**Logistic Delivery Optimization**

**Background**

To become a good or efficient logistics manager, it requires significant experience and the consideration of various factors such as time, fuel prices, traffic, availability of manpower, and more. In this project, the scope is limited to simplify the complexity by focusing on key factors like distance, cost, capacity, and vehicle. Furthermore, additional constrains to be consider are the routing must only be visited once, and the demand should not exceed maximum capacity which will depend on the number of vehicles used as well as type. Typically, this is a minimization optimization or in other word to operate at optimal condition using least resources.

**Tackling Problem**

One of the simplest approaches in tackling this problem is dividing the problem or objective function separately from the optimization algorithm. Why separate? So that it is easier to test multiple type of optimization algorithms which in this project, Grey Wolf Optimizer was proposed as the benchmark optimizer. In addition, by separating, it is easier to implement different type of objective function either by swapping point, 2-Opt approach (used in this project) or greedy approach. Furthermore, the simplistic approach of implementing GWO to only optimized one factor (actual cost) based on multiple input are the key idea for this project.

**Results**

Since the project is rather small, not all algorithms were tested, only GWO was used. The essence of this project is to demonstrate its scalability in term of implementation and further development in case of introducing new objective functions as well as algorithms. While there are several experiments conducted, the highlight of the results is shown below. Do note that the results are purposely run on a small-scale parameter.

1. Best Optimization

|  |  |  |
| --- | --- | --- |
| Actual Cost | : | RM 1282.9777968974718 |
| Best Route | : | D0 -> C3 -> C4 -> C1 -> C8 -> C2 -> C5 -> C6 -> C7 -> C10 -> C9 -> D0 |
| Round Trip Distance | : | 116.33465396307635 km |
| Vehicle Choosen | : | Type B |

Table 1

Based on the table 1, the results for the GWO best score or least actual cost (round trip distance \* vehicle type cost \* number of vehicles) were presented. The GWO hyper-parameter used during this computational were 50 search agent, 100 iteration and using 2-Opt approach for producing the next sample generation.

1. Worst Optimization

|  |  |  |
| --- | --- | --- |
| Actual Cost | : | RM 1598.0162890055203 |
| Best Route | : | D0 -> C1 -> C2 -> C3 -> C4 -> C5 -> C6 -> C7 -> C8 -> C9 -> C10 -> D0 |
| Round Trip Distance | : | 90.03130056469814 km |
| Vehicle Choosen | : | Type A |

Table 2

Based on table 2, the results for the GWO worst score were presented as RM 1598.02. Furthermore, it takes shorter route compared to the best optimization score. In addition, the hyper-parameters used during this experiment is the same as the best optimization experiment.

**Conclusion**

While this approach was successfully implemented for logistic delivery optimization, some limitations need to be addressed. First of all, the implementation of GWO in optimizing the logistic delivery was purposely delivered in a small-scale manner such as low hyper-parameter setting of search agents and iteration. Furthermore, only the 2-Opt approach in producing new neighbour was explored during this limited amount of experimentation. Finally, based on small differences between best optimization and worst optimization, it is clear that the standard GWO with 2-Opt objective function is unlikely suitable for this problem. Therefore, a new approach such as modification of GWO with Simulated annealing (SA) needs to be explored or a new objective function such as Greedy approach needs to be introduced.