SASTRA
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School of Computing
First CIA Exam – Feb 2025
Course Code: INT314
Course Name: Artificial Intelligence and Logical Reasoning
Duration: 90 minutes Max Marks: 50

Answer Key

1. You are building food delivery agent within SASTRA. Discuss the type of its environments. (5)
   Partial, Multi, Stochastic, Sequential , Dynamic, Continuous

2. You have to develop an agent to work in a blind environment, Develop the steps of Breadth First Search algorithm to give instruction to the agent to do a task. (5)

```
function BREADTH-FIRST-SEARCH(problem) returns a solution, or failure
  node ← a node with STATE = problem.INITIAL-STATE, PATH-COST = 0
  if problem.GOAL-TEST(node.STATE) then return SOLUTION(node)
  frontier ← a FIFO queue with node as the only element
  explored ← an empty set
  loop do
    if EMPTY?(frontier) then return failure
    node ← POP(frontier)  /* chooses the shallowest node in frontier */
    add node.STATE to explored
    for each action in problem.ACTIONS(node.STATE) do
      child ← CHILD-NODE(problem, node, action)
      if child.STATE is not in explored or frontier then
        if problem.GOAL-TEST(child.STATE) then return SOLUTION(child)
        frontier ← INSERT(child, frontier)
```

Figure 3.11 Breadth-first search on a graph.

3. Assume that you are planning to build Learning agent. Discuss the components which are to be present. (5)

learning element, which is responsible for making improvements. uses feedback from the **critic** on how the agent is doing and determines how the performance element should be modified to do better in the future.
performance element, which is responsible for selecting external actions, entire agent: it takes in percepts and decides on actions
problem generator. It is responsible for suggesting actions that will lead to new and **informative experiences**-But if the agent is willing to explore a little, it might discover much better actions for the long run.
The problem generator's job is to suggest these **exploratory actions**. This is what scientists do when they carry out experiments.

4. Discuss the type of environments you mentioned in question 1 (5)
   Partial- Only to some extend the agent knows and have access at a point on the environment. What the other agents in the environment, students, canteen persons are doing can not be visualized fully.
   Multi- Environment is changing by multiple agents such as students, workers, working on the same environment same time
   Stochastic- next state is not completely determined by current sate and more randomness in environment
   Sequential – current state actions affect the next state and the actions are sequential such as taking the order, payment checking, grabbing food, deliver…
   Dynamic-environment is changing while agent is deliberating and other agents also making changes in the environment
   Continuous- no limited number of discrete states, they are continues, there no discrete steps defined.
5. Compare the performance metrics of all uninformed search strategies. (5)

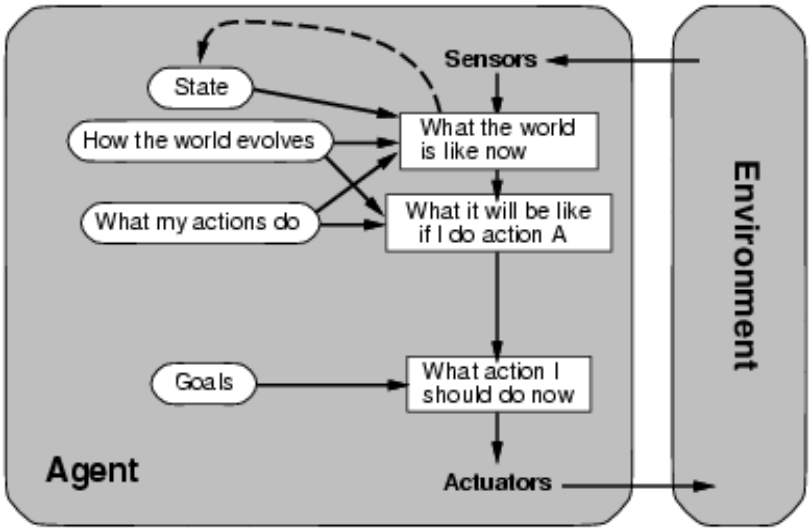
Criterion	Breadth-First	Uniform-Cost	Depth-First	Depth-Limited	Iterative Deepening	Bidirectional (if applicable)
Complete?	Yes[a]	Yes[a,b]	No	No	Yes[a]	Yes[a,d]
Time	$O(b^{d+1})$	$O(b^{1+\lfloor C^*/\epsilon \rfloor})$	$O(b^m)$	$O(b^\ell)$	$O(b^d)$	$O(b^{d/2})$
Space	$O(b^{d+1})$	$O(b^{1+\lfloor C^*/\epsilon \rfloor})$	$O(bm)$	$O(b\ell)$	$O(bd)$	$O(b^{d/2})$
Optimal?	Yes[c]	Yes	No	No	Yes[c]	Yes[c,d]

Evaluation of search strategies,b is the branching factor; d is the depth of the shallowest solution; m is the maximum depth of the search tree; l is the depth limit. Superscript caveats are as follows: [a] complete if b is finite; [b] complete if step costs >= E for positive E; [c] optimal if step costs are all identical; [d] if both directions use breadth-first search

6. Anand developed a part-picking robot to identify defective part. Identify PEAS of that agent. (5)

Part-picking robot	Percentage of parts in correct	Conveyor belt with parts; bins	Jointed arm and hand	Camera, joint angle sensors

7. Draw the block diagram of Goal based Agent. (5)



8. Discuss how bidirectional search is better than BFS and DFS. (5)

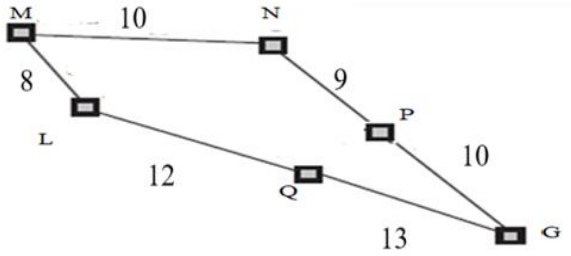
In parallel the search - start to goal and goal to start, this reduces the time complexity as $b^{d/2}$, Where BFS and DFS witn b^d

The motivation is that $b^{d/2} + b^{d/2}$ is much less than b^d, (the area of the two small circles is less than the area of one big circle centered on the start and reaching to the goal.)

Space complexity is $b^{d/2}$

- Complete and optimal similar to BFS, where DFS is not complete and optimal.
- Eg: solution depth d = 6, and each direction runs BFS one node at a time, then in the worst case the two searches meet when each has expanded all but one of the nodes at depth 3.
- For b = 10, this means a total of 22,200 node generations, compared with 1 1,111,100 for a standard breadth-first search.
- Checking a node for membership in the other search tree can be done in constant time with a hash table,

9. The courier delivery bot has to travel in the given state space. The possible states and costs are given in the graph. M-Start, G-Goal. How UCS can be applied and least cost path be found? (10)



Fringe	Goal test	Close list	Comparison
M	M×		
L,N 8,10	L×	M	M-L<M-N 8<10, goto L
N,M-L-Q 10,8+12	N×	M	M-N<M-L-Q 10<20, goto N
M-L-Q, M-N-P 8+12, 10+9	P×	M,L	M-N-P< M-L-Q 19<20 Proceed with P
M-L-Q, M-N-P-G 8+12, 10+9+10	Q×	M,L,N	M-L-Q<M-N-P-G 20<29 Though goal is reached, goto Q
M-L-Q-G, M-N-P-G 8+12+13, 10+9+10	G ✓		M-N-P-G< M-L-Q-G 29<33 Goal reached with least cost 29 Sol: M-N-P-G