Detailed Solution Scheme - Artificial Intelligence Mid Semester Exam

1. Answer all the questions. [1 Mark x 5]

a) Components in Node: state, parent, action, path cost, depth.

b) Bidirectional Search: Two simultaneous searches from start and goal, meeting in the middle. Time complexity reduced from O(b^d) to O(b^(d/2)).

c) DFS is incomplete as it may get stuck in infinite depth paths in infinite or cyclic spaces.

d) A* Search is preferred for shortest path due to its optimality and completeness when using admissible heuristics.

e) Greedy Best-First Search uses only heuristic (h(n)), not optimal or complete always. Fast but can be misleading.

2. Prove or counter:

a) True. Breadth-First is Uniform Cost Search with equal step cost.

b) False. UCS does not use heuristic; A* does. Hence UCS is not a special case of A*.

3. A* Algorithm:

Data Structures: Open list (priority queue), Closed list (visited nodes).

Steps:

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1. Initialize open with start node.
2. Loop until open is empty:
   a. Remove node with lowest f(n) = g(n) + h(n)
   b. If goal, return path.
   c. For each successor, compute f(n), add/update in open.
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Switching paths: A* always chooses path with lower f(n); switches if better path is found.

Example: Grid from (0,0) to (2,2) with obstacle at (1,1). Heuristic: Manhattan distance.

4. Water Jug Problem:

Jugs: 12, 8, 3 gallons.

Goal: 1 gallon.

State: (12_g, 8_g, 3_g)

Initial: (0, 0, 0)

Goal: any state where one jug has 1 gallon.

Partial Path from image:

(0,0,0) -> Fill 3 -> (0,0,3) -> Pour 3 to 8 -> (0,3,0) -> Fill 3 -> (0,3,3) -> Pour 3 to 8 -> (0,6,0) -> Fill 3 -> (0,6,3) -> Pour 3 to 8 -> (0,8,1) -> Goal.

5. N-Queen using GA:

a) 4-Queen:

- Chromosome: [row of queen in each column], e.g. [2, 4, 1, 3]

- Fitness: Number of non-attacking pairs

- Iteration 1: Initialize population, evaluate fitness

- Iteration 2: Crossover, Mutation, Select best

b) GA vs Others:

GA uses evolutionary strategy (selection, crossover, mutation).

Traditional: backtracking (systematic), local search (hill climbing).

GA explores larger space, avoids local optima.