

Application Of The A-Star Algorithm On The Mapping Of Sports Team In The City Of Pematang Siantar Based On Android

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Abstract: Geographic information system is a system that has the function to build, store, manage, and display information related to geography. This geographic information system is very helpful for human work in any case. This Android-based GIS application design produces complete information and can be accessed online or can download the application on our cellphones. Currently the city of Pematang Siantar is developing, especially in the field of technology. This research designs a technology that can help people to find a shortest route solution in searching for information on sports teams and their training locations in the city of Pematang Siantar using the A-Star algorithm. The A-Star algorithm is very helpful because the time to find the nearest route is faster and the routes found can be different but at the same cost, making it easier for designers to code in worksheets. The results of this study are in the form of an android application that is connected to the internet network so that it makes it easier for people to find information about sports teams and the closest location to where the user is using only a mobile phone and anywhere that is reachable by the internet network. This android application displays detailed information about sports teams, training locations, and training schedules controlled by the admin who is responsible for adding and changing sports team data so that the application runs properly.

Keywords: Geographic information system, Algorithm, A-Star, Android, Sport Teams

INTRODUCTION

Pematang Siantar City, located in North Sumatra Province, is a fairly large city with a dense population with a total population of 268,254 in 2020. (Nasution & Wahyuningsih, 2021) In this regard, the problem that is often faced by the community is that there are still many people who have talents but are still not well distributed. Related to this problem, this research helps solve the problem by building an android-based geographic information system application to find information on sports teams and training places, in order to make it easier for people to develop their talents in the sports teams they are interested in. This geographic information system uses the A-Star algorithm which will search for sports teams and their training locations by determining the shortest route that can be traveled from the starting node to the goal node. (Astri & Sularno, 2020) (Hermanto & Dermawan, 2018)

There are several references to previous research, namely the research conducted by Risdianto et al. (Risdianto et al., 2020) entitled "Web-Based Geographic Information System for Mapping Football Training Locations in Malang City using Arcgis" this research is about solving the problems of the general public in finding the location of soccer training schools in Malang city. In research conducted

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by Risdianto et al, using the ArcGis application to map the distribution of soccer training school locations in the city of Malang. In this study the researchers designed a GIS application that can be run in a web browser by providing information about the distribution of football schools in each sub-district along with complete information by accessing it online via the internet network. In the design of this application uses a method in collecting data - data, namely spatial data and non-spatial data/attributes.

There is also previous research conducted by Sandi Purnama et al.(Purnama et al., 2018) The title is "Application of the A Star Algorithm (A*) for determining the shortest distance for culinary tourism in the city of Bandar Lampung". In this study the authors raise the problem of culinary tourism in the city of Bandar Lampung to inform a culinary tour that is there to tourists who have difficulty determining the nearest route. Here the researchers designed an Android-based GIS application that can be run on mobile phones by providing information about the location of the nearest restaurant in the city of Bandar Lampung. The results of this study are to produce alternative routes for the community in finding the closest route using the A Star algorithm through an Android application to achieve this goal.

And there is also previous research written by Rasita natasya et al.(Sitepu & Putra, 2022) Which is entitled "Determination of the Shortest Route Using the A Star Algorithm (Case Study: Goods Distributor)". In this study the authors solve the problems experienced by society in general, such as speed of time, distance and minimum costs in the delivery of goods. It often happens among distributors that delivery of goods is late, or the cost of traveling is too expensive, due to the many highways with too many vehicles, and lack of knowledge about alternative routes. So the authors research to solve this problem by using the A-Star algorithm in finding the closest route with minimum distance, time and cost. The results of this study are that using the A Star algorithm can help distributors deliver goods with the closest route in minimum time, distance and cost using Google API Map which displays a map of the closest route.

LITERATURE REVIEW

Geographic Information System (GIS) is a computer-based and android-based information system that has the function of building, managing, and storing geographic data or information. According to Aronoff, the notion of GIS is a collection consisting of hardware, software, geographic data and human resources that work together effectively to enter, create, manage, repair, integrate, analyze, update, store, manipulate, and produce data in an information-based geographic.(Sumantri et al., 2019)(Kholil, 2017)

Basically GIS can be done manually but with the development of increasingly advanced times, GIS is always linked to information systems based on computers and Android. This GIS can help manage large amounts and interrelated data. GIS can also relate various data at a certain point on the earth, and is able to analyze, synthesize, and finally map the results. The data managed by GIS is spatial data. Spatial data is defined as data related to geography and also locations that have a certain coordinate system. So that GIS can solve problems and provide information in the form of conditions, locations, trends, patterns and modeling. This is also a differentiator between GIS and other systems.(Sumantri et al., 2019)

A - star algorithm is an algorithm that is used extensively in path finding and transverse graphs. This A - star uses the best first search route (Best First Search) and also finds the route with the least cost (least coast path) from the given starting point (Start node) to the destination point (goal node). In this a - star uses the cost estimation function (heuristic), distance plus cost (can be denoted by $f(x)$) to determine the search order through the existing points.(Dalem, 2018)(Yulia Hadi Nuryoso, 2020) The heuristic function can be interpreted as a function that is used to produce a solution and an estimate of the costs incurred in route search.(Arsyad et al., 2019)

METHOD

In this study, researchers used a qualitative approach so that the stages of the research process can be seen in Figure 1.

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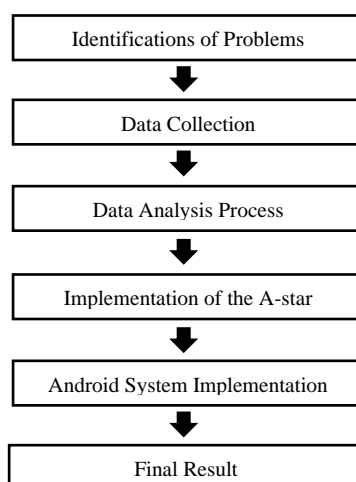


Figure 1. Research design

Research Stages

Identification of problems, or analyzing problems that often occur among the people in the city of Pematang Siantar is the initial stage in this research. In collecting this data, the researcher used several techniques, namely: Observation. Observation was carried out by visiting the Pematang Siantar city youth and sports service directly and observing the training flow of several sports teams and training locations. then interview, this interview was conducted by asking questions related to sports teams in the city of Pematang Siantar, to collect the necessary data. then Presentation of Data, Presentation of this data is done by searching, studying and collecting several documents related to the system to be made. (Ikhwan & Aslami, 2022)(Prasanti, 2018) Data analysis process, this process contains collecting, cleaning, organizing, and managing raw data into information about problems that occur. Implementation of the A-Star Algorithm: In this study using the A-star algorithm to solve problems in finding the closest route. Android System Implementation. The system used for this problem uses an Android-based application system.(Kresna & Oktaviani, 2023)

System Development Method

This system development method uses the waterfall method. This method is a software life-flow approach model that has sequential or sequential system development: analysis, design, code and test. This waterfall model implies a systematic and sequential approach to system development (Nurseptaji et al., 2021)(Tabrani & Pudjiarti, 2017). For more details about the waterfall method can be seen in Figure 2.

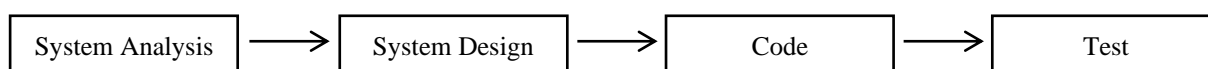


Figure 2. Waterfall Method

System analysis, This stage analyzes and defines the problem and also the solution related to the development of a geographic information system for mapping sports teams in the city of Pematang Siantar. System Design, This stage is the system design stage needed to support a geographic information system for mapping sports teams in the city of Pematang Siantar. And then the researchers also made an interface display on this mobile-based information system. Code, This stage is a stage made by programmers in translating problems faced by users into computer programming languages. The resulting computer program is in the form of a mobile-based application model. This mobile-based application was built using Android Studio tools as the media and Android platform, Visual Studio as the web platform for data processing, and also uses the CodeIgniter framework, and uses the Xampp application for the MySQL database. Testing, After coding is complete, the next step is to test

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the mobile-based system that has been made. The purpose of this test is to test the system if there are errors in the system and then fix it again.(Handrianto & Sanjaya, 2020)(Larasati & Satriadi, 2020)

Programming Algorithm

The formula used by the A-Star algorithm can be seen in formula (1) below:

$$f(n) = g(n) + h(n) \tag{1}$$

Information :

f(n) = lowest estimated cost

g(n) = cost from initial node to node n

h(n) = estimated cost from node n to the final node.

Graph

Graph is a combination of connected nodes and edges. There are two basis that is on graph : illegal generating position in the graph and set the edge of each node (Fadillah et al., 2022). Can be seen in figure 3.

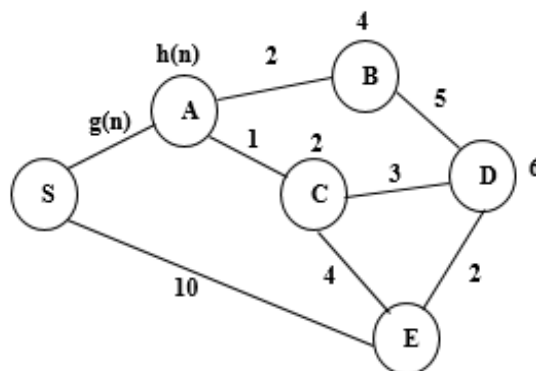


Figure 3. Graph

In figure 3 above we can see graph to determine the nearest track path with the lowest weight through the line.

Table 1. Open List

<i>Open list</i>		
Goals	Value	Via
A	$g(n) + h(n)$	S
E	$10 + 0$	S

Table 2. Close List

<i>Close List</i>		
Goals	Value	Via
S	$g(n) + h(n)$	S
A	10	S

In implementing the A-Star algorithm, it has some basic terminology, namely; The starting point (start node) is defined as a term for the initial position of an object. Points (nodes) are defined as small squares that represent path finding areas, which can be circles, squares, or triangles. The open list is

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defined as a place to store data nodes that may be accessed from the starting point or the node that is currently running. Closed list is a data storage node before S which is also the shortest route that has been obtained. Price is defined as the value obtained from the sum, the resulting value of each node in the shortest route from the starting point to S, and the estimated total value from the initial node to the final node. Obstacles are interpreted as a symbol which states that each node cannot be traversed by S.(Dalem, 2018)

RESULT

At this stage a result is obtained from the design of a sports team mapping application using the A-Star algorithm which has been implemented into a program created using Android Studio, so that it becomes an application used by users to search for sports teams in the city of Pematang Siantar. The system in this study also designed a flowchart and system flow, so that the designed program can be easily applied and run on Android devices. An overview of the flowchart in this system can be seen in Figure 4.

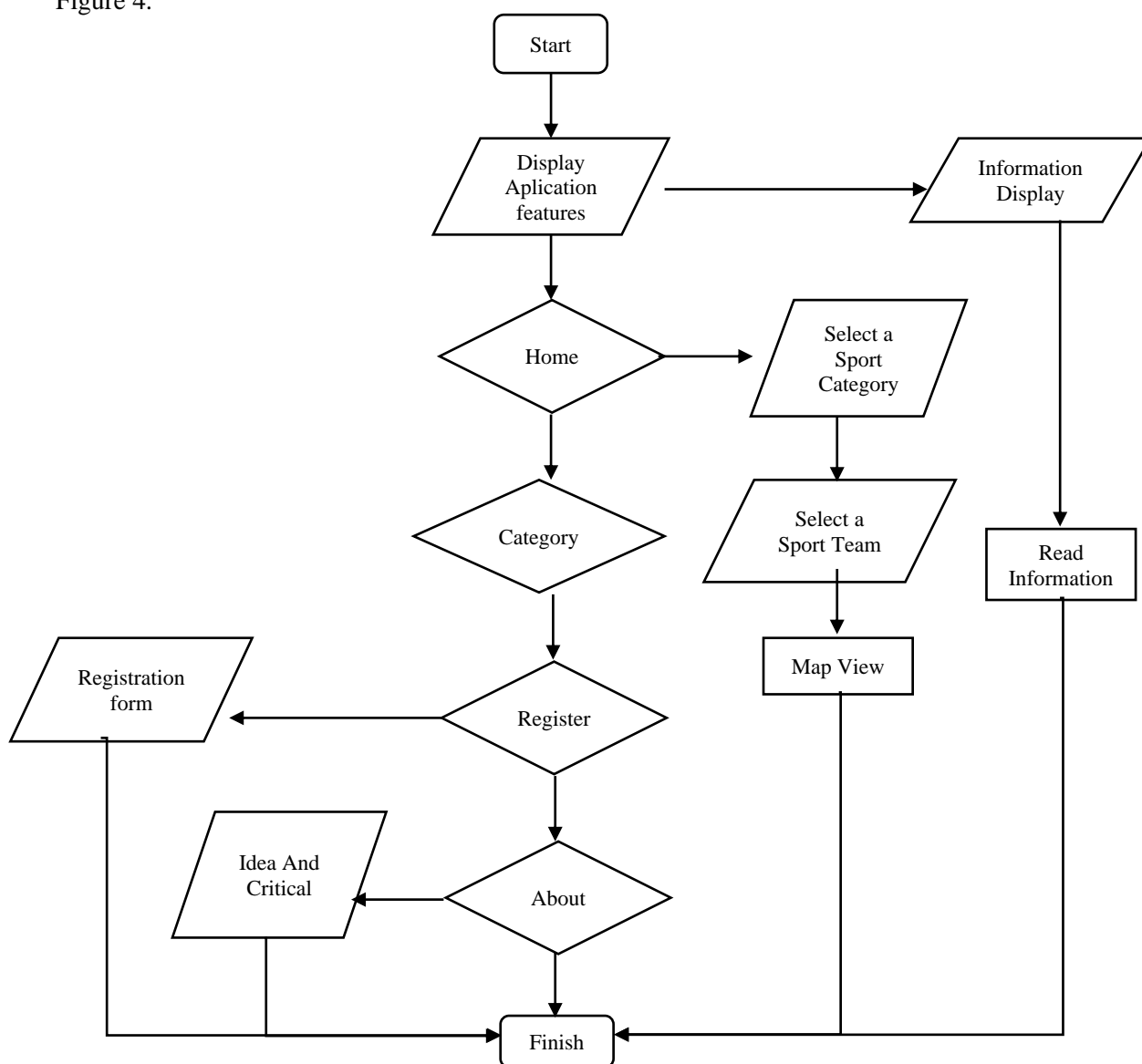


Figure 4. Flowchart

Application of the A-star Algorithm

The initial stage for finding the shortest route is to see the route that will be passed. In applying the A-Star algorithm, there is a map that has several alternative routes in Figure 5.

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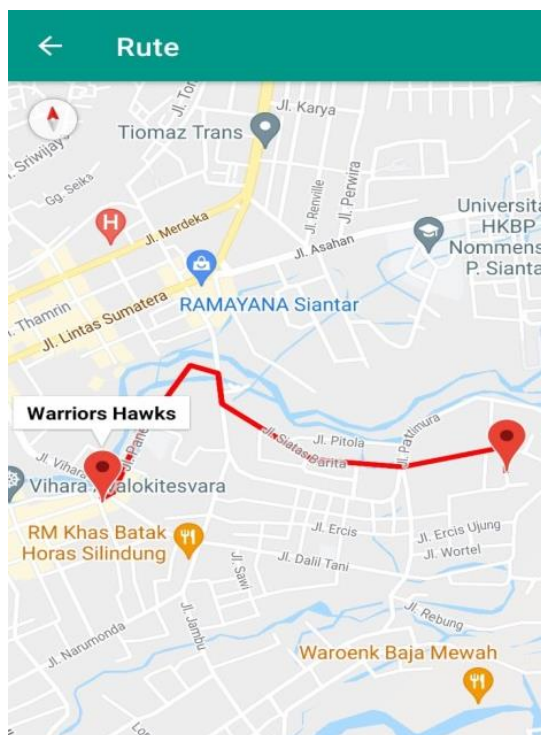


Figure 5. Nearest Route Map

After that, make a graph by calculating or giving the distance between points and determining the heuristic value. As in Figure 6.

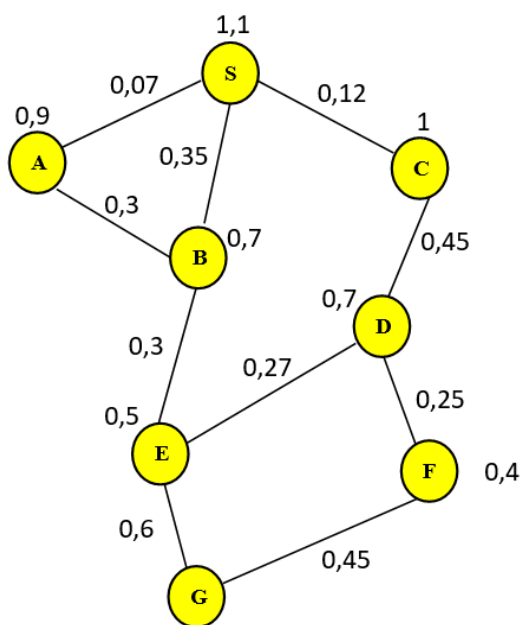


Figure 6. Route Graph Passed

Table 3. Description of street names from Point S to H

No	Point On the Graph	Street Name	Distance
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1	S – A	Jl. Patimura	0,07 km
2	S – B	Jl. Siatas Barita	0,35 km
3	S – C	Jl. Patimura	0,12 km
4	A – B	Jl. Pitola	0,3 km
5	B – E	Jl. Patimura	0,3 km
6	C – D	Jl. Patimura	0,45 km
7	D – E	Jl. Patimura	0,27 km
8	D – F	Jl. Narumonda Bawah	0,25 km
9	E – G	Jl. Pane	0,6 km
10	F – G	Jl. Dalil Tani	0,45 km

The next step is, judging from the graph above, the distance and heuristic values have been determined. After that, we look at the starting point, which starts from point S. From Figure 7 above, point S has 3 choices of the closest path, namely S-A, S-B, and S-C. then we calculate using the formula; $f(n) = g(n) + h(n)$. The point S-A is $f(A) = 0.7 + 0.9 = 0.97$; point S-B i.e. $f(B) = 0.35 + 0.7 = 1.05$; point S-C $f(C) = 0.12 + 1 = 1.12$. Then we enter into the Open List table and Close List table.

Table 4. Open List

Open list		
Goal	Value	Via
A	0,97	S
E	1,05	S
C	1,12	S

Table 5. Close List

Close list		
Goal	Value	Via
S	1,1	S
A	0,97	S

The second step, after getting the lowest value, which has already been entered into the close list table, then proceed from point A – B, namely $f(B) = (0.07 + 0.3) + 0.7 = 1.07$. If we see that the results from point A – B are still greater in value than point S – B, namely $f(B) = 0.35 + 0.7 = 1.05$, then what we enter into the close list is point S – B.

Table 6. Open List

Open list		
Goal	Value	Via
B	1,07	A
B	1,05	S

Table 7. Close List

Close list		
Goal	Value	Via
S	1,1	S
B	1,05	S

The third step, after we know the value of S – A – B is greater than the point value S – B, then the next step is from point B – E, namely $f(E) = (0.35 + 0.3) + 0.5 = 1.15$.

Table 8. Open List

Open list		
Goal	Value	Via
E	1,15	B

Table 9. Close List

Close list		
Goal	Value	Via
S	1,1	S
B	1,05	S
E	1,15	B

The fourth step, after getting the lowest score, B-E with a value of 1.15. then proceed to point E – G, namely $f(G) = (0.35 + 0.3 + 0.6) + 0 = 1.25$.

Table 10. Open List

Open list		
Goal	Value	Via

Table 11. Close List

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			Close list		
Goal	Value	Via			
G	1,25	E	S	1,1	S
			B	1,05	S
			E	1,15	B
			G	1,25	E

Point G is the destination point, so a solution has been found to find the closest route using the A-star algorithm, which starts from point S – B – E – G with a value of $0.35 + 0.3 + 0.6 = 1.25$. With the path traversed, namely Jl. Siatas Barita – Jl. Pattimura – Jl. Pane, with a distance of 1.25 km.

Implementation

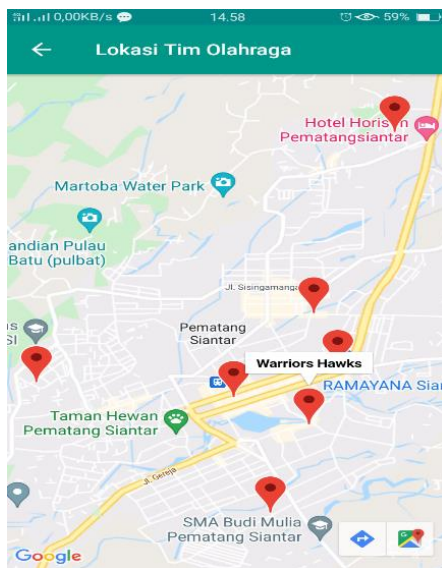


Figure 7. Sports Team Map View

Figure 7. is a map view of several sports teams nearby in the city of Pematang Siantar. When you click on one of the red dots, the name of the team will appear, and when you click on the name of the sports team, you are immediately directed to the sports team's information menu display.

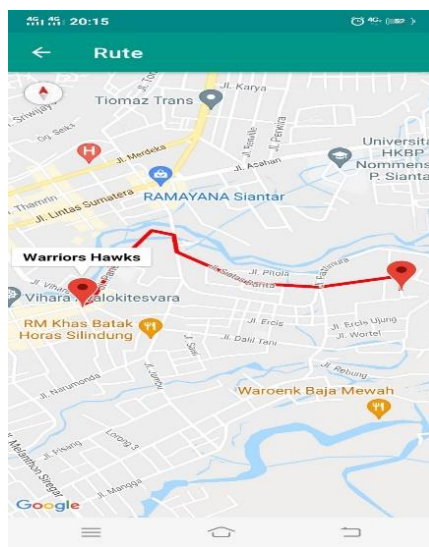


Figure 8. Nearest route result display

Figure 8. is a display of the closest route search results using the a-star algorithm. In this display we can see the closest route from where the user is to the destination you want to visit.

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DISCUSSIONS

Technology users such as android applications that implement the A* algorithm can help sports teams and sports fans plan trips related to sports teams more easily and efficiently. In addition to looking for the shortest path, users must also pay attention to safety and comfort factors while traveling, such as road conditions, travel time and so on. By expanding access to locations related to sports teams, it is hoped that people can be more easily involved in sports activities and can increase their interest and achievements. in sports. The mapping of sports teams in the city of Pematang Siantar can be an attraction for tourists who want to visit locations related to sports teams, therefore the development of sports tourism can be an option to increase the economic potential of the city of Pematang Siantar. In optimizing the use of technology and increasing community participation and developing sports tourism, cooperation between sports teams, the government and other relevant stakeholders is needed, so that the expected goals can be achieved properly.

CONCLUSION

The implementation of the A-Star algorithm in mapping sports teams is in accordance with the required application display design. And it's easier to use for finding the shortest route, so it's faster to find the shortest route very quickly through the calculation of the mathematical formula. The application development process for determining the shortest route has been successful and produces the same assessment between the results of determining the shortest route using the application and the calculation results using the mathematical formula in the A-Star algorithm manually.

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