Fundamentals of AI exercises

BDA option

Exercise 1

Give the name of the algorithm which results from:

1. Local beam search with k=1
2. Local beam search with one initial state and no limit on the number of states retained
3. Simulated annealing with temperature $Temp = \infty$ at all times

Exercise 2

Confused (or inverse) n-queens problem is a variant of n-queens in which one seeks all ways to place n queens on an $n \times n$ chess board, having one queen per row, so that *each* pair of queens *does* attack each other. Given that $n = 3$ answer the following questions.

1. What is the number of possible states for this problem?
2. What is the number of solutions?
3. In case of success what is the average number of steps?
4. What is the expected number of restarts for this problem?
5. Are there local maxima?

Exercise 3

Consider the following graph where each state has the objective value or measure of quality of states given in Table 1. We can perform an action which would take us from one state to another. Action identifiers are denoted on the edges between nodes. The goal is to perform a sequence of actions that would maximize the objective function. Assume A is the initial state.

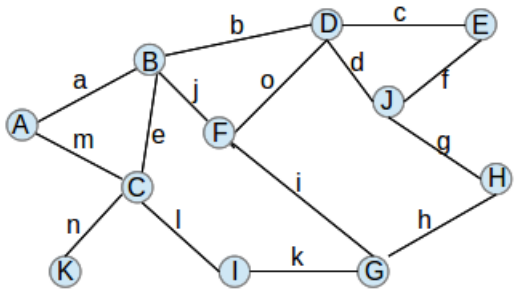


Table 1: Objective values of the states

State	Value
A	1
B	5
C	4
D	7
E	9
F	5
G	4
H	6
I	3
J	6
K	10

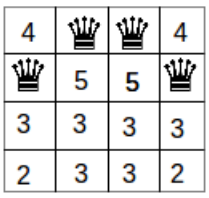
1. If you were to perform hill-climbing, what would be the final state you would reach?
2. Perform tabu search such that the tabu list keeps states we pass by in the sequence of actions. E.g., if we pass by state F that state is stored in the tabu list and thus we cannot go back to that state. Use the following template for solutions:

Current state	Neighbourhood	Best successor	Action taken	Tabu list
A	B,C	B	a	$< A >$
B	C,F,D	D	b	$< A, B >$

3. Perform tabu search where we keep actions performed in the tabu list.
4. Do the searches in 2) and 3) return the same result?

Exercise 4

Consider the initial state of the 4-queens problem shown below.



Consider the hill-climbing local search with number of conflicts heuristic to find a valid state of the n-queens problem. The heuristic value of a state is the

number of distinct queen pairs that can attack each other. The successors of a state are all possible states generated by moving a single queen to another square in the same column. Hill-climbing would at each step take the successor with the smallest number of conflicts.

1. Draw the tree of states that hill-climbing using the minimum conflict heuristic explores from the initial state. The successors of each state are those states that have least conflicts. Draw the tree corresponding to all possible exploration paths of hill-climbing.

2. Are all the leaves in the tree constructed in 1) solutions to the 4-queens problem? If not, how to achieve that all the leaves in the tree represent the solution?