

# Fakulti Sains Komputer Dan Matematik

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VEHICLE ROUTING PROBLEM WITH PICK-UP AND DELIVERY  
USING GENETIC ALGORITHM

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## ABSTRACT

The Vehicle Routing Problem with Pickup and Delivery is a logistics problem where both pickup and delivery of goods is done simultaneously. The constraint for the problem is that it must start and end at the depot while capacity when reaching nodes must not exceed the capacity of the vehicle. The objective of solving this problem is to find the optimal solution which then will reduce the cost for the route taken by the vehicle. Since the traditional approach of solving this problem, which is the exact solution, will consume a lot of time, Genetic Algorithm is proposed. Another focus we will be looking at is the effect of changing the operator used, where we will create two GA models where each model consists of only one operator to differentiate which model provides a better solution. Our findings show that GA with a mutation operator is better at solving the problem compared to crossover operator because it provides a smaller total distance within a given iteration while GA with a crossover operator does not have any change at all until the iteration stops. The most optimal solution for the data used is 233641.009 calculated using a software that uses the Ruin and Recreate principle. By the end of the study, both objectives are satisfied.

# 1 INTRODUCTION

## 1.1 Background of Study

The impact of logistics has grown in recent decades due to increased transportation costs where a certain sector is cost-cutting for more profit and the demand for goods to reach the market as quickly as feasible. The vehicle routing issue is a difficulty in logistics management. The vehicle routing problem (VRP) is a general name involving problems with customer visiting by vehicles. VRP is known for designing routes for delivery to customers where the main solution is to get minimal cost while also satisfying a certain demand by Sharma et al. (2018). According to Goetschalckx (2011), VRP can be defined as a decision-making problem in finding the shortest path of a vehicle that satisfies the condition of starting from one depot to one or more destinations with various addresses based on the types of customer needs. Jayarathna et al. (2019), also explained VRP as issues of figuring the minimal cost of delivery paths from a depot to client's location in addition to different constraints. Both definitions share the same meaning and condition where a vehicle must start at a depot meant for organizing goods for delivery. The focus of VRP is to find the optimal route where every customer needs are satisfied with the most minimal cost since the total distance traveled by all vehicles is proportional to the cost Purnamasari & Santoso (2018). To put it simply, shorter routes are equivalent to a lower cost.

VRP varies from school bus problem to the dispatching vehicle with the task of picking up or dropping off goods to customer or supplier with many different approaches and it is the most important part which is routing especially in logistics Sadat Hosseini Khajouei & Pilevari (2021). VRP's resolution considers the easiest assignment of the customers to the vehicles and the route order through which they travel along to serve the customers in order to minimize the overall distance of the whole journey. As more research of VRP was conducted, there exists