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Optimization of The Smallest Road Using The Traveling Salesman Problem (TSP) Method

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Abstract

Optimization is the process of obtaining a minimum (small) or maximum (largest) value in an opportunity function. One case that uses the optimization function is the Traveling Salesman Problem (TSP). The case study problem in this research is to find the shortest route to a destination city in order to get a short time to get to that city and save time and costs on the way. The completion of the search for the shortest route uses the TSP concept. Basic concepts in running CSR 1. The journey starts and ends in the same city as the origin city of the salesperson. 2. Entire cities must be visited without missing a single city.3. Sales are not allowed to return to the city of origin before all cities have been visited. By using this method, the distance between each city will be analyzed. The cities that the salesman will go to consist of 4 cities A, B, C and D with a combination process obtained as many as 24 lanes that can be passed by the salesman. From each route taken by the salesman, there are 2 shortest paths that can be used as alternatives, including the CABD=17+15+19=51 route and the DBAC=19+15+17=51 route. The final results of this study can be used as a reference in determining the shortest route by salesmen with a distance value of 15.

Keywords: *Optimization,Travel,Shortest Route,Traveling Salesman Problem*

1. Introduction

In principle, the mathematical optimization theory consists of three approaches, namely classical methods, evolutionary algorithms, and hybrid methods. The optimization problem basically determines the various variable values of a function to be maximum or minimum by taking into account the existing limitations. One form of optimization concept that continues to develop is combinatorial optimization. This optimization refers to a particular optimization case that organizes all possible and feasible solutions in discrete form [9]. One type of combinatorial optimization that is often discussed is TSP. The optimization process in TSP is to find a salesman's travel route starting from one initial location to several predetermined locations, then returning to the original location in such a way that the total distance traveled is minimum and each city is visited exactly once [1]. The Traveling Salesman Problem (TSP) is known as one of the optimization problems that has attracted the attention of researchers for decades. The Traveling Salesman Problem (TSP) is one of the most well-known problems in graph theory. The name of this problem was inspired by the problem of a merchant traveling around several cities. The description of the problem is as follows: given a number of cities and the distance between cities. Determine the shortest circuit that must be traversed by a trader if the trader departs from a city of origin and stops each city exactly once and returns to the city of origin of departure. The problem of merchant travel is to determine the Hamilton cycle which has the minimum weight on a connected graph (Wicaksana et al., 2014).3 Most TSPs are symmetric, which means that for two cities A and B, the distance from city A to city B is the same. with the distance from city B to city A. in this case, we will get the exact same length of the round trip if we reverse the circuit of the trip. Otherwise there is no difference between a round trip and the other way around. In this TSP problem, if

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each vertex has an edge to another vertex, then the graph that represents it is a weighted complete graph[2]. According to research [3], the definition of the Traveling Salesman Problem is the problem of finding the minimum tour cost from a group of cities, where each city is only visited once (Pesant, 1998). In the Traveling Salesman Problem relates to the total travel distance (total distance of the intended tourist destination). The Traveling Salesman Problem has a minimum side weight, where the side weight is the distance by determining the shortest distance. In this study, the concept of the Traveling Salesman Problem assumes that every tourist starts and ends his or her travels from the hotel where they stay. Every tourist destination only visited once per packet. In the process of finding a route, you must first know the distance between tourist destinations.

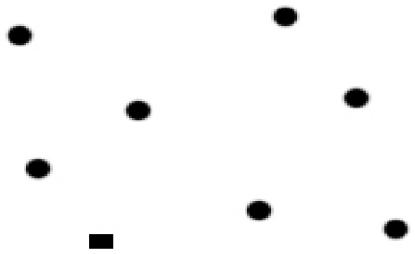


Figure 1. Points of tourist destinations that will be passed

Tourist destinations are known, then the shortest route can be searched by trying all combinations and adding up the distances from these combinations so that the route is obtained as shown in Figure 2.

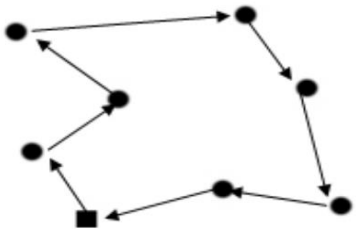


Figure 2. The shortest route for tourist destinations obtained

Traveling Salesman Problem can be solved using several methods, for example branch and bound, nearest neighbor and other methods. The research was conducted using the branch and bound and nearest neighbor methods with the help of WinQSB software to solve the traveling salesman problem case in order to minimize distance by saving distance [4].The main purpose of TSP is to find the minimum length of the Hamiltonian circuit of a graph, Hamiltonian circuit is the shortest distance to go through each node exactly n times[5]. Many studies use the TSP method, including Optimization of Multiple Traveling Salesman Problems (M-Tsp) in Determining the Optimal Route for Picking Up Traveling Passengers Using Genetic Algorithms[6], Solving Traveling Salesman Problems With Self Organizing Neural Networks[7]. One case that is often used in AI terminology is the Traveling Salesman Problem (TSP).In this case, it is analogous to a salesman who wants to visit a number of cities. The solution is in the form of the shortest route of all the routes between these cities with the rule that each city can only be passed once[8]. Based on [9], TSP is said to be of 2 types, namely:

1.TSP asymmetric
2.TSP symmetric

Determination of mileage using the Traveling Salesman Problem (TSP) method, the solution is using the heuristic method, the results are almost optimal.The simplest method

of the heuristic approach, with the approach of the nearest city that has not been visited, the procedure is:

a) By looking at the distribution network map which has the shortest distance entered into the table.
b) Based on the data table in the form of a matrix processed using the TSP method with a heuristic approach with

the following steps:

a) Step 1By looking at the horizontal row in the table to find the shortest distance from the source.
b) Step 2 By looking vertically at the point in step 1 find the shortest distance.
c) Step 3 Repeat steps 1 and 2, until all the cities are passed. Then choose a solution by seeing which one has the shortest distance from the source. Then if there are paths that have the same value choose one [10].

2. Research Methodology

Research Methodology is a path in determining the research to be carried out. Methodology must be done systematically and conceptually. The steps in solving the Traveling Salesman Problem case are as follows:

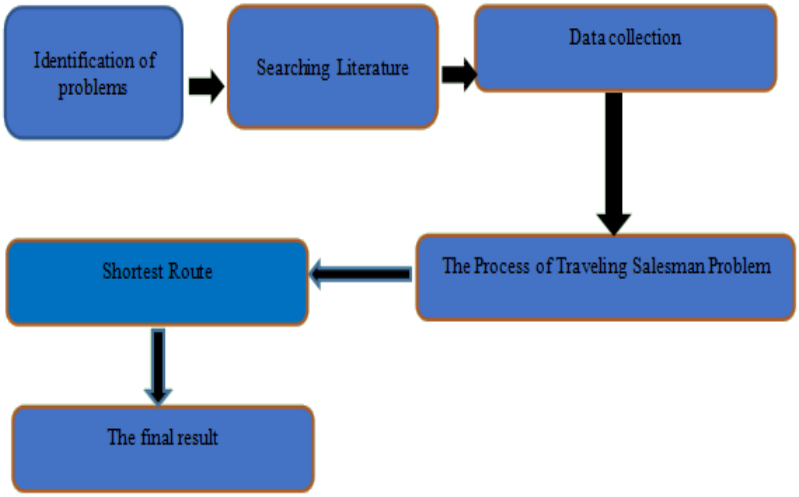


Figure 3. Framework

3. Results and Discussion

If a problem has been defined for determining the smallest route in the concept of traveling salesman, the problem is as follows: a route that the sales person can take which must pass through every correct marketing office. There are 4 offices, with a distance of each city

1. AB = 15 KM
2. AC=17 KM
3. AD=20 KM
4. BC=18 KM
5. BD=19 KM
6. CB=22 KM

The goal is to find the shortest distance for sales to visit all Marketing Offices once. The solution using generate-test is to generate possible solutions according to the problems faced by the salesperson. Alphabet combinations as possible solutions are n! = 4! = 24. The goal is to find a solution for the shortest route. The route is said to be valid if the path

traversed is not 0. If the route is valid, then the distance is calculated and then compared to get a very optimal distance.

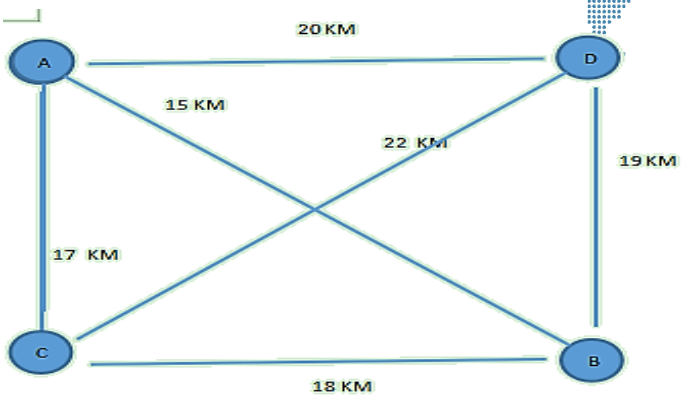


Figure 4. Distance Route Flow

This route consists of 4 cities, namely A, D, C, and D, using the Vaktorial concept. Each city gets 6 combinations, because 4 cities get a value of 24. The form of the route to be taken can be seen in the image below:

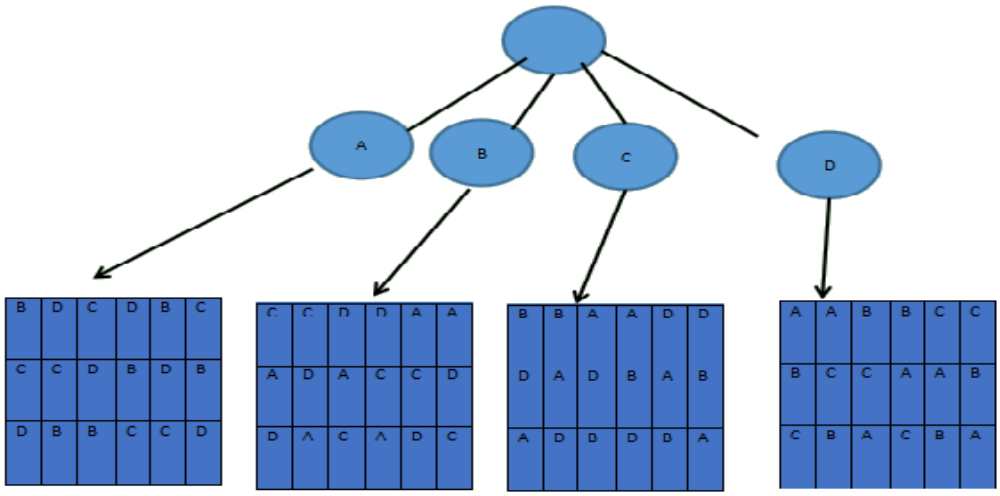


Figure 5. Combination of 24 . Routes

After looking for the combination value of 24, the next step is to calculate all the distance values that will be covered by the salesman. The function of the calculation of this distance as information by the slesman to choose the smallest path to be traversed to save time. The process can be seen in the table below:

Table 1. Distance calculation process

Number	Route Line	Route Length	Preferred Track	Route Length
1	ABCD	15+18+22=55	55	55
2	ADCB	20+22+18=60	55	55
3	ACBD	17+22+19=58	55	55
4	ADBC	20+19+18=57	55	55
5	ABDC	15+19+22=56	55	55
6	ACBD	17+18+19=54	54	54

Number	Route Line	Route Length	Preferred Track	Route Length
7	BCAD	18+17+20=55	54	54
8	BCDA	18+22+20=60	54	54
9	BDAC	19+20+17=56	54	54
10	BDCA	19+22+17=58	54	54
11	BACD	15+17+22=54	54	54
12	BADC	15+20+22=57	54	54
13	CBDA	18+19+20=57	54	54
14	CBAD	18+15+20=53	53	53
15	CADB	17+19+20=56	53	53
16	CABD	17+15+20=51	51	51
17	CDAB	22+20+15=57	51	51
18	CDBA	22+19+15=56	51	51
19	DABC	20+15+18=53	51	51
20	DACB	20+17+18=55	51	51
21	DBCA	19+18+17=54	51	51
22	DBAC	19+15+17=51	51	51
23	DCAB	22+17+15=54	51	51
24	DCBA	22+18+15=55	51	51

From the picture above, it can be seen that the shortest route is 51 KM on routes 16 and 22. The selected route is the smallest route to be taken. The process of combining route numbers 16 and 22 are:

a) CABD=17+15+19= 51

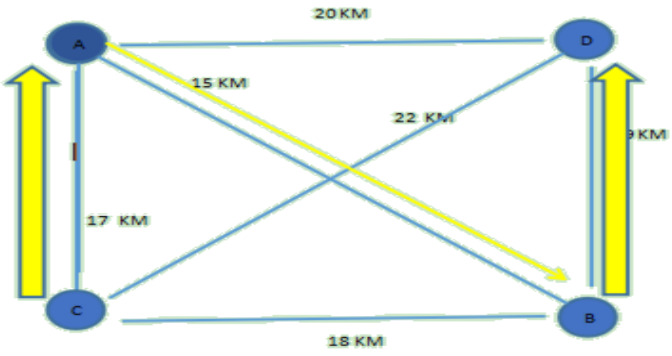


Figure 6. The first route

b) DBAC=19+15+17=51

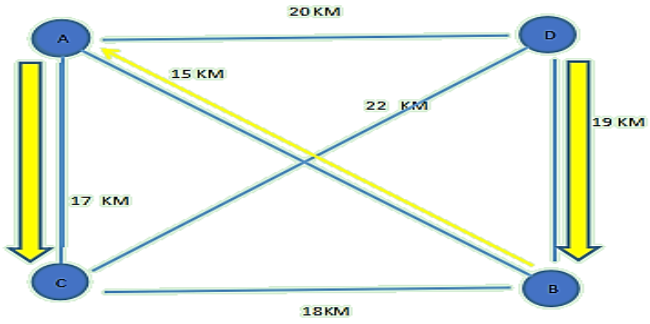
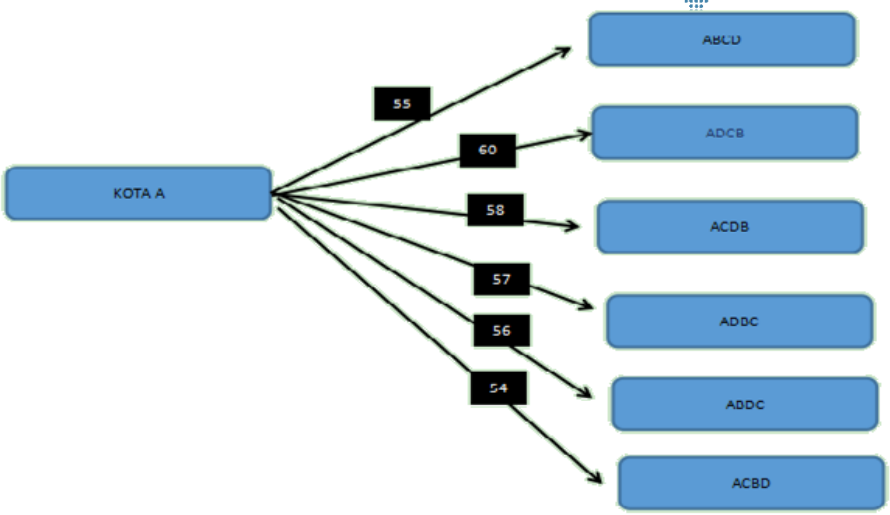


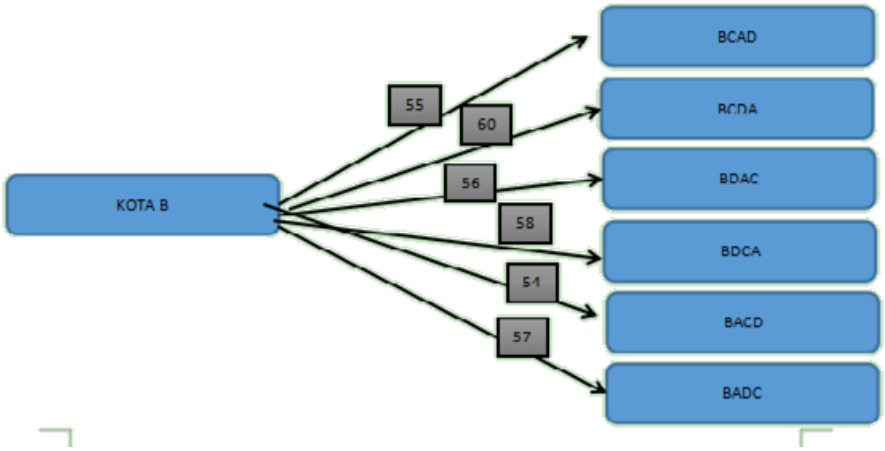
Figure 7. Second Route

Below will be shown each City Route that will be passed by the Salesman to find the nearest net to be selected:

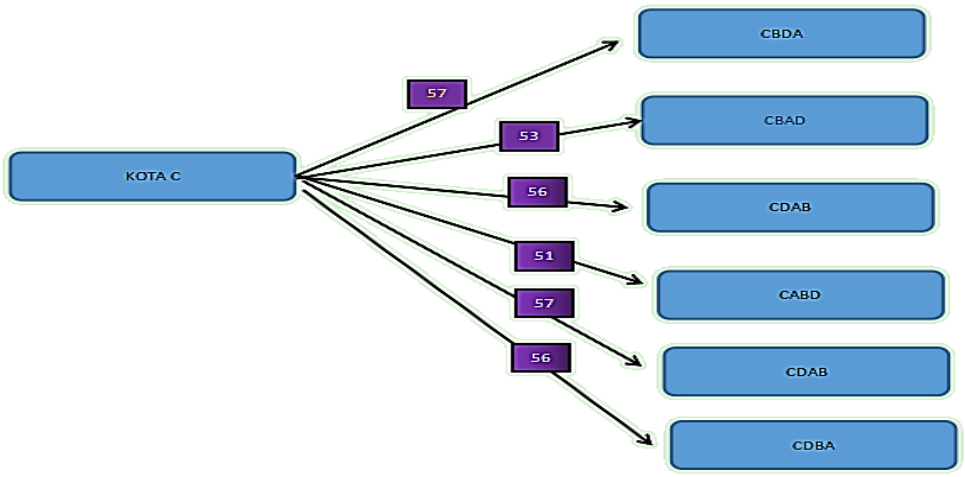
1) City A



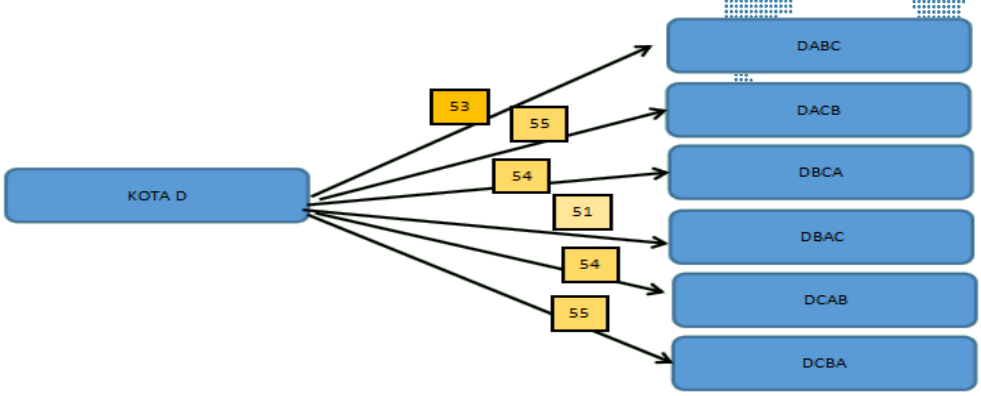
2) City B



3) City C



4) City D



The analysis carried out obtained 24 paths that can be taken with each different value. After adding up the overall results, various results are obtained, the first route, the second route, when they have different values. The selected value and can be used as a reference for salesmen in making decisions in determining the smallest route, so as to save travel costs and mileage time to be passed.

4. Conclusion

Based on the research that has been carried out to completion, it can be concluded that the Traveling Salesman Problem is able to solve the search for the shortest route to a city with the rule that it can only pass 1 time at that location. The paths obtained are 24 combinations, of which the smallest value is obtained at 51 km on the route CABD=17+15+19=51 and DBAC=19+15+17=51. The Traveling Salesman Problem method can be used as a decision-making system for determining the closest distance route, thus being able to minimize the time and cost of traveling to get to the final destination to be taken.

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