

AI- Assignment 1

Q1. Define in your own words :-

1. Intelligence.

→ The ability to learn, understand, or deal with new or upcoming situations

2. AI

Artificial Intelligence is the simulation of human intelligence produced by machines, especially computer systems.

3. Agent

An agent is an independent entity which observes and operates upon an environment and directs its activity towards accomplishing goals

4. Agent functions

This is a function in which actions are mapped from a certain percept sequence. Percept sequence refers to a history of what the intelligent agent has perceived.

5. Agent program

Agent program is an implementation of an agent function.

6. Rationality:

The quality or state of being agreeable to reason, and the ability to think with reason, draw sensible

conclusions from facts, logics & data.

7. Autonomy

Autonomy generally refers to the capacity of an artificial agent to operate independently of human guidance.

8. Reflex agent :-

It is a type of intelligent agent that performs actions based solely on the current situation.

9. Model based agent

A model-based agent can handle partially observable environments by the use of a model about the world. It has to keep track of the initial state.

10. Utility based agent

It acts based not only on what the goal is but also the best way to reach the goal.

11. Learning agent

A learning agent is the type of agent that can learn from its past experiences or has learning capabilities.

12. State

A state contains all of the information necessary to predict the effects of an action and to determine if

it is a state space.

13. State space

A path sequence of states connected by a sequence of actions. It is the part of the graph (state tree).

14. Search Tree

A search tree is a tree data structure used for locating specific keys from within a set. It allows fast insertion, removal, and lookup of items while offering an efficient way to iterate them, in sorted order.

15. Search Node

In a search tree, a search node (root node) is the state & set of the children for each node consists of states reachable by taking any action while nodes in the tree are called search nodes.

16. Goal

The desired resulting condition in a given problem, and what search algorithms are looking for.

17. Action

It is a basic system in which the problem can be analyzed by the AI machine to understand what it has to do next to get closer to the solution of the problem.

18.

Successor function

It is a description of possible actions, a set of operators, it is a transformation function on a state representation, which convert it into another state.

19.

Branching factor

Branching factors is the no. of successors generated by a given node.

Q2.

Explain PEAS. Why is it required? Find out PEAS for

- 1] Satellite image analysis
- 2] Mahnum picking robot
- 3] X-ray diagnosis for TB

PEAS

- 1] Performance measure
- 2] Environment
- 3] Actuator
- 4] Sensor

PEAS system is used to categorize similar agents together. It delivers the performance measure with respect to the environment, actuators, & sensors of the respective agent. Most of the highest performing agents are Rational Agents.

- 1] Satellite image analysis

- P → Correct image categorization
- E → Image from orbiting satellite
- A → Display categorization of a scene
- S → Color pixel arrays.

Picking Robot

- P → Percentage parts in correct bins
- E → Conveyor belt with parts, bins
- A → Joined arm & hand
- S → Camera, joint angle sensors.

X-ray diagnosis

- P → Healthy patient, minimize cost
- E → Patient, hospital, staff
- A → Questions, tests, treatments
- S → Symptoms, findings, patient answers.

Q 3. What do you mean by Problem Formulation? Explain by taking e.g. of missionaries and cannibals

~~Problem Formulation is one of the core steps of problem-solving which decides what action should be taken to achieve the formulated goal. In AI this core part is dependent upon software agent which consisted of the following components to formulate the associated problem.~~

Q4. Write a program that will take as input two WEB page URLs & find a path of links from one to the another . What is the appropriate search strategy is bidirectional search a good idea? Could a search engine be used to implement a predecessor function?

As an ordinary person (or agent) browsing the web we can only generate the successors of a page by visiting it. We can then do BFS or perhaps Best search where the heuristic is some function of the number of words in common between the start & goal pages ; this may provide the user access to all (or at least some) of the pages that link to a page: this would allow us to do bidirectional search.

Q 5.

→ Uninformed search is a class of general-purpose search algorithms which operates in brute force-way. Uninformed search algorithms do not have additional information about state or search space other than how to traverse the tree, so it also called blind search.

1] BFS (Breadth-first search)

Breadth-first search is the most common search strategy for traversing a tree or graph. This algorithm searches breadthwise in a tree or graph, so it is called breadth-first-search.

Time & Space complexity :- $O(b^d)$.

2] DFS (Depth-first search)

It is a recursive algorithm for traversing a tree or graph data structure, using a stack DS for its implementation.

Time :- $O(n^m)$ & Space complexity :- $O(bm)$

3] Depth-Limited Search Algorithm

It is similar to DFS with a predetermined limit. Depth limited search can solve the drawback of the infinite path in DFS.

Time :- $O(b^d)$ Space :- $O(b \times d)$

4] Iterative deepening depth first search

The iterative deepening algorithm is a combination

of DFS & BFS algorithms. This search algorithm finds out the best depth limit & does it by gradually increasing the limit until a goal is found. It performs search up to a certain depth limit & it keeps increasing the depth limit after each iteration until the goal node is found.

5] Uniform Cost Search

Ucs is a searching algorithm used for traversing a weighted tree or graph. This algorithm comes into play when a different cost is available for each edge. The primary goal of Ucs is to find a path to the goal node which has the lowest cumulative cost.

6] Bidirectional Search Algorithm

Bidirectional search runs two simultaneous searches, one from initial state called as forward search & other from goal node called backward search to find the goal node. It uses search techniques like BFS, DFS etc.

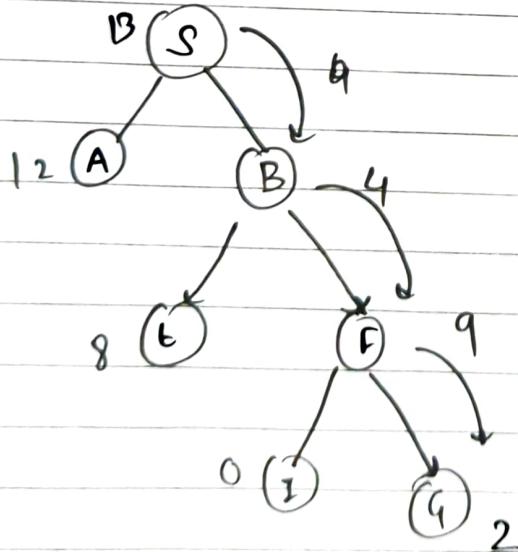
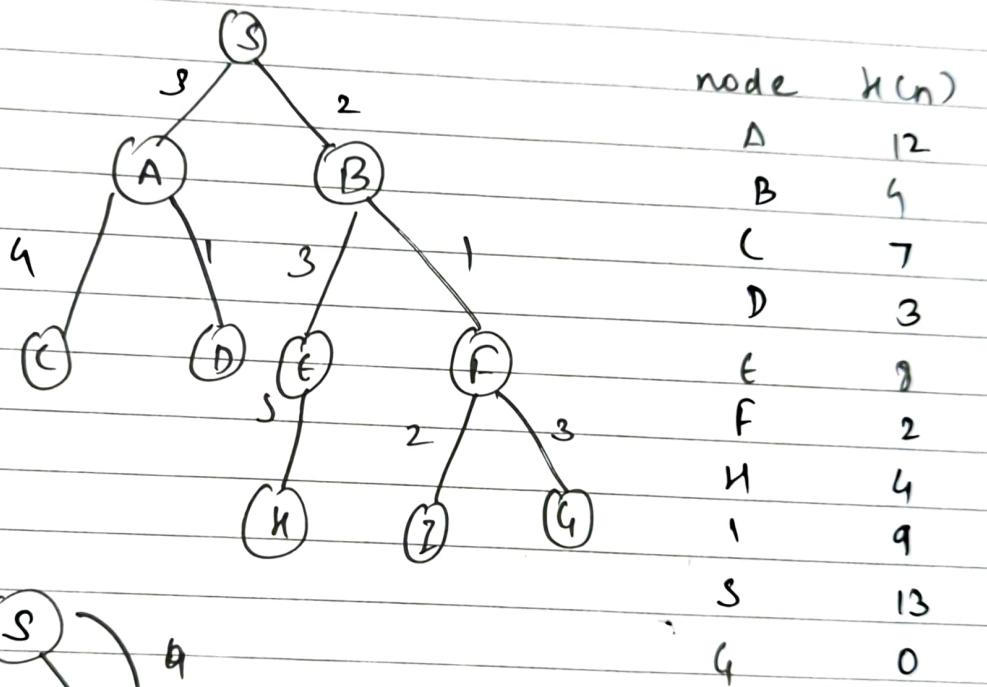
Q 6] Explain informed search? explain greedy best first & A* with example.

→ Informed search contains information on goal state, it helps search efficiently. It helps to find the solution quickly, it consumes less time and gives the direction about the solution.

(1)

Greedy best-first search algo. always selects the path which appears best at the moment. It is the combination of depth-first search & breadth first. It uses the heuristic function $h(s)$ to search. BFS allows us to take the advantage of both algorithms.

Example



Initialization: Open [A, B], Closed [S]
 Iteration 1: Open [A] Closed [S, B]
 Iteration 2: Open [E, F, A] Closed [S, B]
 : Open [E, A] Closed [S, B, F]
 Iteration 3: Open [I, G, E, A]
 : Open [I, G, E] Closed [S, B, F, G]

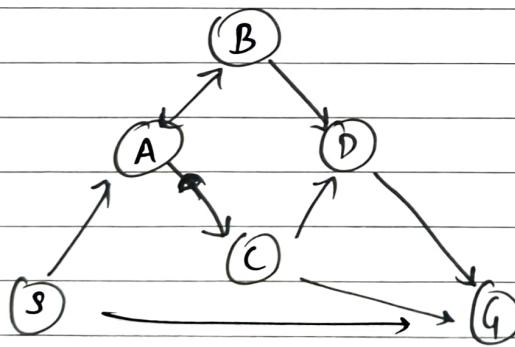
Final path: $S \rightarrow B \rightarrow F \rightarrow G$.

A* search algorithm

It is most commonly known form of BFS. It uses heuristic function $h(n)$ & cost to reach the node n from the start state to $g(n)$. It has combined features of UCS & Greedy Best F.S. by which it solve the problem efficiently.

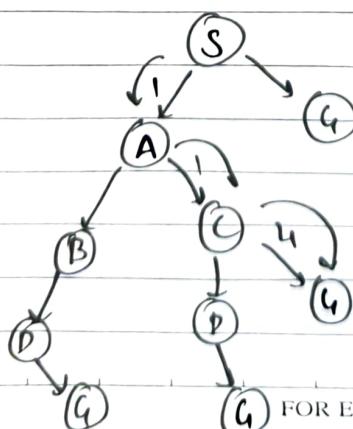
$$f(n) = g(n) + h(n)$$

↓ ↑
 Cost to lost to reach
 reach n from from node n
 start state to goal node.



State	$h(n)$
S	5
A	3
B	4
C	2
D	6
G	0

Solution



Initialization ($S, 5$)

iteration 1 $S \rightarrow A, 4, S \rightarrow G, 10$
 iteration 2 $S \rightarrow A \rightarrow C, 4, S \rightarrow A \rightarrow B, 7$
 $S \rightarrow G, 10$

iteration 3

$S \rightarrow A \rightarrow C \rightarrow G, 6$

final result $S \rightarrow A \rightarrow C \rightarrow G$.

Q7.

1] Crossword Puzzle

Fully Observable

Deterministic

Sequential

Static

Discrete

Single

2] Poker

Partially observable

Strategic

Sequential

Static

Discrete

Multi

3] Taxi Driving

Partially Observable

Stochastic

Sequential

Dynamic

Continuous

Multi

4] Interactive Math tutor

Partially Observable

Stochastic

Sequential

Dynamic

Discrete

Multi

Q3

What do you mean by Problem formulation? Explain by taking example of missionaries & cannibals.

Problem formulation is one of the core steps of problem-solving which decides what action should be taken to achieve the formulated goal. In AI this core part is dependent upon software agent which consisted of the following components to formulate the associated problem. It can be done in many steps such as the definition of the initial state of the agent, determining possible actions that the agent.

First let us consider the both missionaries (M) & cannibals (C) are on the same side of the river. The goal state is to take all 3M & 3C to the other side of the river.

The condition is the no. of cannibals should not exceed the no. of missionaries on the either side of the river.

BFS algorithm is used to find the solution. The boat can carry only 2 people at a time.

Missionary and Cannibals problem state space tree.

