Route Optimization of Alternative Fuel Vehicles in Logistics Operations

- STUDENTS / UNIVERSITIES
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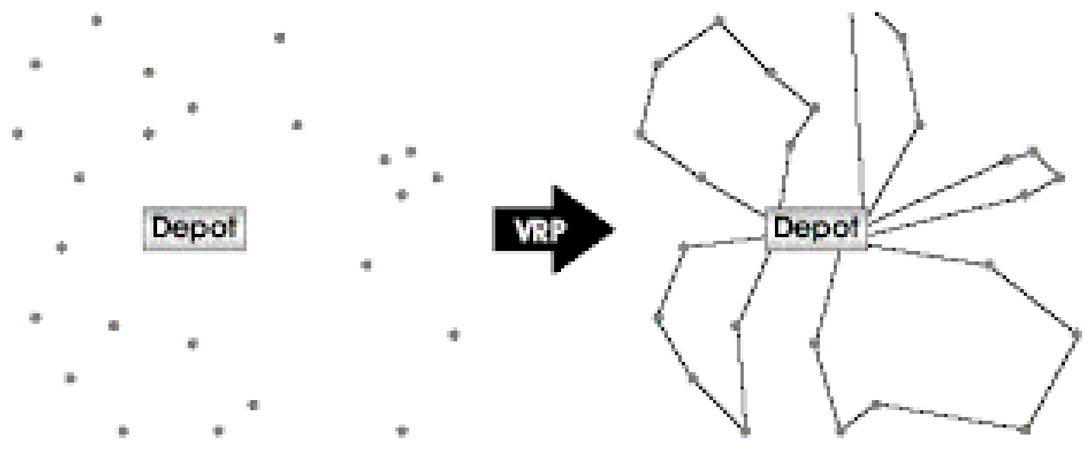
ABSTRACT

The research that has been conducted for the past weeks was to come up with a solution to an alternative fuel vehicle routing problem. The problem at hand has 3 different kind of locations: depot, stations and customers. We are to satisfy the demand of each customer in one visit. Vehicles that are at hand are using alternative fuel and fuel of each vehicle is limited. Moreover, there is a time limitation for each driver. Throughout the research the nearest neighbourhood algorithm was chosen as the constructive algorithm to create an initial feasible solution. This algorithm is used on different datasets in order to come up with different results. Furthermore, an improvement algorithm is used as well to reduce the total distance that has been travelled to fulfill the demands. The improvement algorithm that has been used was swap.

OBJECTIVES

- To create an algorithm in order to come up with an initial feasible solution for an alternative fuel vehicle routing problem
- To improve the result with further iterations and improvement algorithms.

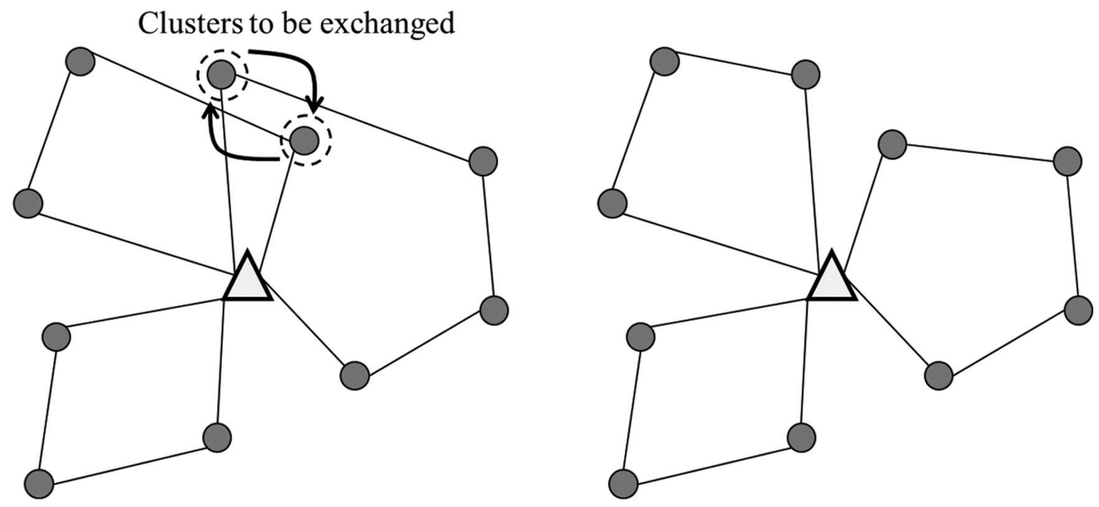
PROJECT DETAILS



The initial step for the research to start is literature review. The research that was conducted included several articles. To fully understand what was the problem framing I looked through various articles that are similar to this case. There were few constructive algorithms that are being used in the literature. Nearest neighbourhood algorithm suited my needs the best considering the limited amount of time that I had . Nearest neighbourhood algorithm was the simplest and fastest working amongst these articles. It also had the most iteration-wise approach thus it was easier to track. However its nature is not to consider multiple moves ahead, thus it cannot promise the best result at all times. It works quite simply:

- It calculates the distances between every location given by the data set.
- Compares the distances between the current location and every possible location that can be the next station and chooses the smallest distance.

PROJECT DETAILS 2



- Continues in this trend until every customer has been visited.
- Keeps track of time and fuel spent so it can deploy new vehicles.

On top of nearest neigbourhood algorithm, a swap operation was also implemented to further improve the result. This local search logic works as follows:

- Identifies routes of every vehicle and assignes routes and vehicles.
- Swaps customers in a vehicles route to find out if there can be an improvement in the distance travelled by that vehicle.

It is also really important to make sure that depot is the first and last place that a vehicle goes during the swap operation since this is a binding constraint.

There were many improvement algorithms that was offered in the literature such as 2-opt and relocation; however my work was limited up to this point as I was trying to establish the relocations algorithm as well.

CONCLUSIONS

The algorithms that were implemented actually created results that were promising. However, the results with or without improvement algorithm were less preferable than the optimal solution that were created by optimization software. This means that with more iterations,time and algorithm work, the result that we currently have can be further improved.

Data Sample	Article Solution	NNA Solution	Swap Solution
20c3sU2	1614.15	3026.3	2710.16
20c3sU4	1513.45	2517.7	2297.3
20c3sU8	1766.36	4006.6	3078.3

REFERENCES

- Erdoğan, S., & Miller-Hooks, E. (2012). A Green Vehicle Routing Problem. *Transportation Research Part E: Logistics and Transportation Review, 48*(1), 100-114. doi:10.1016/j.tre.2011.08.001
- Golden, B. L., Raghavan, S., & Wasil, E. A. (2011). *The vehicle routing problem: Latest advances and new challenges*. New York: Springer.