ensure our expert system functions well in the real world, we need to consider three key areas beyond the core knowledge representation. First, for scalability and efficiency, the chosen knowledge representation technique should handle a growing knowledge base without significant performance drawbacks. Second, a user-friendly interface is crucial for easy interaction and clear explanations of the system's recommendations. Finally, integrating with existing data sources and workflows will enhance practicality by leveraging already available information and processes.

Expert System in Experiment-9:

The expert system created in experiment 9 represents a simple rule-based system. While it doesn't explicitly handle uncertainty, it offers a basic framework. It could be improved upon by:

1. Assigning confidence levels to rules: Each rule could have a weight reflecting the expert's confidence in its accuracy.

2. Incorporating probabilistic reasoning: Instead of hard thresholds (e.g., blood sugar > 140), use probabilities based on medical guidelines.

3. Adding explanations: The system could explain why a specific diet is recommended based on the triggered rules.

B)

Strengths and weaknesses of various AI approaches to knowledge-intensive problem solving are as follows:

Rule-based Systems: (Expert System created in Experiment-9 is a rule based system)

Strengths:

1. Easy to understand and explain.
2. Well-suited for well-defined problems with clear rules.

Weaknesses:

1. Difficulty handling uncertainty and exceptions.
2. Knowledge base maintenance can be cumbersome as the domain complexity increases. (The provided system exemplifies these limitations)

Probabilistic Reasoning Systems:

Strengths:

1. Can effectively handle uncertainty and noisy data.
2. Provide a principled way to combine evidence from multiple sources.

Weaknesses:

1. Requires significant expertise to design and train the model.
2. May not be easily interpretable, especially with complex models.

Fuzzy Logic Systems:

Strengths:

1. Can handle imprecise and subjective data.
2. Often easier to interpret than complex probabilistic models.

Weaknesses:

1. Knowledge representation can become cumbersome for complex domains.
2. May not be as accurate as probabilistic models in some cases.

Machine Learning:

Strengths:

1. Can learn complex relationships from data without explicit rules.
2. Can adapt to new information and improve over time.

Weaknesses:

1. Often requires large amounts of labeled data for training.
2. Can be difficult to explain the reasoning behind their decisions (black box problem).

In conclusion, the optimal AI approach for a knowledge-intensive problem depends on the specific characteristics of the domain and the desired level of explainability. When dealing with uncertainty and unreliable information, techniques like probabilistic reasoning or fuzzy logic offer advantages over simpler rule-based systems. However, they require more expertise and computational resources. Machine learning offers powerful learning capabilities but might lack transparency and require significant training data.

For instance, the **expert system of experiment 9** utilizes a rule-based approach. While it provides a basic framework for reasoning about patient data, it struggles to handle inherent uncertainties in real-world health information. To improve this system, techniques like assigning confidence levels to rules or using probabilistic reasoning based on medical guidelines could be incorporated.

However, such improvements would introduce complexity. Therefore, the choice of approach hinges on factors like the trade-off between accuracy and explainability, as well as the available resources and expertise.