

CS360 Homework 6– Solution

Local Search

- 1) In the N -Queens problem, we want to place N queens on an $N \times N$ board with no two queens on the same row, column, or diagonal. Come up with a value function and use hill climbing to try to solve the problem by minimizing this value function, starting with the configuration given below. Generate the successors of a state by moving a single queen vertically.

	A	B	C	D
1				
2	Q1		Q3	
3		Q2		Q4
4				

Answer:

The value function is the number of pairs of queens that can attack each other, assuming no other queens are on the board (that is, three queens in the same row count as three pairs, not two). In the initial state, we have the pairs (Q1, Q2), (Q1, Q3), (Q2, Q3), (Q2, Q4), (Q3, Q4), making its value 5.

Moving Q1 to A1 removes the pairs (Q1, Q2) and (Q1, Q3), decreasing the value by 2. Moving it to A3 removes the pair (Q1, Q3), but adds the pair (Q1, Q4). Moving it to A4 does not change the pairs. A symmetric argument can be made for Q4.

Moving Q2 to B1 does not change the pairs. Moving it to B2 removes the pair (Q2, Q4). Moving it to B4 removes all three pairs that Q2 appears in. A symmetric argument can be made for Q3.

The lowest value we can get with one move is 2, either by moving Q2 to B4 or Q3 to C1. Moving Q2 to B4, we get:

	A	B	C	D
1				
2	Q1		Q3	
3				Q4
4		Q2		

There are many possible moves in this state, but moving Q3 to C1 finds the solution (that is, a state with the lowest possible value of 0), so we can skip the other moves:

	A	B	C	D
1			Q3	
2	Q1			
3				Q4
4		Q2		

- 2) How would you approach the Traveling Salesman Problem if we wanted to find a good (but not necessarily the best) solution to it using hill climbing?

Answer:

We start with a random solution that visits all cities. The value function is the total distance traveled by the salesperson. We can generate the successors of a state by picking any two cities on the tour and exchanging them. The 2-opt and 3-opt algorithms are more complex but very well performing hill-climbing algorithms for the Traveling Salesperson Problem. The 2-opt algorithm was discussed in class and picks any subpath of the tour and reverses the order of the cities visited on this subpath.