WRITING ASSIGNMENT 2

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1 Problem description

This paper is presenting several algorithms that are intended to find a solution to the classical Salesman problem. The goal of comparing several algorithms is to find the best way pros and cons for each algorithm and ultimately finding an optimal or near optimal solution to the Salesman problem.

In order to find a solution to Salesman problem, an efficient and fast search techniques needed to be formulated and developed to specifically solve such a problem where it is simply impossible for sequential processing computer to go over all of the permutation results of all the nodes. For instance, trying to find an optimal path for an instance with 85,900 nodes would take over 136 CPU-years [1].

2 Summary and Analysis

The first algorithmic candidate to solve the TSP is genetic algorithm (GA). The basic functionally of genetic algorithm can be sum in two operations. The first process is the selection of individuals to be moved to the next generation. The second process is manipulation the selected individuals to form the next generation by crossover and mutation techniques As the authors indicates in the paper "the selection mechanism determines which individuals are chosen for mating (reproduction) and how many offspring each selected individual produces" [4]. This means that the main principle of this algorithm is the better an individual; the higher is its chance of being parent. Making the produce of each new generation be better than its successor. In this algorithm, it's important to balance between exploration and

exploration within the mechanism of the selection. In solving TSP, The GA algorithm start set initial random cities and then evaluate how fit each city current set of cities. Followed by selecting parent cities for next generation and cross over these parents' cities to create new set of cities. Evaluate the fitness of search city and then decide if it is the optimal or near optimal path. If it is then terminating the algorithm and if it's not, then keep producing new generation of cities. The downside of GA algorithm is that it takes a lot of time to reach a to a good-enough result. As well as it does not produce an optimal solution for TSP because the fact it's randomness nature in moving from on generation to another.

Another algorithmic to solve TSP is lin-kernighan algorithm (LH). This algorism starts by having a set of cites described in paper [2] by a tour. LH algorithm refining the path that links cities by swapping pairs of sub-tours of cities to make a new tour and thus getting closer to the optimal solution each time. It works by switching two or three cities to make the tour shorter. With each step, LH decides how many paths between cities need to be switched to find a shorter tour. It keeps refining and switching between two/three cites until there is no further improvement that can be made to any of the cities. By then, it can be concluded that LH algorithm have reached an optimal solution. LH algorithm is the best out of the three algorithms presented in this paper. Because the fact it's relatively fast in reaching to a result. Also, usually the results produced by this algorithm are usually optimal. The only downside is that it requires some sort of symmetry to the problem.

The last algorithm presented in solving TSP is African Buffalo Optimization Algorithm (ABO). First of all, the authors of this paper [3] have chosen to represent population-based stochastic optimization technique as African buffalos as the ABO algorithm was inspiration from their behavior. ABO start choosing a start city for each of the buffalos and randomly locate them in those cities. Then it Updates the buffalo fitness by updating their locations as they follow the current best path with the shortest heuristic value. The determine the local minimal path and compare it to the overall minimal path. Using heuristic to construct new path by adding cities that the buffalos have not visited. Repeats this process until the local path cannot be minimized further. Once reaching the minimal local path the algorithm spits out the results. The only downside for ABO algorithm is that it takes an exponential time to reach to the solution. This is due to the repetitiveness of updating the path for each node each time something changes.

References

[1] K. K. Burusco Goñi. *Methodological approach to conformational search a study case: cyclodextrins*. Universitat Autònoma de Barcelona,, 2009.

[2] K. Helsgaun. An effective implementation of the lin–kernighan traveling salesman heuristic. *European Journal of Operational Research*, 126(1):106–130, 2000.

[3] J. B. Odili and M. N. Mohmad Kahar. Solving the traveling salesman's problem using the african buffalo optimization. *Computational intelligence and neuroscience*, 2016:3, 2016.

[4] N. M. Razali, J. Geraghty, et al. Genetic algorithm performance with different selection strategies in solving tsp. In *Proceedings of the world congress on engineering*, volume 2, pages 1–6. International Association of Engineers Hong Kong, 2011.