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Dijkstra Algorithm in Transportation Systems at Kediri's Central Post Office

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Abstract. One of the graph role in everyday life is to determine the shortest path, including public transportation, service delivery, and to search nearby locations (eg hotels, hospitals, railway stations, tourist sites, etc.). By knowing the nearest location, the place will be reached with faster time, in addition, we can also save costs. In the field of correspondence through the post office, the determination of the alternative pathway for effective and efficient in the delivery of mail and goods by postmen need role graph theory. Alternative path is the path taken by the postman choice when making the delivery process thus accelerate the journey to the destination. One way that can be applied to determine the shortest path in the delivery of mail is to use Dijkstra's algorithm. This algorithm aims to find the shortest path based on the weight of the smallest from one point to another. Suppose point line depicts a portrait of buildings and roads, Dijkstra's algorithm calculates all possible weight to the smallest of any point. The purpose of this study are to: 1) Describe the problems of the mail and goods transport distributions system in Kediri's Post Office in the form of graphs, and 2) Describe the shortest route in the mail and goods transport distributions system in Kediri's Post Office by using dijkstra's algorithm.

The results of this study that are explained in this paper is the problem of the transport systems in Kediri's Central Post Office and describie the solution for it. It means that this paper will explain the alternatives pathway for the effective and efficient in the delivery of mail and good in Kediri's Central Post Office. In addition, also as a consideration for the relevant authorities, in this case the Kediri's Post Office to take the shortest route policy in the distribution of mail and goods.

Keywords: Dijkstra Algorithm

1. Introduction

Mathematics as the queen of science has very much role in everyday life. Various problems in everyday life often involve mathematics in solving them. Branches of mathematics including algebra, calculus, trigonometry, numerical, and graph have a role in various fields. Along with advances in technology, mathematics too many roles as a basis for rapid industrial and technological fields.

A branch of mathematics that is very important and plays a role in everyday life is graph theory. Graph is one of the mathematical models of complex and quite difficult, but it can also be a very good solution for a particular problem. Currently graph theory is growing and attractive because of its uniqueness and a lot of aplications. That is the one reason why the growth of graph theory is so rapid and have many application in everyday life and in various fields of science [1]. The uniqueness of graph theory is the simplicity of the subject being studied, because it can be served as a point (vertex) and the side (edge) [2].

Among the graph role in everyday life is to determine the shortest path to optimize the distance from one place to another. Many of the areas that require graph role in determining the shortest path, including public transport, service delivery, and search nearby locations (eg hotels, hospitals, railway stations, tourist sites, etc.). By knowing the location of the nearest, the place you want to target will be reached with a faster time, in addition, can also save costs.

Courier services are widely known in the community since the first is through the Post Office. At the post office, every day goes on transmission and distribution activities as well as the letter and goods to be delivered to the recipients that are at various addresses in the range of the working area of the post office. Mail and goods distribution system which took place at the post office is one of the areas that can be optimized through the application of a graph.

Determination of the alternative pathway of effective and efficient in the delivery of mail and goods by postmen need role graph theory. Alternative path is the path taken by the postman choice when making the delivery process thus accelerate the journey to the final destination. The mail delivery process is a process postman traveling from one destination address to another destination address. In this process required the use of the alternative pathway or pathways that several options will be pursued. In addition, the mail delivery process takes time and costs a lot so can result in cost or financial waste that may result in losses. To avoid such problems, we need an alternative path. Alternative path can be used to find the shortest path from one address to another.

The issue of distribution of mail and goods is essential in optimizing decisions will be taken. Graph used to this problem is a weighted graph (weighted graph). In essence, the shortest term does not mean just calculate the shortest path that can be taken to get a point other than a point, but it can also calculate the shortest means the minimum cost that could be incurred to do something. The shortest means to calculate the total weight of the minimum that can be achieved in achieving a goal of a certain starting point.

Distribution of letters and items of post offices covering the entire territory Kediri. From Kediri's Central post office, letters and items distributed each day by the postman to the post office in each district. While the post office each district will distribute to the village that is in scope of the work. Considering the wide range of areas in Kediri, it is necessary to find the shortest route in the distribution of mail and goods so that the delivery of mail and goods to each post office sub-district would be optimal. The shortest route search in letters and goods can be done by using one piece of graph theory, namely the dijkstra algorithm. This algorithm aims to find the shortest path based on the weight of the smallest from one point to another. Suppose point line depicts a portrait of buildings and roads, then Dijkstra's algorithm calculates all possible weight to the smallest of any point. This algorithm first proposed by Edsger W. Dijkstra in 1959 and has been widely used in determining the shortest route or the shortest path based on criteria certain used as constraints [3]. One example application is the graph if a programmer wants to create software on the transport network that allows users to move from one point to the other point and up to the starting point again with efficient [4]

The problems of this study are: 1) How to solve the problems of the transport system and the mail distributing goods in Kediri Post Office in the form of graphs?, 2) How is the shortest route in the transportation system and the mail distributing goods in Kediri Post Office by using dijkstra algorithm?

2. Discussion

A graph G = (V, E) is called a weighted graph (weight graph), if there is a real-valued weighting function W on the set E, W: E ∈ R, the value of W (e) is called the weight of edge e, e ∈ E. Graph weight is stated as well as G = (V, E, W). Weighted graph G = (V, E, W) can be expressed for an air

transport system, in which V is the set of cities, E is the set direct flights from one city to another, W is the real-valued function on E stating the distance or the cost or time. In another case, it can be describe a computer network system, which V is the set computer, E is the set of direct line of communication between two computers, and W is the real-valued function on E stating the distance or the cost or time

With the weights on each side, then raised the issue of determining the shortest path (shortest path) between two vertices in a weighted graph. The shortest path can mean the lowest path or the shortest or quickest depends on the meaning of the relevant weighting function. There are several algorithms to find the shortest path between two vertices in a weighted graph, one of which is Dijkstra's algorithm.

In dijkstra algorithm first step is to choose one point as the starting node. then give weight within the first node to node nearest one by one, Dijkstra will develop a search from one point to another point and point to the next stage by stage. This is the logical sequence of Dijkstra's algorithm [5]:

- Give the weight values (distance) for each point to another point, and then set the value 0 in the initial node and infinite value to other nodes (unfilled)
- Set all nodes "Not touchable" and set the initial node as "Node departure"
- From node departure, consider neighboring nodes unspoiled and calculate its distance from the point of departure. For example, if the departure point A to B has a weight within 6 and from B to node C is 2, then the distance to C pass through B 6 + 2 = 8. If this distance is smaller than the previous one (which had been previously recorded) delete the old data, re-save the distance data with the new distance.
- When we finish considering any distance to the neighboring node, mark the node that has been touched as "Node-touched". Node touchable never checked back in, the distance saved is within the last and the least amount of weight.
- Set "Node undiscovered" by the smallest distance (from the departure node) as "Node Departures" and proceed further by going back to step 3.

The problems of transport systems and goods distribution of letters at the post office Kediri will be converted into a graph. Kediri consists of several districts are: District Plosoklaten, Gampengrejo, Purwoasri, Gurah, Puncu, Wates, Pare, Tarokan, Ngasem, Banyakan, Semen, Mojo, Kepung, Kunjang, Papar, Plemahan, Ngadiluwih, Kandangan, Pagu, Kras, Ringin Rejo, Kandat, Ngancar, and Kayen Kidul. In each district there is a post office sub-district which will distribute the letter and the goods to the destination address within the territory of these districts. Letters and goods received by the Post Office Kediri will be distributed to the post office in the District of Kediri region.

Specifically, this study focuses on determining the shortest distance from the post office mail distribution center to the post office sub-district Kediri Pare. On the distribution of mail and goods from the Central Post Office Pare Kediri to the post office there are several post offices that must be passed, the post office sub-district Ngasem, Gurah, Plosoklaten, Pagu, Kayen Kidul.

Distribution problems of the Central Post Office letter to the Pare's post office can be expressed in the form of graphs. A graph G = (V, E) is called a weighted graph (weight graph), if there is a real-valued weighting function W on the set E, W: E → R, the value of W (e) is called the weight of edge e, ∀ e ∈E. Graph weight is expressed also as G = (V, E, W).

Weighted graph G = (V, E, W) in this study expressed a transportation system, which V is the set of Post Office, E is the set transportation lines connecting between the post office and W is the real-valued function on E which states the distance between the post office which is calculated as the weight between points

Suppose the location of the Post Office in the respective districts declared as point a, b, c, d, e, f, z with a note:

a: Post Office Kediri
b: the District Post Office Ngasem
c: the District Post Office Gurah
d: Capping the District Post Office
e: Post Office District of Kayen Kidul
f: Post Office District of Plosoklaten

z: Post Office District of Pare

The location of the post office can be described as the point with the location as given in Figure 1.

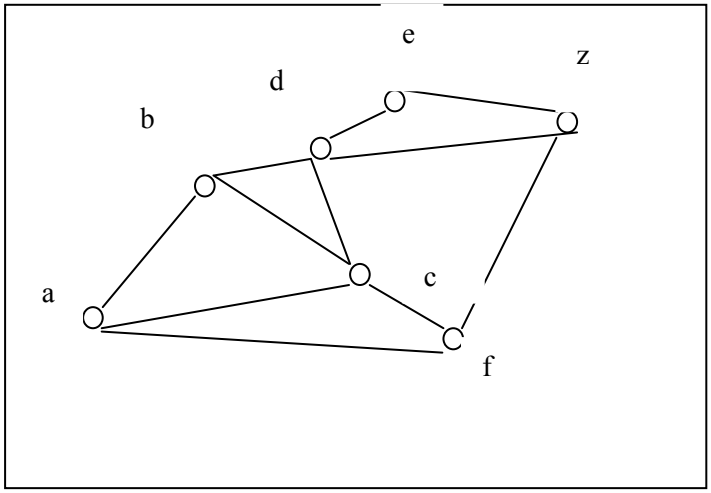

Figure 1. Location of the post office

If the problem is converted in the form of a graph, then there is a weighted graph G = (V, E, W), with

V = {a, b, c, d, e, f, z},

E = {(a, b), (a, c), (a, f), (b, c), (b, d), (c, d),

(C, e), (c, f), (c, z), (d, e), (d, z), (e, z), (f, z)}

and W (a, b) = 5, W (a, c) = 12 W (a, f) = 20 W (b, c) = 7, W (b, d) = 5, W (c, d) = 5, W (c, e) = 7, W (c, f) = 8, W (c, z) = 12 W (d, e) = 2, W (d, z) = 10, W (e, z) = 9, W (f, z) = 8.

After determining each point of stating the location of the Post Office and the weight between the point which states the distance between the Post Office, measures the shortest distance calculations based on Dijkstra's algorithm is as follows:

- Determine the starting point is a point and the shortest distance to the points that are connected directly to a point, the point b, c and f. Since W (a, b) = 5, W (a, c) = 12 W (a, f) = 20 then the destination point is within closest to a, ie the point b with weights w (a, b) = 5
- Next point b is regarded as a starting point and calculated the shortest distance to the points that are connected directly to the point b, ie the point c, and d. Since W (b, c) = 7, W (b, d) = 5, then the destination point is within closest to b, ie the point with a weight W d (b, d) = 5. In order to obtain the shortest path from A to D with a weight W (a, d) = W (a, b) + W (b, d) = 5 + 5 = 10
- The next point is used as the starting point is the point d. Furthermore, in calculated shortest distance to the points that are connected directly to the point d, the point e, and z. Since W (d, e) = 2, W (d, z) = 10, then the destination point is within closest to d, which is the point e with weight W (d, e) = 2. In order to obtain the shortest path from A to E with the weight W (a, e) = W (a, d) + W (d, e) = 10 + 2 = 12
- Next select the point e as a starting point, and because there is only one point that is connected with the point e, ie the point z, then the shortest distance from A to Z is W (a, z) = W (a, e) + W (e, z) = 12 + 9 = 21
- The shortest track is obtained based on Dijkstra's algorithm is from point A, to point B, to point d, e and next to the last point to the point z with the shortest distance 21 km.

Based on the calculation of the shortest distance with the Dijkstra's algorithm, obtained the shortest distance to determine the distribution of mail transport path that is from the Post Office Kediri, towards the post office Ngasem, Pagu, Kayen Kidul and to the Post Office Pare with the distance 21 km.

3. Conclusion

Several conclusions can be drawn from this study are as follows:

- The distribution problem of the Central Post Office letter to the Pare's post office can be expressed in the form of graphs. A graph G = (V, E) is called a weighted graph (weight graph), if there is a real-valued weighting function W on the set E, W: E →R, the value of W (e) is called the weight of edge e, ∀e ∈E. Graph weight is expressed also as G = (V, E, W). Weighted graph G = (V, E, W) in this study expressed a transportation system, in which V is the set of Post Office, E is the set transportation lines connecting between the post office and W is the real-valued function on E which states the distance between the post office which is calculated as the weight between points
- Based on the calculation algorithm Dijkstra shortest distance, shortest distance is obtained to determine the distribution of the letter, namely transportation of Kediri Post Office, headed post office Ngasem, Pagu, Kayen Kidul and to the Post Office Pare with the distance 21 km.

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