

Q1 Explain BFS and DFS with example. State the differences between them.

Ans: Best first search is an instance of graph search algorithm in which a node is selected for expansion based on evaluation function  $f(n)$ . Traditionally, the node which is the lowest evaluation is selected for the explanation because the evaluation measures distance to the goal. Best first search can be implemented within general search frame work via a priority queue, a data structure that will maintain the fringe in ascending order of values.

DFS is also an important type of uniform search. DFS visits all the vertices in the graph. This type of algorithm always chooses to go deeper into the graph. After DFS visited all the reachable vertices from a particular sources vertices it chooses one of the remaining undiscovered vertices and continues the search. DFS reminds the space limitation of breath first search by always generating next a child of the deepest unexpanded noded. The data structure stack or last in first out (LIFO) is used for DFS.

#### **Difference between BFS and DFS**

##### **BFS**

It uses the data structure queue.

BFS is complete because it finds the solution if one exists.

BFS takes more space i.e. equivalent to  $O(b^d)$  where  $b$  is the maximum breath exist in a search tree and  $d$  is the maximum depth exit in a search tree.

In case of several goals, it finds the best one.

##### **DFS**

It uses the data structure stack.

It is not complete because it may take infinite loop to reach at the goal node.

The space complexity is  $O(d)$ .

In case of several goals, it will terminate the solution in any order.

Q2) Explain A\* and AO\* algorithm.

Ans: **A\* algorithm**

A\* search finds the shortest path through a search space to goal state using heuristic function. This technique finds minimal cost solutions and is directed to a goal state called A\* search. The A\* algorithm also finds the lowest cost path between the start and goal state, where changing from one state to

another requires some cost. A\* requires heuristic function to evaluate the cost of path that passes through the particular state. This algorithm is complete if the branching factor is finite and every action has fixed cost. A\* requires heuristic function to evaluate the cost of path that passes through the particular state.

**Algorithm:**

Step 1: Place the starting node into OPEN and find its  $f(n)$  value.

Step 2: Remove the node from OPEN, having smallest  $f(n)$  value. If it is a goal node then stop and return success.

Step 3: Else remove the node from OPEN, find all its successors.

Step 4: Find the  $f(n)$  value of all successors; place them into OPEN and place the removed node into CLOSE.

Step 5: Go to Step-2. Step 6: Exit.

**AO\* Algorithm**

The Depth first search and Breadth first search given earlier for OR trees or graphs can be easily adopted by AND-OR graph. The main difference lies in the way termination conditions are determined, since all goals following an AND nodes must be realized; where as a single goal node following an OR node will do. So for this purpose we are using AO\* algorithm

**Algorithm:**

Step 1: Place the starting node into OPEN.

Step 2: Compute the most promising solution tree say  $T_0$ .

Step 3: Select a node  $n$  that is both on OPEN and a member of  $T_0$ . Remove it from OPEN and place it in CLOSE

Step 4: If  $n$  is the terminal goal node then leveled  $n$  as solved and leveled all the ancestors of  $n$  as solved. If the starting node is marked as solved then success and exit.

Step 5: If  $n$  is not a solvable node, then mark  $n$  as unsolvable. If starting node is marked as unsolvable, then return failure and exit.

Step 6: Expand  $n$ . Find all its successors and find their  $h(n)$  value, push them into OPEN.

Step 7: Return to Step 2.

Step 8: Exit.

Q3) Explain genetic algorithm.

Ans: Genetic algorithms are based on the theory of natural selection and work on generating a set of random solutions and making them compete in an area where only the fittest survive. Each solution in the set is equivalent to a chromosome. Genetic algorithm learning methods are based on models of natural adaptation and evolution. These learning methods improve their performance through processes which model population genetics and survival of the fittest. In the field of genetics, a population is subjected to an environment which places demands on the members. The members which adapt well are selected for mating and reproduction. Generally genetic algorithm uses three basic genetic operators like reproduction, crossover and mutation. These are combined together to evolve a new population. Starting from a random set of solutions the algorithm uses these operators and the fitness function to guide its search for the optimal solution. The fitness function guesses how good the solution in question is and provides a measure to its capability. The genetic operators copy the mechanisms based on the principles of human evolution. The main advantage of the genetic algorithm formulation is that fairly accurate results may be obtained using a very simple algorithm. The genetic algorithm is a method of finding a good answer to a problem, based on the feedback received from its repeated attempts at a solution. The genetic algorithm described as follows.

Step 1: Generate the initial population.

Step 2: Calculate the fitness function of each individuals.

Step 3: Some sort of performance utility values or the fitness values are assigned to individuals.

Step 4: New populations are generated from the best individuals by the process of selection.

Step 5: Perform the crossover and mutation operation.

Step 6: Replace the old population with the new individuals.

Step 7: Perform step-2 until the goal is reached.

Q4) Explain knowledge acquisition.

Ans: Knowledge acquisition is the gathering or collecting knowledge from various sources. It is the process of adding new knowledge to a knowledge base and refining or improving knowledge that was previously acquired. Acquisition is the process of expanding the capabilities of a system or improving its performance at some specified task. So it is the goal oriented creation and refinement of knowledge. Acquired knowledge may consist of facts, rules, concepts, procedures, heuristics, formulas, relationships, statistics or any other useful information. Source of these knowledges may be experts in the domain of interest, text books, technical papers, database reports, journals and the environments. The knowledge acquisition is a continuous process and is spread over entire lifetime. Example of knowledge acquisition is machine learning. It may be process of autonomous knowledge creation or refinements through the use of computer programs. The newly acquired knowledge should be integrated with existing knowledge in some meaningful way. The knowledge should be accurate, non-redundant, consistent and fairly complete. Knowledge acquisition supports the activities like entering the knowledge and maintaining knowledge base. The knowledge acquisition process also sets dynamic

data structures for existing knowledge to refine the knowledge. The role of knowledge engineer is also very important with respect to develop the refinements of knowledge. Knowledge engineers may be the professionals who elicit knowledge from experts. They integrate knowledge from various sources like creates and edits code, operates the various interactive tools, build the knowledge base etc.

**All questions carry equal marks**

Q.1 Write the definition of artificial intelligence. What are the components of artificial intelligence?

Ans : **Artificial Intelligence:** It is the study of how to make computers do things which at the moment people do better. This is ephemeral as it refers to the current state of computer science and it excludes a major area ; problems that cannot be solved well either by computers or by people at the moment. 2. AI is a field of study that encompasses computational techniques for performing tasks that apparently require intelligence when performed by humans. 3. AI is the branch of computer science that is concerned with the automation of intelligent behaviour. AI is based upon the principles of computer science namely data structures used in knowledge representation, the algorithms needed to apply that knowledge and the languages and programming techniques used in their implementation.

**Components of artificial intelligence:**

1) Hardware Components of AI a) Pattern Matching b) Logic Representation c) Symbolic Processing d) Numeric Processing e) Problem Solving f) Heuristic Search g) Natural Language processing h) Knowledge Representation i) Expert System j) Neural Network k) Learning l) Planning m) Semantic Network

2) Software Components a) Machine Language b) Assembly language c) High level Language d) LISP Language e) Fourth generation Language f) Object Oriented Language g) Distributed Language h) Natural Language i) Particular Problem Solving Language

3) Architectural Components a) Uniprocessor b) Multiprocessor c) Special Purpose Processor d) Array Processor e) Vector Processor f) Parallel Processor g) Distributed Processor.

Q.2 Define state space and explain water jug problem.

Ans: A state represents a status of the solution at a given step of the problem solving procedure. The solution of a problem, thus, is a collection of the problem states. The problem solving procedure applies an operator to a state to get the next state. Then it applies another operator to the resulting state to derive a new state. The process of applying an operator to a state and its subsequent transition to the next state, thus, is continued until the goal (desired) state is derived. Such a method of solving a problem is generally referred to as state space approach.

**The water jug problem :**

There are two jugs called four and three ; four holds a maximum of four gallons and three a maximum of three gallons. How can we get 2 gallons in the jug four. The state space is a set of ordered pairs giving the number of gallons in the pair of jugs at any time ie (four, three) where four = 0, 1, 2, 3, 4 and three = 0, 1, 2, 3. The start state is (0,0) and the goal state is (2,n) where n is a don't care but is limited to three holding from 0 to 3 gallons. The major production rules for solving this problem are shown below:

Initial	condition	goal	comment
1 (four,three)	if four < 4	(4,three)	fill four from tap
2 (four,three)	if three < 3	(four,3)	fill three from tap
3 (four,three)	If four > 0	(0,three)	empty four into drain
4 (four,three)	if three > 0	(four,0)	empty three into drain
5 (four,three)	if four+three<4	(four+three,0)	empty three into four
6 (four,three)	if four+three<3	(0,four+three)	empty four into three
7 (0,three)	If three>0	(three,0)	empty three into four
8 (four,0)	if four>0	(0,four)	empty four into three
9 (0,2)		(2,0)	empty three into four
10 (2,0)		(0,2)	empty four into three
11 (four,three)	if four	(4,three-diff)	pour diff, 4-four, into four from three
12 (three,four)	if three		pour diff, 3-three, into three from four and a solution is given below Jug four, jug three rule applied

0 0

0 3 2

3 0 7

3 3 2

4 2 11

0 2 3

2 0 10

Q.3 Explain production system and its characteristics.

Ans: The production system is a model of computation that can be applied to implement search algorithms and model human problem solving. Such problem solving knowledge can be packed up in the form of little quanta called productions. A production is a rule consisting of a situation recognition part and an action part. A production is a situation-action pair in which the left side is a list of things to watch for and the right side is a list of things to do so.

A production system consists of following components:

(a) A set of production rules, which are of the form  $A \rightarrow B$ . Each rule consists of left hand side constituent that represent the current problem state and a right hand side that represent an output state. A rule is applicable if its left hand side matches with the current problem state.

(b) A database, which contains all the appropriate information for the particular task. Some part of the database may be permanent while some part of this may pertain only to the solution of the current problem.

(c) A control strategy that specifies order in which the rules will be compared to the database of rules and a way of resolving the conflicts that arise when several rules match simultaneously. (d) A rule applier, which checks the capability of rule by matching the content state with the left hand side of the rule and finds the appropriate rule from database of rules.

Q.4 Explain weak and strong AI.

Ans: The **strong AI** is very much promising about the fact that the machine is almost capable of solve a complex problem like an intelligent man. They claim that a computer is much more efficient to solve the problems than some of the human experts. According to strong AI, the computer is not merely a tool in the study of mind, rather the appropriately programmed computer is really a mind. Strong AI is the supposition that some forms of artificial intelligence can truly reason and solve problems.

**Weak AI** is not so enthusiastic about the outcomes of AI and it simply says that some thinking like features can be added to computers to make them more useful tools. It says that computers to make them more useful tools. It says that computers cannot be made intelligent equal to human being, unless constructed significantly differently. They claim that computers may be similar to human experts but not equal in any cases. Generally weak AI refers to the use of software to study or accomplish specific problem solving that do not encompass the full range of human cognitive abilities.