Department of Computer Engineering

T.E. (Computer Sem VI) Artificial Intelligence (CSC604)

Assignment -2

Student Name: Devesh Vengurlekar Roll No: 9766 Class: TE Comps A

Considering the fallowing 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?"

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 :

Name : Devesh Nayan Vengurlekar
Roll No : 9766
Class : TE COMPS A

AI Assignment 2.

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?

Ans : 1. Knowledge Representation Techniques : Choose appropriate knowledge representation techniques such as Rules, frames, semantic networks, or probabilistic models based on the nature of the problem domain and the type of uncertainty involved.

2. Uncertainty handling : Implement mechanisms to handle uncertainty effectively, including probabilistic reasoning, fuzzy logic, Bayesian Networks, or Dempster-Shafer theory. Each approach has its strengths and weaknesses, so selecting the most suitable one depends on requirements.

3. Reliability Assessment : Develop methods to assess the reliability of information sources or inference process within the expert system. This may involve assigning trust values to sources or using feedback mechanisms.

4. Integrating Multiple Knowledge sources : Incorporate diverse sources of knowledge, including domain experts, databases, sensor data and historical records.

5. Explanation and Transparency : Ensure that the expert system provides explanations for its decisions and reasoning processes.

6. Scalability and Efficiency: Design the system to be scalable and efficient, capable of handling large volumes of data and performing computations within acceptable timeframes.
7. Adaptability and Learning: Incorporate mechanisms for the expert system to adapt and learn from new data or feedback from users.
8. Robustness and Error Handling: Implement error-handling mechanisms to deal with unexpected situations, erroneous input data, or system failures.
9. Ethical and Legal Considerations: Consider ethical and legal implications related to the use of expert system, including issues such as bias, privacy, accountability, and compliance with regulations.
10. User Interface and Interaction Design: Design an intuitive user interface that facilitates interaction with expert system and provide relevant feedback to users.

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

Ans: The considerations align with the strengths and weakness of various AI approaches to knowledge-intensive problem solving.

Ans 1. Symbolic AI (Expert Systems):

Strengths: Expert-Systems excel at representing and reasoning with symbol knowledge, making them well-suited for capturing human expertise. The can handle uncertainty though fuzzy logic.

Weakness: Expert systems may struggle with handling large amounts of data and may lack the flexibility to adapt to changing environments without manual intervention.

Name: Devesh Nayan Vengurlekar
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2. Connectionist AI (Neural Networks):
Strengths: Neural networks are powerful for pattern recognition and can learn complex relationships from data.
Weakness: Neural Networks often lack transparency in their decision-making processes, making it challenging to explain their reasoning.

3. Probabilistic AI (Bayesian Networks, Markov Decision Processes):
Strengths: Probabilistic approaches provide a principled framework for representing and reasoning under uncertainty.
Weakness: Probabilistic models can become complex and computationally intensive, particularly when dealing with large networks or high-dimensional data.

4. Hybrid AI Systems:
Strengths: Hybrid systems combine the strengths of multiple approaches, allowing for more robust and flexible problem-solving.
Weakness: Designing and integrating hybrid systems can be challenging and may require expertise in multiple AI techniques. Managing the interactions between different components of the system can also introduce additional complexity.

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

Rules of the Expert System in Experiment-9:

```
if patient.blood_glucose_level > 140 and patient.cholesterol > 200:
            return "Recommendation: Follow a low-carb, low-cholesterol diet."
        elif patient.blood_glucose_level < 70 or patient.blood_pressure < 90:
                return "Recommendation: Follow a balanced diet and consult with a healthcare
professional."
        elif patient.age > 50 and patient.weight > 200:
                return "Recommendation: Follow a low-fat, high-fiber diet and engage in regular
physical activity."
        elif patient.blood_pressure > 140 and patient.cholesterol > 200:
            return "Recommendation: Follow a low-sodium, low-cholesterol diet."
        elif patient.blood_glucose_level > 140 or (patient.age > 50 and patient.weight > 200):
                return "Recommendation: Follow a low-carb diet and engage in regular physical
activity."
        else:
                return "Recommendation: Maintain a balanced diet with a good mix of fruits,
vegetables, lean proteins, and whole grains."
```

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.

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.

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 explain ability, as well as the available resources and expertise.

Name: Devesh Vengurlekar
Roll No: 9766
TE Comps A

AI Experiment No. 9

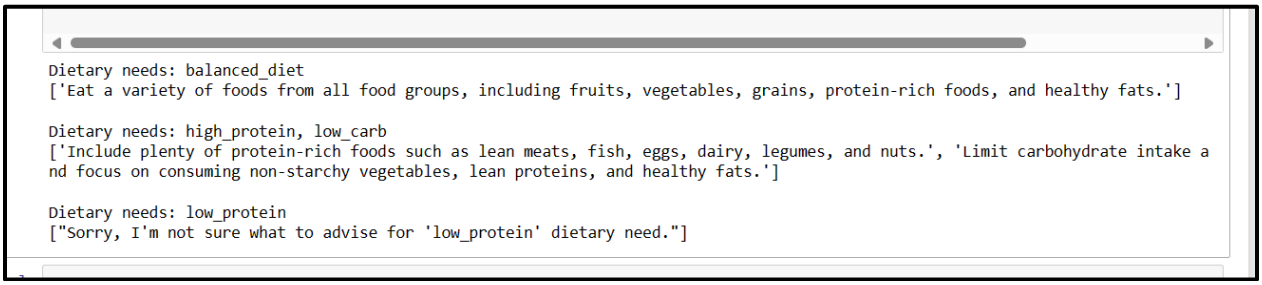
Title : Simple prototype for Expert System

Program:

```
# Devesh Vengurlekar
#Roll No: 9766
# TE Comps A


class ExpertSystem:
    def __init__(self):
        self.rules = {
            "low_calorie": "Focus on consuming fruits, vegetables, lean proteins, and whole grains. Limit added sugars and fats.",
            "high_protein": "Include plenty of protein-rich foods such as lean meats, fish, eggs, dairy, legumes, and nuts.",
            "low_carb": "Limit carbohydrate intake and focus on consuming non-starchy vegetables, lean proteins, and healthy fats.",
            "balanced_diet": "Eat a variety of foods from all food groups, including fruits, vegetables, grains, protein-rich foods, and healthy fats."
        }

    def consult(self, dietary_needs):
        recommendations = []
        for need in dietary_needs:
            if need in self.rules:
                recommendations.append(self.rules[need])
            else:
                recommendations.append("Sorry, I'm not sure what to advise for '{}' dietary need.".format(need))
        return recommendations

def main():
    expert_system = ExpertSystem()
    # Example consultations
    print("Dietary needs: balanced_diet")
```

```
    print(expert_system.consult(["balanced_diet"]))
    print("\nDietary needs: high_protein, low_carb")
    print(expert_system.consult(["high_protein", "low_carb"]))
    print("\nDietary needs: low_protein")
    print(expert_system.consult(["low_protein"]))

if __name__ == "__main__":
    main()
```

Output:



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AI Experiment 9 PostLab

Q1) What are the applications of expert systems?

Expert systems, which are computer systems designed to mimic the decision-making abilities of a human expert in a specific domain, have a wide range of applications across various fields. Some common applications of expert systems include:

1. **Medical Diagnosis**: Expert systems can assist healthcare professionals in diagnosing diseases and recommending treatment plans based on patient symptoms, medical history, and diagnostic tests. They can help identify patterns in patient data and provide accurate and timely medical advice.
2. **Financial Analysis and Investment**: Expert systems can analyze financial data, market trends, and investment strategies to provide recommendations for portfolio management, risk assessment, and investment decisions. They can assist investorsandfinancial analysts in making informed choices to maximize returns and minimize risks.
3. **Manufacturing and Engineering**: In manufacturing and engineering industries,expert systems can be used for quality control, process optimization, fault diagnosis, and predictive maintenance. They can analyze sensor data, identify anomalies or defects, and recommend corrective actions to improve productivity and efficiency.
4. **Customer Support and Help Desks**: Expert systems can be deployed in customer support centers and help desks to provide automated assistance and troubleshooting for common problems and inquiries. They can answer frequently asked questions, guide users through troubleshooting steps, and escalate complex issues to human agents when necessary.
5. **Natural Language Processing (NLP)**: Expert systems can be integrated with natural language processing techniques to understand and respond to user queries and requests in human-like language. They can be used in virtual assistants, chatbots, and customer service applications to provide personalized recommendations and support.
6. **Education and Training**: Expert systems can be employed in educational settings to deliver personalized learning experiences, adaptive tutoring, and interactive simulations. They can assess students' knowledge and skills, provide feedback and explanations, and adapt instructional content to individual learning needs.
7. **Diagnostic Systems in Engineering and Maintenance**: In industries such as

aerospace, automotive, and telecommunications, expert systems are used for diagnosing equipment malfunctions, identifying root causes of failures, and recommending maintenance or repair procedures. They help minimize downtime, improve reliability, and optimize maintenance schedules.

8. **Environmental Monitoring and Management**: Expert systems can analyze environmental data, such as air and water quality measurements, weather forecasts, and ecological parameters, to assess environmental risks, predict future trends, and recommend mitigation strategies. They support environmental monitoring and management efforts aimed at preserving natural resources and ecosystems.