Abstract

Introduction

Optimization problems require immense amount of computational time as the problem scales increase. It is often unrealistic to compute an optimization problem using classical computers because of the problem’s nondeterministic polynomial computational time. Metaheuristic algorithms are built to overcome this computational time problem. Although metaheuristic algorithms do not always output the global optimal solution, they provide efficiency in approximating optimal solutions. They make assumptions about the problem space in order to reduce search space and computation.

Background

It is often difficult to create an optimization algorithm because of its variety and complex relationships between parameters. Thus, in many cases, optimization algorithms often inspired by phenomena in nature. These are nature proven methods of optimization and deriving the properties from these natural optimization can assist in creating an optimization algorithm that works. One of the most prominent nature-derived method is the “Simulated Annealing”. Its inspiration comes from annealing metallurgy, a technique that involves in cooling the heated material in a controlled manner in order to help the molecules form strong crystals. Each material has its optimum cooling rate to create the strongest form of that material after cooling. Similarly, this method can be used to find a global minimum of a system or a problem. The mathematical function used in simulated annealing determines the probability in which the search will accept worse solution. As the temperature within this function decreases, this probability also decreases. This means that the higher temperature allows for exploration in the initial phase of the search iterations. Once the temperature starts to cool down, the search starts its exploitation and hones down to one area in the search space. Simulated annealing is essentially a tool to balance the exploration and the exploitation within the algorithm. It also offers the probability characteristic that will allow for a more randomized search.

In contrast to simulated annealing method, there is a straight forward concept to pick the solution each step in the optimization algorithm. As simulated annealing offers a probability whether to accept the solution or not, this classic method called “Beam search” is a greedy search algorithm that always accepts the best solution. Thus, the probability of accepting a worse solution is always zero. The benefit of the Beam search is that it will get to the optimum solution much quicker than the methods that uses probabilities. However, the disadvantage of Beam search is that it may converge quicker into a local optimum will not be able to get out.