**Velammal College of Engineering and Technology**

**CS8691 –Artificial Intelligence**

**IAT I**

**Answer key**

**Part A**

1. **Define AI**

Artificial Intelligence is the branch of computer science concerned with making computers behave like humans.

* Systems that think like humans
* Systems that act like humans
* Systems that think rationally
* Systems that act rationally

1. **Write any five Future scope of AI**

* **Cyber Security.** Cybercrime is an issue lately and AI can help us in eliminating this issue. There are detection techniques, but they are still ineffective. AI with its neural networks can detect fraud in its initial stage.
* **Face Recognition.** Yep, iPhone X did it thanks to AI. But it also can be used to track down criminals and identify citizens. In future, it will be able to detect emotional stances.
* **Data Analysis.** AI is already able to perceive patterns in data that regular human brain can not. This enables business’ to target the right customers for the product.
* **Marketing and Ads.** AI can increase the efficiency of sales and marketing organization. The focus will be on improving conversion rates and sales. Personalised advertising, knowledge of customers and their behavior gleamed through facial recognition can generate more revenue.
* **Medical diagnosis programs:** Medical diagnosis programs based on probabilistic analysis have been able to perform at the level of an expert physician in several areas of medicine.

1. **Write any five Applications of AI**

* **Autonomous Planning and Scheduling**
* **Game Planning**
* **Autonomous Control**
* **Diagnosis**
* **Logistics Planning**
* **Robotics**

1. **Name the elements of an agent and list down the characteristics of intelligent agent.**

Agent interacts with environment through sensors and actuators.An Agent is anything that can be viewed as perceiving (i.e.) understanding its environment through sensors and acting upon that environment through actuators.

* + - A human agent has eyes, ears, and other organs for sensors and hands, legs, mouth, and other body parts for actuators.
    - A robotic agent might have cameras and infrared range finders for sensors and various motors for actuators.
    - A software agent receives keystrokes, file contents, and network packets as sensory inputs and acts on the environment by displaying on the screen, writing files, and sending network packets.



***characteristics of intelligent agent***

* The **performance measures**, which determine the degree of success.
* Agent’s **Percept Sequence** till now.
* The agent’s **prior knowledge about the environment**.
* The **actions** that the agent can carry out.

**5.      What do you infer from the word Agent?**

An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through effectors.

We use the term performance measure for the how—the criteria that determine how MEASURE successful an agent is. Obviously, there is not one fixed measure suitable for all agents.

Agent program: a function that implements the agent mapping from percepts to actions.

We assume this program will run on some sort of ARCHITECTURE- computing

device.

Hence Agent is a combination of Architecture and Program.

Agent = architecture + program

6.      **What are the components of well-defined problems?**

A **problem** can be formally defined by **following components**:

The **initial state** that the agent starts in .

A **Successor Function** returns the possible **actions** available to the agent. Given a state x,SUCCESSOR-FN(x) returns a set of {action,successor} ordered pairs where each action is one of the legal actions in state x,and each successor is a state that can be reached from x by applying the action.

For example,from the state In(Arad),the successor function for the Romania problem would return

{ [Go(Sibiu),In(Sibiu)],[Go(Timisoara),In(Timisoara)],[Go(Zerind),In(Zerind)] }

**State Space** : The set of all states reachable from the initial state. The state space forms a graph in which the nodes are states and the arcs between nodes are actions.

A **path** in the state space is a sequence of states connected by a sequence of actions.

Thr **goal test** determines whether the given state is a goal state.

A **path cost** function assigns numeric cost to each action. For the Romania problem the cost of path might be its length in kilometers.

The **step cost** of taking action a to go from state x to state y is denoted by c(x,a,y). It is assumed that the step costs are non negative.

A **solution** to the problem is a path from the initial state to a goal state.

An **optimal solution** has the lowest path cost among all solutions.

**7.      Apply problem solving algorithm to measure performance.**

The rational agent that we are aiming at should be successful in the task it is performing

• To assess the success we need to have a *performance measure*

• What is rational at any given time depends on

• The performance measure that defines the criterion of success.

• The agent’s prior knowledge of the environment.

• The actions that the agent can perform.

• The agent’s percept sequence to date.

For each possible percept sequence a *rational agent* should select an action that is expected to maximize its performance measure, given the evidence provided by the percept sequence and whatever built-in knowledge the agent has.

8.      **How would you quote PEAS description?**

**PEAS** (Performance, Environment, Actuators, Sensors) description.

In designing an agent, the first step must always be to specify the task environment as fully as possible.



9.      **Define search and search algorithm.**

An agent with several immediate options of unknown value can decide what to do by examining different possible sequences of actions that leads to the states of known value,and then choosing the best sequence. The process of looking for sequences actions from the current state to reach the goal state is called **search.**

The **search algorithm** takes a **problem** as **input** and returns a **solution** in the form of **action sequence.** Once a solution is found,the **execution phase** consists of carrying out the recommended action.

**10.  Define problem solving agents and list its algorithms.**

A Problem solving agent is a **goal-based** agent . It decide what to do by finding sequence of actions that lead to desirable states. The agent can adopt a goal and aim at satisfying it.

To illustrate the agent’s behavior ,let us take an example where our agent is in the city of Arad,which is in Romania. The agent has to adopt a **goal** of getting to Bucharest.

**Goal formulation**,based on the current situation and the agent’s performance measure,is the first step in problem solving.

The agent’s task is to find out which sequence of actions will get to a goal state.

**Problem formulation** is the process of deciding what actions and states to consider given a goal.

* Simple reflex agents;
* Model-based reflex agents;
* Goal-based agents; and
* Utility-based agents.

**11.  Will you state or interpret in your own words PEAS description for a Vacuum cleaner?**

Same agent would be irrational under different circumstances

– once all dirt is cleaned up it will oscillate needlessly back and forth.

– If the **performance measure** includes a penalty of one point for each movement left or right, the agent will fare poorly.

– A better agent for this case would do nothing once it is sure that **all the squares are clean**.

– If the clean squares can become dirty again, the agent should occasionally **check and clean** them if needed.

– If the **geography of the environment** is unknown the agent will need to explore it rather than stick to squares A and B

**12.  What are utility based agents?**

Goals alone are not really enough to generate high-quality behavior in most environments. For example, there are many action sequences that will get the taxi to its destination (thereby achieving the goal) but some are quicker, safer, more reliable, or cheaper than others. Goals just provide a crude binary distinction between "happy" and "unhappy" states, whereas a more general **performance measure** should allow a comparison of different world states according to exactly how happy they would make the agent if they could be achieved. Because "happy" does not sound very scientific, the customary terminology is to say that if one world state is preferred to another, then it has higher **utility** for the agent.

**13.  Why problem formulation must follow goal Formulation?**

**Goal formulation**,based on the current situation and the agent’s performance measure,is the first step in problem solving.

The agent’s task is to find out which sequence of actions will get to a goal state.

**Problem formulation** is the process of deciding what actions and states to consider given a goal.

**14.  List the properties of task environments**.

* Fully observable vs. partially observable
* Deterministic vs. stochastic
* Episodic vs. sequential
* Static vs. dynamic
* Discrete vs. continuous
* Single agent vs. multiagent

15.  **What is a task environment? How it is specified?**

Task environments are essentially the "problems" to which rational agents are the "solutions" .

A Task environment is specified using PEAS (Performance, Environment, Actuators, and Sensors) description.

16.  **Define Heuristic function.**

A **heuristic function** or simply a heuristic is a function that ranks alternatives in various search algorithms at each branching step basing on available information in order to make a decision which branch is to be followed during a search.

For example, for shortest path problems, a *heuristic* is a function, *h* (*n*) defined on the nodes of a search tree, which serves as an estimate of the cost of the cheapest path from that node to the goal node. Heuristics are used by informed search algorithms such as Greedy best-first search and A\* to choose the best node to explore.

**17.  What is the problem faced by hill-climbing search?**

Hill-climbing often get stuck for the following reasons:

i. **Local maxima** – A local maxima is a peak that is higher than each of its

neighboring states, but lower than the local maximum. Hill climbing algorithm

that reach the vicinity of a local maximum will be drawn upwards towards the

peak, but will then be stuck with nowhere else to go.

ii. **Ridges** – Ridges result in a sequence of local maxima that is very difficult for

greedy algorithms to navigate.

iii. **Plateaux:** a plateau is an area of state space landscape where the evaluation

function is flat. A hill-climbing search might be unable to find its way off the plateau.

**18.  What are optimization problems?**

**In optimization problems, the** aim is to find the best state according to an **objective function** the optimization problem is then: Find values of the variables that minimize or maximize the objective function while satisfying the constraints**.**

19.  **Point out some of the uninformed search techniques.**

* Breadth-first search
* Uniform-cost search
* Depth-first search
* Depth-limited search
* Iterative deepening search

**20.  What are local search algorithms?**

**Local search** algorithms operate using a single current state (rather than multiple paths) and generally move only to neighbors of that state. The local search algorithms are not systematic. The key two advantages are (i) they use very little memory – usually a constant amount, and (ii) they can often find reasonable solutions in large or infinite (continuous) state spaces for which systematic algorithms are unsuitable.

**21**.  **Define IDDFS**

Iterative deepening search (or iterative-deepening-depth-first-search) is a general strategy often used in combination with depth-first-search,that finds the better depth limit. It does this by gradually increasing the limit – first 0,then 1,then 2, and so on – until a goal is found. This will occur when the depth limit reaches d,the depth of the shallowest goal node.

Iterative deepening combines the benefits of depth-first and breadth-first-search

Like depth-first-search,its memory requirements are modest;O(bd) to be precise.

Like Breadth-first-search,it is complete when the branching factor is finite and optimal when the path cost is a non decreasing function of the depth of the node.

**22.  List the criteria to measure the performance of different search strategies**

* **Completeness**: Is the algorithm guaranteed to find a solution when there is one?
* **Optimality**: Does the strategy find the optimal solution?
* **Time complexity**: How long does it take to find a solution?
* **Space complexity**: How much memory is needed to perform the search?

**23.  Compare Uninformed Search (Blind search) and informed Search (Heuristic**

**Search) strategies.**

Blind search has no information about the no. of steps or the path cost from the current state to the goal, they can distinguish a goal state from nongoal state.

Heuristic search-knowledge given. Problem specification solution is best.

**24. Give the difference between Best first search and Breadth first search**

BFS means **Breadth first search**. Space complexity is more. Do not give optimal solution Queuing fn is same as that of queue operator

Best-first search is an instance of the general TREE-SEARCH or GRAPH-SEARCH algorithm in which a node is selected for expansion based on an evaluation function, f(n). The evaluation function is construed as a cost estimate, so the node with the lowest evaluation is expanded first. The implementation of best-first graph search is identical to that for uniform-cost search , except for the use of f instead of g to order the priority queue. The choice of f determines the search strategy. Most best-first algorithms include as a component of f a heuristic function, denoted h(n):

h(n) = estimated cost of the cheapest path from the state at node n to a goal state.

(Notice that h(n) takes a node as input, but, unlike g(n), it depends only on the state at that node.)

**Part B**

1. What is an agent? Explain the basic kinds of agents program
2. Explain the components necessary to define a problem
3. For each of the following activities, give a PEAS description of the task environment
4. Shopping for used AI books on the Internet.
   1. Playing a tennis match.
   2. Performing a high jump.
   3. Knitting a sweater.
   4. Bidding on an item at an auction.
5. Define the following terms: agent, agent function, agent program, rationality, autonomy, reflex agent, model-based agent, goal-based agent, utility-based agent, learning agent.
6. What are the five uninformed search strategies? Explain any two in detail with example
7. Explain any two informed search strategies
8. Write the algorithm for Generate and Test and Simple Hill Climbing.
9. Explain the Heuristic functions with examples

**Part c**

**From the book back exercises.**