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(***SITE***)

Artificial Intelligence Lab Report

Local Search Algorithms

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Jun, 2022

Introduction

The idea of the local search algorithm is that, we generate different solutions and we evaluate the solutions and tend to optimise the solution. There are different types of local search algorithms, some of them are Hill Climbing Algorithm, Genetic Algorithm and Simulated Annealing Algorithm. In each of the algorithms, we generated various solutions and we implemented some operations on the solutions until we found an optimal solution.

The solutions that we get might not be the optimal solution, but it is a locally optimum value which is not necessarily the global maximum. We can use local search algorithms for many applications such as the travel salesman problem.

Performance Measure

There are many different parameters that the performance of the algorithms can depend on, this includes the size of the sample space, the number of neighbour solutions, the size of population in case of genetic algorithms and other parameters.

When we compare the performance of the three algorithms, we have to note things like

- The performance can depend on the number of neighbours taken at each solution generation. For example in the case of the Hill Climbing algorithm, the performance can depend on the number of neighbours generated for each current solution. In our case we have limited the number of neighbours to be 10. We might make the number depend on the length of solution of some other parameter, but that will only add computational overhead without any considerable algorithm improvements.
- In the case of the Simulated Annealing, the performance depends the same way as the Hill Climbing algorithm. But in addition to that, it also depends on the search space used, and the solution found by the random selection.

- In the case of the Genetic Algorithm, the performance depends on the number of populations chosen. The larger the population, the slower the performance. But if we decrease the population, we might not find the best answer, because there is less population to evolve.

The performance also depends on the number of sample spaces used. Increasing the number of spaces might not necessarily affect the performance of the Hill Climbing Algorithm though because the Hill Climbing Algorithm always sees the neighbouring solutions and increasing the sample space might have no effect on it because it depends heavily on the neighbours not on the whole sample space. But it has an effect on the Simulated annealing because it has to select a random solution for the sample space and proceed slowly. So as the size of the sample space increases the performance of simulated annealing might decrease.

In Simulated annealing, the process is the same as that of the hill climbing algorithm but their difference is that simulated annealing moves with a probability whereas the hill climbing algorithm simply travels in a way that optimises local solution. So performance wise, we can say that simulated annealing might take a little longer than a hill climbing algorithm because the way the probability is calculated determines the performance. Hill climbing algorithm, where as the hill climbing simply chooses the best neighbouring solution and simply proceeds. But when it comes to the genetic algorithm the performance depends heavily on the size of the population chosen.

The following table shows the performance of the three algorithms, the time is in ms.

Benchmark for knapsack problem

Length of List cases	Hill Climbing Algorithm	Simulated Annealing	Genetic Algorithm
10	0.0026808951478969954	0.00688710817105889	0.007422119578371358
15	0.0064664222215897 75	0.007317785187093399	0.009307324594338098
20	0.0068452575195538 49	0.0045533025931134 72	0.0127487907777347 77

Benchmark for travel salesman problem

Length of List cases	Hill Climbing Algorithm	Simulated Annealing	Genetic Algorithm
10	0.0013529660000131116	0.00798310698696717	0.008522863493981441
15	0.0030094618695178 64	0.0093984851601219 55	0.01319138367913796
20	0.0088826526463468 07	0.0096410974445871 04	0.01779913155107258

Generally speaking, the performance of the three local search algorithms decrease as the inputs of the data increase. But specifically speaking, hill climbing is the slowest of the three algorithms, because it doesn't involve much computations. And

the slowest among the three algorithms is genetic algorithm because of a lot of computations involved and a lot of population size is needed to get a better solution.