Experiment no. 02

Aim :- Assignment on PEAS representation for various AI aplications and state space formulation.

Theory:-

PEAS :-

PEAS stands for Performance measure, Environment, Actuators, and Sensors. It is a framework used to describe the setting in which an intelligent agent operates. The PEAS framework helps in defining the goals, working conditions, and tools available to the agent, providing a structured way to analyze and design intelligent systems.

- **Performance Measure (P) :** The performance measure defines the criteria for evaluating the success of an agent's behavior. It specifies what constitutes a successful outcome or goal achievement for the agent. Examples include accuracy, efficiency, speed, and user satisfaction.
- **Environment (E) :** The environment is the external context or the world in which the agent operates. It can be characterized by various properties such as:
  - **Fully observable/Partially observable**: Whether the agent has access to complete information about the environment at any given time.
  - **Deterministic/Stochastic**: Whether the outcome of actions is certain or involves some randomness.
  - **Episodic/Sequential**: Whether the agent's experience is divided into independent episodes or a continuous sequence of actions.
  - **Static/Dynamic**: Whether the environment changes only in response to the agent's actions or on its own.
  - **Discrete/Continuous**: Whether the state and actions are clearly defined or vary smoothly over a range.

- **Actuators (A) :** Actuators are the mechanisms through which an agent interacts with its environment. They are the tools or devices that allow the agent to perform actions.
- **Sensors (S) :** Sensors are the devices or mechanisms through which an agent perceives its environment. They provide the agent with information needed to make decisions.

Intelligent Agents

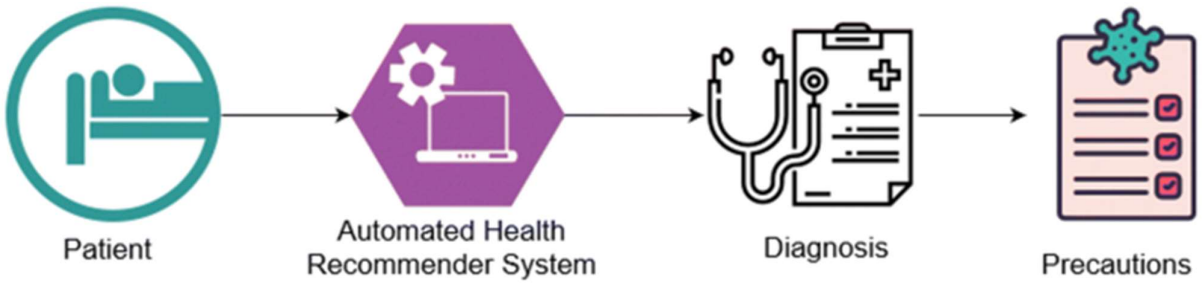
Intelligent agents are systems capable of perceiving their environment through sensors and acting upon it using actuators to achieve specific goals. They are designed to operate autonomously and make decisions to optimize their performance measure.

Types of Intelligent Agents

1. **Simple Reflex Agents**: Act based on current perceptions, ignoring the history of past perceptions.
2. **Model-Based Reflex Agents**: Maintain an internal state to keep track of past perceptions and make decisions based on both current and past inputs.
3. **Goal-Based Agents**: Make decisions based on goals they need to achieve and consider future states resulting from their actions.
4. **Utility-Based Agents**: Evaluate different actions based on a utility function to maximize their performance measure.
5. **Learning Agents**: Improve their performance over time by learning from their experiences and adapting their behavior accordingly.

PEAS representation for Medical diagnosis system

- **Performance measure:** Healthy patient, minimize costs, lawsuits
- **Environment:** Patient, hospital, staff
- **Actuators:** Screen display (questions, tests, diagnosis, treatments,Internet, referrals)
- **Sensors:** Keyboard (entry of symptoms, findings, patient's answers, Reports)



STATE-SPACE formulation :

A mathematical description of the relationships of the input , output and state of the system

Well-defined problems and Solutions :

A problem is defined by 5 components :

1) Initial state
2) Actions
3) Transition model or (successor functions)
4) Goal
5) Path cost

State space formulation is a way of representing problems in artificial intelligence, particularly in search and planning, by defining all possible states and the transitions between them. Here's a breakdown of its components:

1. **Initial State**: The starting point of the problem, detailing the initial conditions before any actions are taken.
2. **Actions**: The set of possible operations the agent can perform to transition from one state to another.
3. **Transition Model (Successor Functions)**: Defines how each action changes the state of the environment, specifying the result of applying an action to a given state.
4. **Goal** : The specific condition or set of conditions that signify the successful completion of the problem.
5. **Path Cost**: A function assigning a numerical cost to each path or sequence of actions, used to evaluate and compare different solutions based on their efficiency or resource usage.

State Space Formulation for the Missionaries and Cannibals Problem

The Missionaries and Cannibals problem involves three missionaries and three cannibals who need to cross a river using a boat that can carry at most two people. The challenge is to ensure that at no point do the cannibals outnumber the missionaries on either side of the river, as this would result in the missionaries being eaten.

Components of State Space Formulation

1. **Initial State**:
    - All three missionaries and three cannibals are on the starting side of the river.
    - The state can be represented as (M,C,B), where MMM is the number of missionaries, CCC is the number of cannibals, and BBB indicates the boat's position (0 for the starting side and 1 for the other side).
    - Initial state: (3,3,0).
2. **Actions**:
    - Possible actions involve moving one or two people across the river in the boat.
    - Actions can be represented as (m,c), where mmm is the number of missionaries and ccc is the number of cannibals to move.
3. **Transition Model**:
    - The transition model defines the result of each action.
    - If the boat is on the starting side (B=0), and we move mmm missionaries and ccc cannibals, the new state will be (M−m,C−c,1).
    - If the boat is on the other side (B=1), and we move mmm missionaries and ccc cannibals, the new state will be (M+m,C+c,0).
4. **Goal State**:
    - All missionaries and cannibals have successfully crossed the river.
    - Goal state: (0,0,1).
5. **Path Cost**:
    - The path cost can be the number of crossings made by the boat.

Example

Initial State:

(3,3,0) - Three missionaries and three cannibals on the starting side with the boat.

No.	Actions and Transitions:	(M,C,B)
1.	Move two cannibals	(3,1,1).
2.	Move one cannibal back	(3,2,0).
3.	Move two cannibals	(3,0,1).
4.	Move one cannibal back	(3,1,0).
5.	Move two missionaries	(1,1,1).
6.	Move one cannibal and one missionary back	(2,2,0).
7.	Move two missionaries	(0,2,1).
8.	Move one cannibal back	(0,3,0).
9.	Move two cannibals	(0,1,1).
10.	Move one cannibal back	(0,2,0).
11.	Move two cannibals	(0,0,1).

Goal State:

(0,0,1) - All missionaries and cannibals are on the other side with the boat.

Summary of the State Space Formulation

- **Initial State**: (3,3,0)
- **Actions**: Possible moves of missionaries and cannibals.
- **Transition Model**: Defines how the state changes with each action i.e how many missionaires and cannibals are present on the bank.
- **Goal State**: (0,0,1)
- **Path Cost**: Number of boat crossings.