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Depth First Search Algorithm In Solving the Shortest Route Using the Concept of Generate and Test

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Abstract

Depth First Search Algorithm is a search process to find the right solution that requires short memory and time in finding the Goal. The problem in this research is the difficulty of salesmen to find alternative short routes to arrive at the final node as consideration for finding solutions. The purpose of this study is to find the shortest path so that salesmen can easily and quickly get to the final solution by saving time and mileage. The Generate And Test concept consists of combining the Depth first search algorithm with the backward tracking process. All processes must be completed before the testing process is carried out. If the General And Test process is carried out sequentially or systematically, it will get the best value in finding a solution, the weakness if the search process is large or extensive then the search process takes a very long time. How it works Generatr and test, namely 1. Generate possible solutions in the form of state states with the concept of a one-position path to the destination path. 2. Test, select whether the solution can be accepted according to the existing criteria 3. If the solution has got the Goal then the search is stopped, if not then the process is continued until finding a solution. The final result of testing the shortest route is A-B-E-J-P-S-U = 25+21+24+24+17+18=129

Keywords*; Algorithm Depth First, Searching, Distance, Time, Generate and Test.*

1. Introduction

Artificial intelligence (AI) is a challenging and creative field [1]. One example of the fastest route finding is the selection of the route chosen by the delivery driver to arrive at the destination on time. Each delivery destination must be visited once, then return to the initial place [1]. [2] A common problem that often arises and is solved by graph theory is the Shortest Path Problem/SPP with the solution finding the shortest path through the destination points to be determined. The shortest path and time dependent vehicle routes rely on realistic and reasonable test data for demonstration and performance evaluation. The problem of finding the minimum distance in a closed loop against various parameters without having to go to the same place more than once. Later the results obtained from determining the closest distance that has been weighted will be a reference in determining which path will be chosen to be passed.

The DFS algorithm was first introduced by Tarjan and Hopcroft. One of the most basic problemsin graph theory is a search problem. One of the simplest algorithms to solve this problem is the DFS algorithm. In finding the DFS algorithm, an adjacency matrix is used. The adjacency matrix is a matrix that connects vertices with vertices with a certain value on a graph [3]. The DFS algorithm is an algorithm that performs a search withvisit recursively. The procedure of the DFS algorithm can be described as follows. a) The transversal starts from vertex v, b) Visits vertex v, c) Visits vertex w that is adjacent to v, d) Repeats DFS starting from vertex w, e) When it reaches vertex u such that all neighboring vertices havevisited, the search is backtracked to the last previously visited node and has an unvisited node w, f) The search ends when there are no more unvisited nodes that can be reached from the visited node dikunjung [4].

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Depth First Search (DFS) is a vertex search algorithm in an inward-running graph. In the search with the Depth First Search algorithm, the search starts from the very first level (level 0)then proceed to the leftmost child at the next level (level 1) and so on until there are no more children or a deeper level. If the search has reached the node or child at mostInside, backtracking will be carried out to search for the next child node [5].

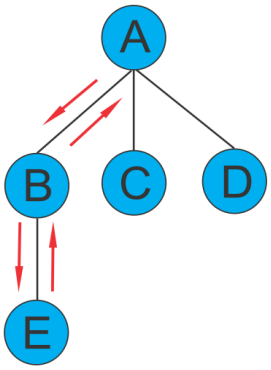


Figure 1. Example of implementing DFS on a tree diagram

Depth First Search Also has advantages such as quickly reaching the depth of the search space. If it is known that the path to the solution of the problem will be long then Depth First Search will not waste time doing a large number of shallow states in the problem graph. Depth First Search is much more efficient for search space with multiple branches because it doesn't need to execute all nodes at a certain level in the open list. In addition, Depth First Search requires relatively small memory because only many nodes on the active path are stored. In addition to the advantages, Depth First Search also has weaknesses, including the possibility of not finding the expected destination and will only get one solution on every search [6]. In Figure 1 there are seven cities that will be traverse by the seller and one point is defined as the starting route and the final route of the trip. To find the shortest distance route, you must first know the distance of each point [7].

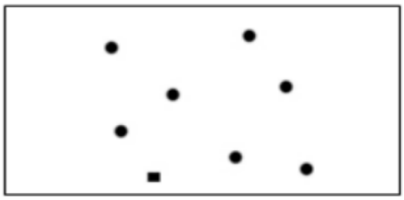


Figure 2. City points that are crossed

Generate and Test method is a method of several heuristic search concepts. According toKusumadewi (2003), in principle this method is a combination of depth-first searchwith backtracking, which is moving backwards towards a situationbeginning. The test value is in the form of 'yes' or 'no' answers. The algorithm of this Generate and Test methodis:

a) Generate a possible solution (generate a certain point or a certain path from the initial state).
b) Test to see if the node is really the solution by comparing the node or the end node of a selected path withexpected set of goals [8].

Vertex is a point or node that shows a place that is used as a goal or destination, a start or a start, or a place that will be passed on a journey. Edge isconnecting line between vertices. An undirected graph is a graph that does nothas a direction and arrows so that it can be traversed by two opposite directions. A directed graph is a graph that has a direction and usuallyindicated by an arrow with one end called tail and head(head). A directed graph cannot be passed in two different directions. A weighted graph isa graph that has a weight or value at each edge and can be either a directed graph or a graphwhich

is undirected. Path (path) is a path that passes through vertices and edges where vertices cannot be passed more than once [9].

2. Research Methodology

Research Methodology is very important in completing a research. To obtain a good solution for the Depth First Search algorithm, the steps that must be carried out are:

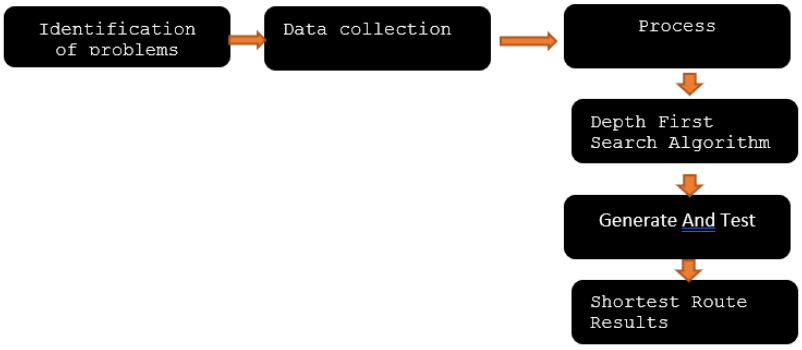


Figure 3. Research Methodology

3. Results and Discussion

General And Test is part of the simplest algorithm in the search process. The working principle of the General And Test algorithm consists of combining the Depth first search algorithm with the backward tracking process. All processes must be completed before the testing process is carried out. If the General And Test process is carried out sequentially or systematically, it will get the best value in finding a solution, the weakness if the search process is large or extensive then the search process takes a very long time. To obtain a good solution, a search process is needed including:

a) Generate possible solutions in the form of state states with the concept of a one-position path to a destination path.
b) Test, select whether the solution can be accepted according to the existing criteria
c) If the solution has got the Goal then the search is stopped, if not then the process is continued until it finds a solution.

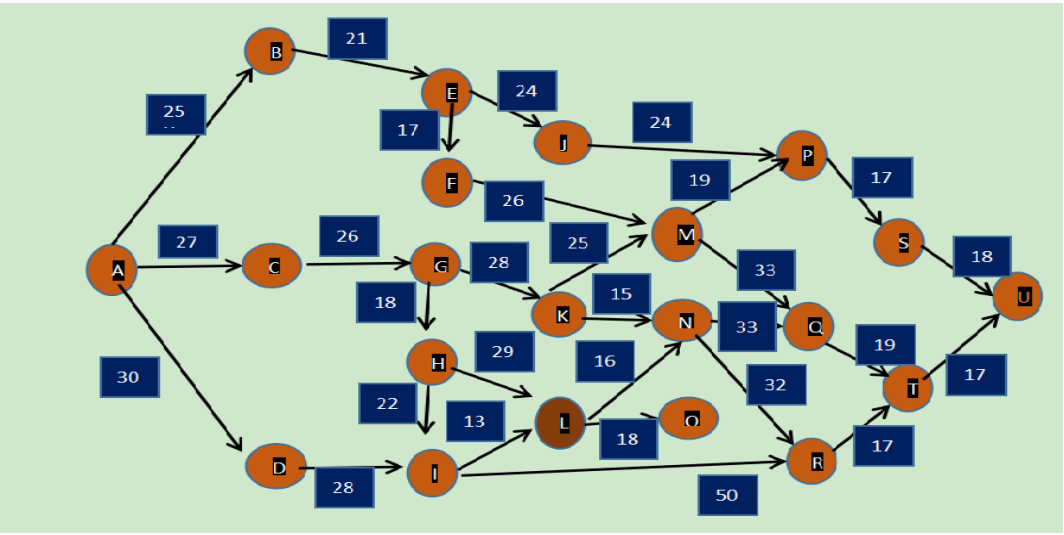


Figure 4. Travel Route Data

In the picture above, it is known that there are 21 city points that will be visited by Cigarette Salesmen including cities A, B, C, D, C, E, F, G, H, I, J, K, L, M, N, O, P, Q , R, S, T, U with each distance can be seen in the picture above. The arrow is a sign of direction that can be passed by the cigarette salesman. In this case the salesman wants to send cigarettes to City U. To save time and costs, the cigarette salesman must find the smallest distance and the fastest time to get to Line U.

Is known
Initial State = A
Final solution =U
The solution to be processed is a solution that begins with path A to path Z with the concept of the Dept First Search Algorithm. Saving costs and time if you get the shortest or smallest value, then the selected criteria are the criteria that get the smallest value, the use of this concept uses a heuristic function system as a guide.

a) Path to 1
   Perform test by generating solution (A-B-E-J-P-S-U)
   f(A-B-E-J-P-S-U)=25+21+24+24+17+18=129
Test the criteria used
Because the path (A-B-E-J-P-S-U) is the initial solution used, it is used as a temporary solution f(A-B-E-J-P-S-U)=129

b) Path to 2
   Perform the test by generating the solution A-B-E-F-M-P-S-U=
   f(A-B-E-F-M-P-S-U= 25+21+17+26+19+17+18=143
Test the criteria used
Because A-B-E-F-M-P-S-U >A-B-E-J-P-S-U, the temporary solution used is A-B-E-J-P-S-U=129

c) Path to 3
   Perform the test by generating the solution A-B-E-F-M-Q-T-U=
   f(A-B-E-F-M-Q-T-U= 25+21+17+26+33+19+17=158
Test the criteria used
Because A-B-E-F-M-Q-T-U>A-B-E-J-P-S-U, the temporary solution used is A-B-E-J-P-S-U=129

d) Path to 4
   Perform the test by generating the solution A-B-E-F-M-P-S-U=
   f(A-C-G-K-N-Q-T-U=27+26+28+15+33+19+17=165
Test the criteria used
Because A-B-E-F-M-P-S-U>A-B-E-J-P-S-U, the temporary solution used is A-B-E-J-P-S-U=129

e) Path to 5
   Perform test by generating solution (A-C-G-K-M-P-S-U)
   f(A-C-G-K-M-P-S-U=27+26+28+25+19+17+18=160
Test the criteria used
Because A-B-E-F-M-Q-T-U>A-C-G-K-M-P-S-U, the temporary solution used is A-B-E-J-P-S-U=129

f) Path to 6
   Do the test by generating solution A-C-G-K-M-Q-T-U
   f(A-C-G-K-M-Q-T-U=27+29+28+33+19+17)=153
Test the criteria used

Because A-C-G-K-M-Q-T-U>A-B-E-J-P-S-U, the temporary solution used is A-B-E-J-P-S-U=129

g) Path to7
Perform test by generating solution (A-C-G-K-N-R-T-U)
f(A-C-G-K-N-R-T-U=26+27+28+15+32+17+17)=162
Test the criteria used
Because A-C-G-K-N-R-T-U>A-B-E-J-P-S-U, the temporary solution used is A-B-E-J-P-S-U=129

h) Path to 8
Do the test by generating solution A-C-G-H-L-N-Q-T-U
f(A-C-G-H-L-N-Q-T-U=27+26+18+15+33+19+17=155
Test the criteria used
Because A-C-G-H-L-N-Q-T-U>A-B-E-J-P-S-U, the temporary solution used is A-B-E-J-P-S-U=129

i) Path to 9
Do the test by generating solution A-C-G-H-L-N-Q-T-U
f(A-C-G-H-L-N-Q-T-U=27+26+18+15+33+19+17=152
Test the criteria used
Because A-C-G-H-L-N-Q-T-U>A-B-E-J-P-S-U, the temporary solution used is A-B-E-J-P-S-U=129

j) Path to 10
Do the test by generating solution A-C-G-H-L-N-R-T-U
f= A-C-G-H-L-N-R-T-U=27+26+18+15+32+17+17=177
Test the criteria used
Because A-C-G-H-L-N-R-T-U>A-B-E-J-P-S-U, the temporary solution used is A-B-E-J-P-S-U=129

k) Path to 11
Do the test by generating solution A-D-I-R-T-U
f=A-D-I-R-T-U=30+28+50+17+17=142
Test the criteria used
Because A-D-I-R-T-U>A-B-E-J-P-S-U, the temporary solution used is A-B-E-J-P-S-U=129

l) Path to 12
Perform the test by generating the solution A-D-I-L-N-Q-T-U
f= A-D-I-L-N-Q-T-U=30+28+13+16+33+19+17=156
Test the criteria used
Because A-D-I-L-N-Q-T-U>A-B-E-J-P-S-U, the temporary solution used is A-B-E-J-P-S-U=129

m) Path to 13
the test by generating the solution A-D-I-L-N-R-T-U
f=A-D-I-L-N-R-T-U=30+28+13+16+31+17+17=153
Test the criteria used
Because A-D-I-L-N-R-T-U>A-B-E-J-P-S-U, the temporary solution used is A-B-E-J-P-S-U=129

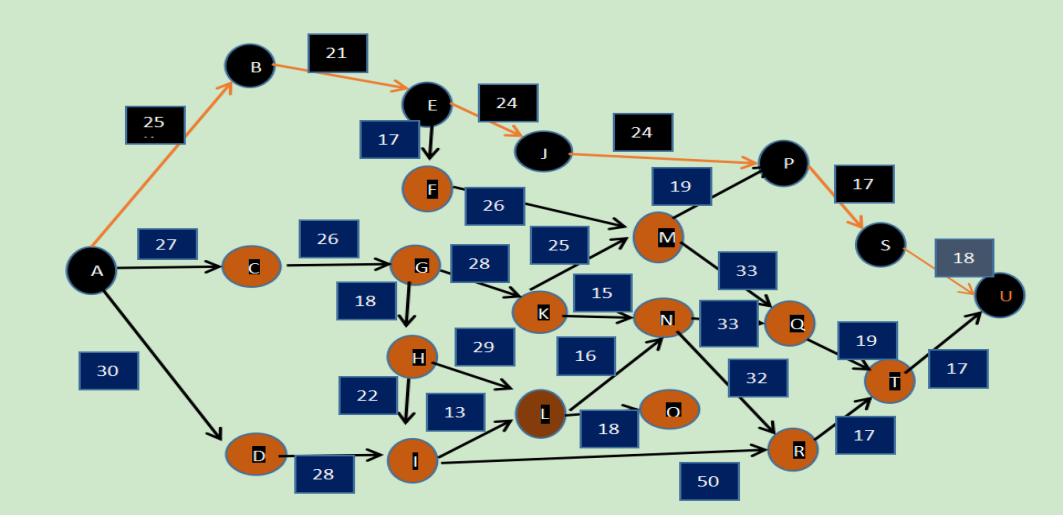
Below is a table for sorting the route from the smallest value to the largest route.

Table 1. Travel Route Table Results

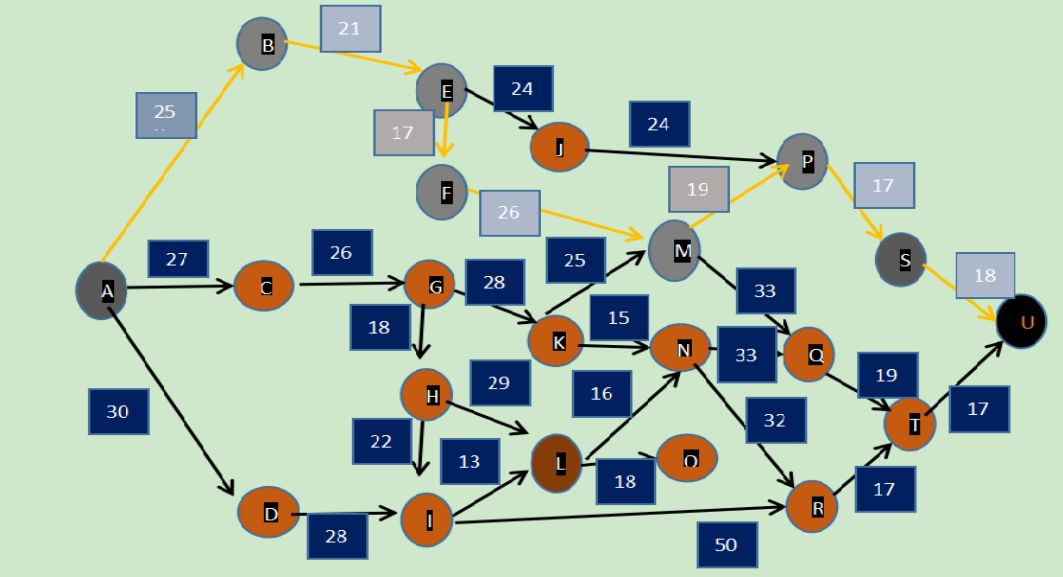
No	Rute	Value
1	A-B-E-J-P-S-U =	25+21+24+24+17+18=129
2	A-D-I-R-T-U=	30+28+50+17+17=142
3	A-B-E-F-M-P-S-U=	25+21+17+26+19+17+18=143
4	A-C-G-H-L-N-Q-T-U=	27+26+18+15+33+19+17=152
5	A-C-G-K-M-Q-T-U=	27+29+28+33+19+17=153
6	A-D-I-L-N-R-T-U=	30+28+13+16+31+17+17=153
7	A-C-G-H-L-N-Q-T-U=	27+26+18+15+33+19+17=155
8	A-D-I-L-N-Q-T-U=	30+28+13+16+33+19+17=156
9	A-B-E-F-M-Q-T-U=	25+21+17+26+33+19+17=158
10	A-C-G-K-M-P-S-U=	27+26+28+25+19+17+18=160
11	A-C-G-K-N-R-T-U=	26+27+28+15+32+17+17=162
12	A-C-G-K-N-Q-T-U=	27+26+28+15+33+19+17=165
13	A-C-G-H-L-N-R-T-U=	27+26+18+15+32+17+17=177

Image Process Results The smallest value can be seen in the image below

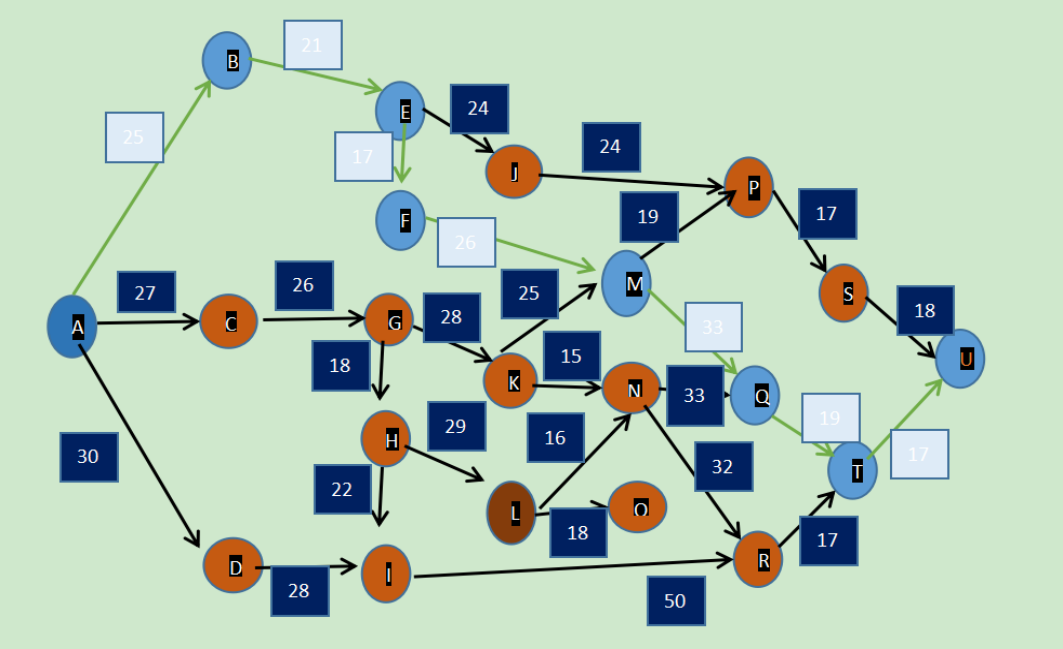
1) A-B-E-J-P-S-U = 25+21+24+24+17+18=129



2) A-D-I-R-T-U=30+28+50+17+17=142



3) A-B-E-F-M-P-S-U= 25+21+17+26+19+17+18=143



The number of known cities is 21 Cities A, B, C, D, C, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U. After doing the search process found 13 routes that have path A to U. The results of the 13 routes obtained values, each of which has a varying value.From several tests, the smallest value is obtained with the route f(A-B-E-J-P-S-U)=25+21+24+24+17+18=129 values that can be used to find the smallest solution to save time and distance traveled by the salesman.

4. Conclusion

The final results obtained after carrying out the process for finding solutions using the Depth first search algorithm with the Generate and test concept are as follows:

a) Depth first search algorithm is able to solve the case of Salesman in finding the shortest route to save time and cost on the way.
b) It is known that the city points consist of A, B, C, D, C, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U with the conditions as A as the crew point and U as the final result finding the shortest route from various combinations of values traversed by the salesman with Node A-B-E-J-P-S-U= 25+21+24+24+17+18=129
c) The advantage of the Depth first search algorithm is that it requires a fast time to find a solution and requires a small memory in the storage media.
d) To complete the search for the shortest route, the depth first search algorithm can be used to produce accurate information.

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