National University
OfComputer&EmergingSciencesFaisalabad-ChiniotCampus

5/6

**Artificial Intelligence**
**Course Instructor**
**Ms. Mahzaib Younas**

| Time allowed = 30 min | Quiz 3 | Total Marks = 30 |
|---|---|---|

**BCS Section E**

| Solution. | | 6E |
|---|---|---|
| Roll No | Name | Signature |

**Question No 01: For each question statement below, choose the correct option.[6]**

| 1. What is the main characteristic of local search algorithms? | 2. What is the key advantage of local search algorithms? |
|---|---|
| a) They operate on multiple nodes at a time<br>b) They operate using single node & move to neighbors<br>c) They systematically can explore all of the possible paths.<br>d) They store all the visited nodes in the memory | a) They guarantee in finding the optimal solution.<br>b) They use little memory and are efficient in large state spaces.<br>c) They always avoid getting stuck in local optima.<br>d) They do not require an evaluation function |
| **3. In hill climbing, what happens when the algorithm reaches a local maximum?** | **4. Which of the following is NOT a type of hill climbing?** |
| a) It restarts automatically from a new state<br>b) It always finds a way to reach the global maximum<br>c) It stops since no neighboring state has a higher value<br>d) It moves randomly to another state | a) Stochastic hill climbing<br>b) Steepest ascent hill climbing<br>c) First-choice hill climbing<br>d) Depth-first hill climbing |
| **5. What is the role of temperature in simulated annealing?** | **6. What are the main cons of hill-climbing search?** |
| a) It determines the probability of accepting worse solutions<br>b) It controls the number of neighbors a state can have<br>c) It determines the final solution directly<br>d) It has no impact on the algorithm | a) Terminates at local optimum & Does not find optimum solution<br>b) Terminates at global optimum & Does not find optimum solution<br>c) Does not find optimum solution & Fail to find a solution<br>d) Fail to find a solution |

**Question No 03: Give the name that results from each of the following special cases: [8 Marks]**

**a) Local Beam search with k =1**

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Best First Search. (stucks at local maxima)
(only taking one best solutions stops when no more best).

b) **Local beam search with one initial state and no limit on the number of states retained.**

BFS (Breadth First Search).

Because expand all nodes at one depth before next level.

c) **Simulated annealing with T=0 at all times (and omitting the termination test).**

Hill Climbing (T=0 not accepting bad move), will stuck at local optima like hill Climbi

d) **Simulated annealing with T=infinity at all times.**

Random Walk. (Doesn't care if solution is improving or not only moves to random neighbor.

**Question No 03: Answer the following** **[8 Marks]**

| Statement | True/False | Justification |
|---|---|---|
| Local search algorithms always find the optimal solution. | False | Can stuck in local optima |
| Simulated annealing is an improved version of hill climbing that allows bad moves. | True | Can allow worse move to take risk to find global optima |
| In local beam search, increasing the value of k allows more states to be explored simultaneously. | True | k = number of neighbours to explore increasing k allow exploring more nodes. |
| Random-restart hill climbing helps to escape local optima by starting from different initial states. | True | Random initial state can be better starting points to eventually find maxima |
| In simulated annealing, if temperature (T) is never lowered, the algorithm will always stay in a high-energy state. | True | T= possible bad move Reduce T to stop accepting bad move. |

**Question No 04: Answer the following question:** **[8Marks]**

Consider an **8-Queens Problem** where the heuristic function is:
h=Number of pairs of queens attacking each other
You apply **hill climbing** but the algorithm gets stuck at a **plateau**.

What does a **plateau** mean in this context?

A state where moving a queen to any neighboring position doesn't reduce the number of pairs of queens attacking each other.

Give an example of how a **random sideways move** can help escape a plateau.

If moving queens Q1, Q2 or Q3 all results in the same number of attacks randomly choosing one of these moves might eventually leads to config where improvements are possible.

How does **simulated annealing** behave differently from hill climbing in this case?

Simulated Annealing will not stop when reached the local optima because of T. It will allow some queens to take bad move that can increase no. of queens attacking but can lead to a better solution.