Genetic Algorithm for Solving the Travel Salesman Problem

By:
Vikaskumar Chaudhary
Niraliben Dipakkumar Mistry
Harshkumar Mehta
Bhargav Dineshbhai Patel
Mohasina Shaikh
Gaurav Pathak

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Department of Mathematics and Computer Science
Faculty of Sciences, Engineering and Architecture
Laurentian University
Sudbury, Ontario, Canada

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Abstract

This research report is the result of implementation of travelling salesman problem (TSP) using genetic algorithm (GA) in python carried out by the authors. TSP is one of the most intensively studied problem in optimization. The main attraction of TSP is a salesman visiting all the cities in his tour in the less possible cost. In genetic algorithm crossover and mutation are the preferred technique to solve the optimization problem using survival for the fittest idea. The implementation can solve the travelling salesman problem up to 29 cities in < 2 minutes on a standard testbed with 8 GB of RAM. For our experimental investigation, result have shown that genetic algorithm leads to a good optimization as high as 70 percent even with less population in consideration.

Keywords

Travelling Salesman Problem, Genetic Algorithms, Path Representation, Optimization.

1. Chapter 1: THE TRAVEL SALESMAN PROBLEM

1.1 Introduction

Travelling salesman problem is classical combinatorial optimisation problems. This program requires colossal amount of system resources to be solved efficiently, as when the size of problem increases the solution space also increases exponentially. The problem objective is to find the shortest route for the travelling salesman who, starting from his home city must visit every city given on list precisely once and then return to his home city. The city visit ends at back at the starting city, this problem is known as NP-hard as it cannot be solved in polynomial time [1] [2]. The main difficulty is the immense number of possible tours for n cities: $(n\text{-}1)!\ /2$ [3]

Travelling salesman problem is relatively an old problem the idea of this problem introduced as early as 1759 by Euler like TSP where a knight visits each square of chessboard exactly once in his tour. Although the term '*travelling salesman*' coined in early 1930's in a German book written by a travelling salesman [3].

Over the years TSP has occupied the interest of numerous researchers. The reason for this is the lack of polynomial time algorithm to resolve the problem Although there are

several techniques available to solve the travelling salesman problem [4], [5] but these techniques are not optimized. TSP is applicable on variety of routing and scheduling problems [6]. Multiple heuristic approach has been developed to solve TSP as described in [7]. Using genetic algorithm the first researcher to tackle the travelling salesman problem was Brady [8]

In recent years numerous papers has been published on the optimization of NP-hard problem in different application domain such as computer science, biology, telecommunication. The search problem using genetic algorithm was introduced by Holland in 1975 [9]. Space search problem are represented as '*individuals*' which are represented by character of strings referred as '*chromosomes'*

```
BEGIN AGA
        Make initial population at random.
        WHILE NOT stop DO
                BEGIN
                        Select parents from the population.
                        Produce children from the selected parents.
                        Mutate the individuals.
                        Extend the population adding the children to it.
                        Reduce the extend population.
                END
        Output the best individual found.
END AGA
```

Figure 1. The pseudo-code of the Abstract Genetic Algorithm (AGA) [3].