QUESTION 4: Knowledge Representation

Step 1: Introduction to Knowledge Representation (KR)

Knowledge Representation is the area of AI focused on how to represent real-world information in a way that a computer can understand and reason with.

Task: Use Python to represent facts, semantic nets, and rules, demonstrate First-Order Logic (FOL) and unification, and build a tiny expert system to diagnose cold vs flu.

It involves:

- Facts: Basic statements that are true

- Semantic networks: Diagrams showing how concepts relate

- Rules: Logic-based conditions for inference

- First Order Logic (FOL): A formal way to express logic

- Unification: Matching patterns for example, variables to values

2. REPRESENT FACTS AND RULES IN PYTHON

```python
# Define symptoms as facts

facts = {

    'fever': True,

    'cough': True,

    'body_ache': True,

    'sneezing': False

}


# Define rules

def diagnose(facts):

    if facts['fever'] and facts['cough'] and facts['body_ache']:

        return "You may have the flu."

    elif facts['cough'] and facts['sneezing']:

        return "You may have a cold."

    else:

        return "You may be fine."
```

print(diagnose(facts))

3. REPRESENT SEMANTICS NETS

```python
semantic_net = {
    'flu': ['fever', 'cough', 'body_ache'],
    'cold': ['sneezing', 'cough']
}
```

This says:

- Flu is connected to: fever, cough, body ache
- Cold is connected to: sneezing, cough

4. EXPRESS FIRST ORDER LOGIC

$\forall x$ (hasFever(x) $\wedge$ hasCough(x) $\wedge$ hasBodyAche(x)) $\rightarrow$ HasFlu(x)

This means: For all x, if x has fever, cough, and body ache, then x has flu.

5. UNIFICATION

This is like pattern matching

```python
def unify(symptoms):
    if set(symptoms) == set(semantic_net['flu']):
        return "Flu"
    elif set(symptoms) == set(semantic_net['cold']):
        return "Cold"
    else:
        return "Unknown illness"


print(unify(['fever', 'cough', 'body_ache']))
```

6. SIMPLE EXPERT SYSTEM

```python
def expert_system():
```

```python
    fever = input("Do you have a fever? (yes/no): ") == 'yes'

    cough = input("Do you have a cough? (yes/no): ") == 'yes'

    body_ache = input("Do you have body aches? (yes/no): ") == 'yes'

    sneezing = input("Are you sneezing? (yes/no): ") == 'yes'


    if fever and cough and body_ache:

        print("Diagnosis: You may have the flu.")

    elif cough and sneezing:

        print("Diagnosis: You may have a cold.")

    else:

        print("Diagnosis: You may be fine.")


# Run the system

expert_system()
```

Suggest whether they likely have a cold, flu, or no illness