Batch: B1	Roll No.: 16010121045
Experiment / assignment / tutorial No. 3	

Title: Implementation of Goal based agent architecture using PROLOG.

Objective: To use the concepts of knowledge engineering to design and solve moderate complex problem.

Expected Outcome of Experiment:

Course Outcome	After successful completion of the course students should be able to
CO1	Understand the history & various application of AI and choose appropriate agent architecture to solve the given problem.

Books/ Journals/ Websites referred:

1. **https://www.csupomona.edu/~jrfisher/www/prolog_tutorial/contents.html**
2. **http://www.csupomona.edu/~jrfisher/www/prolog_tutorial/pt_framer.html**
3. **http://www.doc.gold.ac.uk/~mas02gw/prolog_tutorial/prologpages/**
4. **http://classes.soe.ucsc.edu/cmps112/Spring03/languages/prolog/PrologIntro.pdf**
5. **"Prolog: Programming for Artificial Intelligence" by Ivan Bratko, Pearson education Publications**
6. **"Artificial Intelligence: a Modern Approach" by Russel and Norving, Pearson education Publications**
7. **"Artificial Intelligence" By Rich and knight, Tata Mcgraw Hill Publications**

Pre Lab/ Prior Concepts:

Agents, Agent Architecture, Programming with PROLOG

Historical Profile:

Knowledge is vast, uncertain and continuously changing. These properties of knowledge make it difficult to arrive at a result. A murder mystery is a kind of situation which depicts the uncertain nature of knowledge and also emphasizes the need of choosing right clauses from entire knowledgebase to make a decision. He goal based agent architecture and some knowledge engineering can help in solutioning of such problems.

The logical agents are complex but they can reason and learn from the actions and new precepts. They are less like acting and think like humans but more like acting and thinking rational agents.

Knowledge and reasoning play a crucial role in dealing with partially observable environments. A knowledge based agent can combine the general knowledge with current percept to infer the hidden aspects of the current state prior to selecting actions.

New Concepts to be learned:

Knowledge engineering, implementing complex agent architecture, uncertainty in knowledge.

The Knowledge Engineering Process

1. Identify the task
2. Assemble the relevant knowledge
3. Decide on vocabulary of predicates, functions and constants
4. Encode general knowledge about the domain
5. Encode description of specific problem instance
6. Pose queries to the inference procedure and get answers
7. Debug the knowledge base

Algorithm for KB-Agent:

```
function KB-AGENT(percept) returns an action
    static: KB, a knowledge base
            t, a counter, initially 0, indicating time

    TELL(KB, MAKE-PERCEPT-SENTENCE(percept, t))
    action ← ASK(KB, MAKE-ACTION-QUERY(t))
    TELL(KB, MAKE-ACTION-SENTENCE(action, t))
    t ← t + 1
    return action
```

Problem Statement:

In the middle of last winter, **eight guests** were invited to a luxurious retreat at the Duke of York Grand Hotel. On the last day of their three-day getaway, the guests were free to vacate to their own occupations. **Mrs White and Reverend Green did some "gardening"** walking alongside the water fountains, **Colonel Mustard and Professor Plum played golf** (alone though, purposefully avoiding each other). The other guests spent their days either in their rooms or in the lounge, by the log fire. Later on in the afternoon, all the guests were indoors and **Colonel Mustard was seen playing cards with Reverend Green and Mrs Peacock**.

As the guests were called for dinner, they soon realised that Dr Black was missing. He was later found lying down on the floor of his bedroom. **Dr Black had been shot dead using an old fashion revolver**. Except from a **few muddy footprints** at the entrance of his bedroom, there was no other evidence left by the murderer.

Here is the list of all the guests for the weekend and the rooms they were staying in. Note that the hotel consists of twin bedrooms accommodating two guests per room. We also know that **three of the guests (Reverend Green, Colonel Mustard and Madame Rose) own a revolver that they brought with them and kept in their room**.

Knowledge Engineering steps applied to chosen problem:

1. Identify the task – The main goal is to find who killed Dr. Black.
The facts are the evidence found by Poirot. The main tasks include –
a) Finding all the suspects.
b) Finding all the prime suspects.
c) Finding the killer.

2. Assemble the relevant knowledge:
The relevant knowledge consists of the actors in the scene and the evidence. The actors in the scene are:

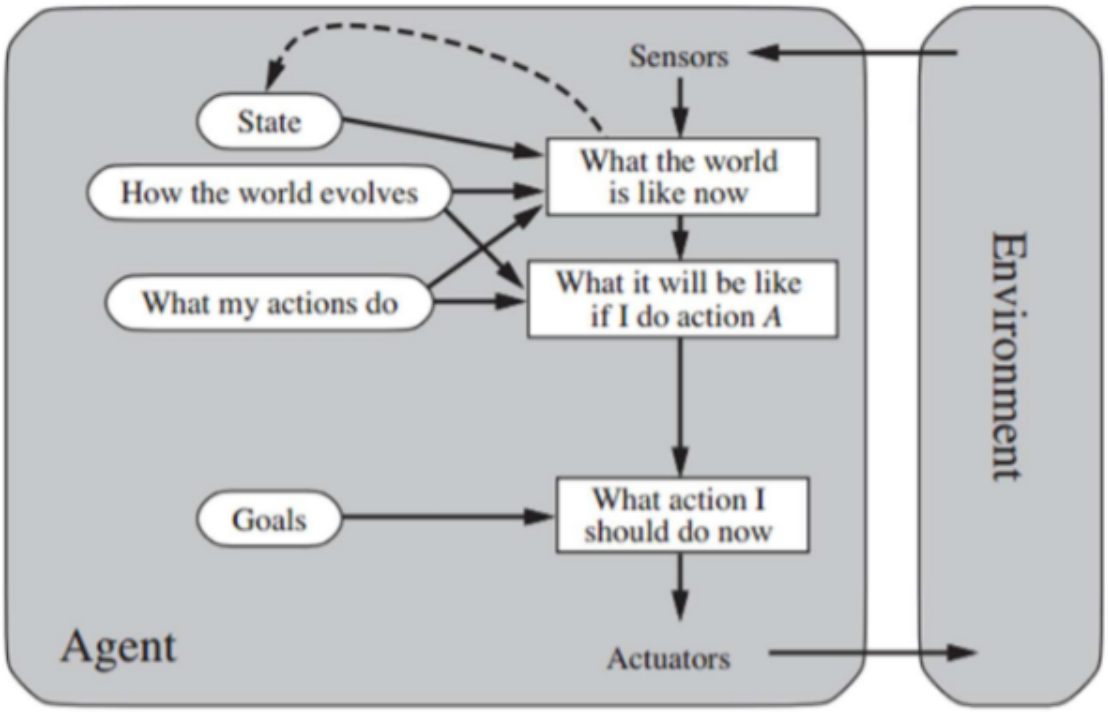
1. Dr Back
2. Reverend Green
3. Colonel Mustard
4. Prof Plum
5. Mrs Peacock
6. Madam Rose
7. Ms Scarlett
8. Mrs White

The evidences are:

1. Dr Black had been shot dead using an old fashion revolver
2. Few muddy footprints at the entrance of the bedroom

Agent Architecture *(Justify the blocks)***:** Goal Based Agent Architecture

These kinds of agents take decisions based on how far they are currently from their goal(description of desirable situations). Their every action is intended to reduce its distance from the goal. This allows the agent a way to choose among multiple possibilities, selecting the one which reaches a goal state.



Various blocks with respect to above case study –

What is the world like now?
This particular question deals with the answer to what the surroundings are like at that particular instance and what the environment is like. Dr. Black is dead there are multiple suspects . We have to find the killer.

What it will be like if I do a particular action?
This block checks for the state that is a direct result of conducting an action on a current state.

In this case, finding out whether the person is a suspect or not. Further, if a person is a suspect, the next block can help us identify whether this individual is the criminal that the AI is looking for.

What should I do now?
Helps to take the appropriate action based on the percept and knowledge to move further towards the goal. Finally, this result is given to the environment via the actuators.

Code:

```
victim(drBlack).

suspect(reverendGreen).

suspect(colonelMustard).

suspect(professorPlum).

suspect(mrsPeacock).

suspect(madameRose).

suspect(missScarlett).

suspect(mrsWhite).


gardening(mrsWhite).

gardening(reverendGreen).


playedGolf(professorPlum).

playedGolf(colonelMustard).


playingCards(colonelMustard).

playingCards(reverendGreen).

playingCards(mrsPeacock).


ownsRevolver(reverendGreen).

ownsRevolver(colonelMustard).

ownsRevolver(madameRose).


smoker(missScarlett).
```

```
smoker(colonelMustard).

smoker(mrsWhite).

smoker(drBlack).

smoker(mrsPeacock).


room(room_21).

room(room_22).

room(room_23).

room(room_24).

room(room_25).


stayIn(drBlack,room_22).

stayIn(reverendGreen,room_24).

stayIn(missScarlett,room_21).

stayIn(colonelMustard,room_24).

stayIn(professorPlum,room_22).

stayIn(mrsPeacock,room_23).

stayIn(madameRose,room_21).

stayIn(mrsWhite,room_23).



safe(X):- suspect(X), playingCards(X).


wentOut(X):- gardening(X).

wentOut(X):- smoker(X).
```

wentOut(X):- playedGolf(X).

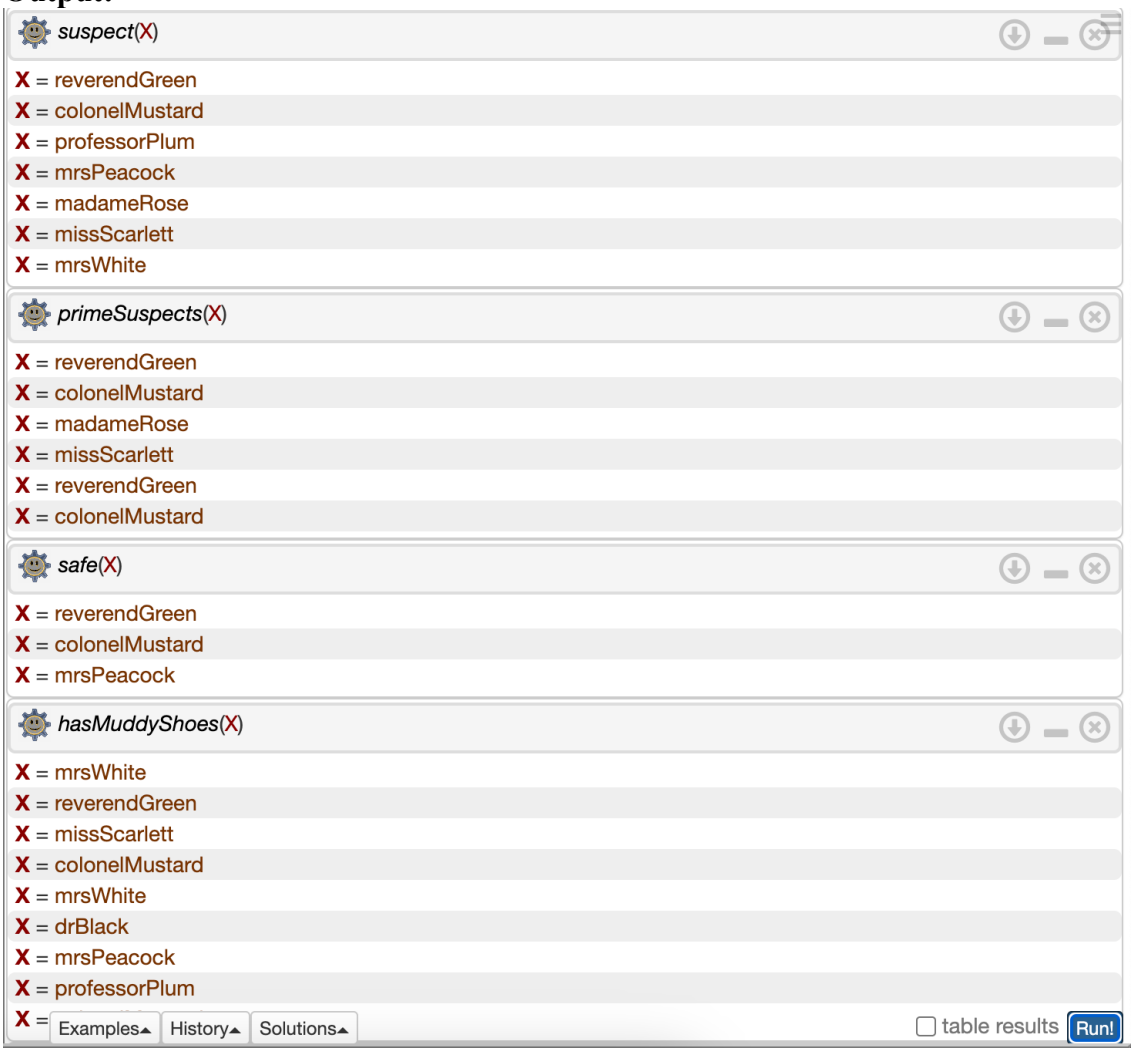
shareRoom(X,Y):- room(R), stayIn(X,R), stayIn(Y,R), X \= Y.

hasRevolver(X):- ownsRevolver(X).

hasRevolver(X):- shareRoom(X,Y), ownsRevolver(Y).

guilty(X):- suspect(X), wentOut(X), \+safe(X), hasRevolver(X).

Output:



Team Members:
1. Pargat Singh

Post Lab Objective Questions

1. Which is not a Goal-based agent?
a. Inference
b. Search
c. Planning
d. Conclusion
e. Dynamic search.
Answer: d) Conclusion

2. Which were built in such a way that humans had to supply the inputs and interpret the outputs?
a. Agents
b. Sensor
c. AI System
d. Actuators
Answer: c) AI System

Post Lab Subjective Questions :
Explain the role of PEAS and task environment in choosing the agent architecture. Justify your answer with an example.

Performance measure, Environment, Actuators, and Sensors is referred to as PEAS. The task environment must always be adequately specified before beginning to develop an agent.

The task environment aids in determining whether or not the setting is

- **Discrete / Continuous** - An environment is discrete if there are just a few clearly defined, different states of it (such as in chess); otherwise, it is continuous (For example, driving).
- **Observable / Partly Observable** – A system is observable if it is feasible to infer from the precepts the whole state of the environment at each time point; otherwise, it is only partially observable.
- **Static / Dynamic** -The environment is static if it stays the same while an agent is acting; otherwise, it is dynamic.

- **One agent / Many agents** - Other agents, which may be of the same or a different sort as the agent, may be present in the environment.
- **Accessible / Inaccessible** - Whether an environment is accessible or inaccessible depends on whether the agent's sensory apparatus can access the entire state of the environment.
- **Deterministic / Non-deterministic** - Environments can be either deterministic or non-deterministic depending on whether the next state of the environment is entirely determined by the present state and the activities of the agent.
- **Episodic / Non-episodic** − In an episodic environment, each episode consists of the agent perceiving and then acting. The quality of its action depends just on the episode itself. Subsequent episodes do not depend on the actions in the previous episodes. Episodic environments are much simpler because the agent does not need to think ahead.
- Once the environment has been fully understood, the appropriate agent architecture can be chosen based on the characteristics of the environment.