

OCTOBER 2023

OPTIMIZING TRAVEL ROUTES WITH ANT COLONY OPTIMIZATION AND GOOGLE MAPS API

Presented by Viet-Dung Tran



INTRODUCTION

- MAP APPLICATIONS ARE IMPORTANT FOR TRAVELLERS
- PROBLEMS: LIMITED NUMBER OF DESTINATIONS, PATHS MAY NOT BE OPTIMIZED
- SOLUTION: NAVIGATION APPLICATION COMBINING ACO(ANT COLONY OPTIMIZATION) & GOOGLE MAPS PLATFORM API



source: pngtree.com

ACO (ANT COLONY OPTIMIZATION)

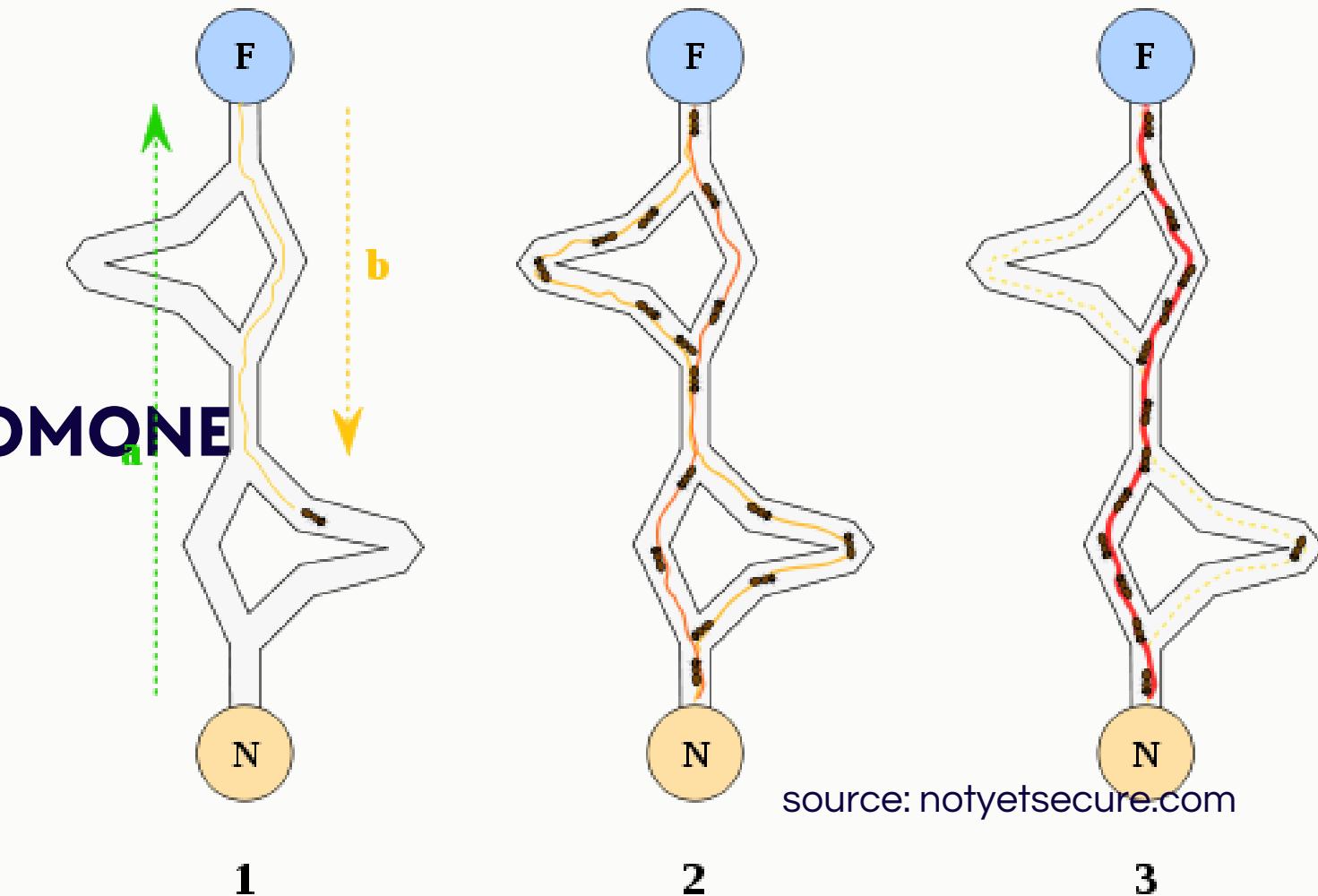
- A NATURE-INSPIRED ALGORITHM --> SIMULATES THE FORAGING BEHAVIOR OF ANTS TO FIND OPTIMAL PATHS.

- ANTS COMMUNICATE THROUGH PEROMONES

- THE SHORTER THE PATH, THE HIGHER THE PHEROMONE CONCENTRATION
=> MAKING IT MORE ATTRACTIVE TO OTHER ANTS.

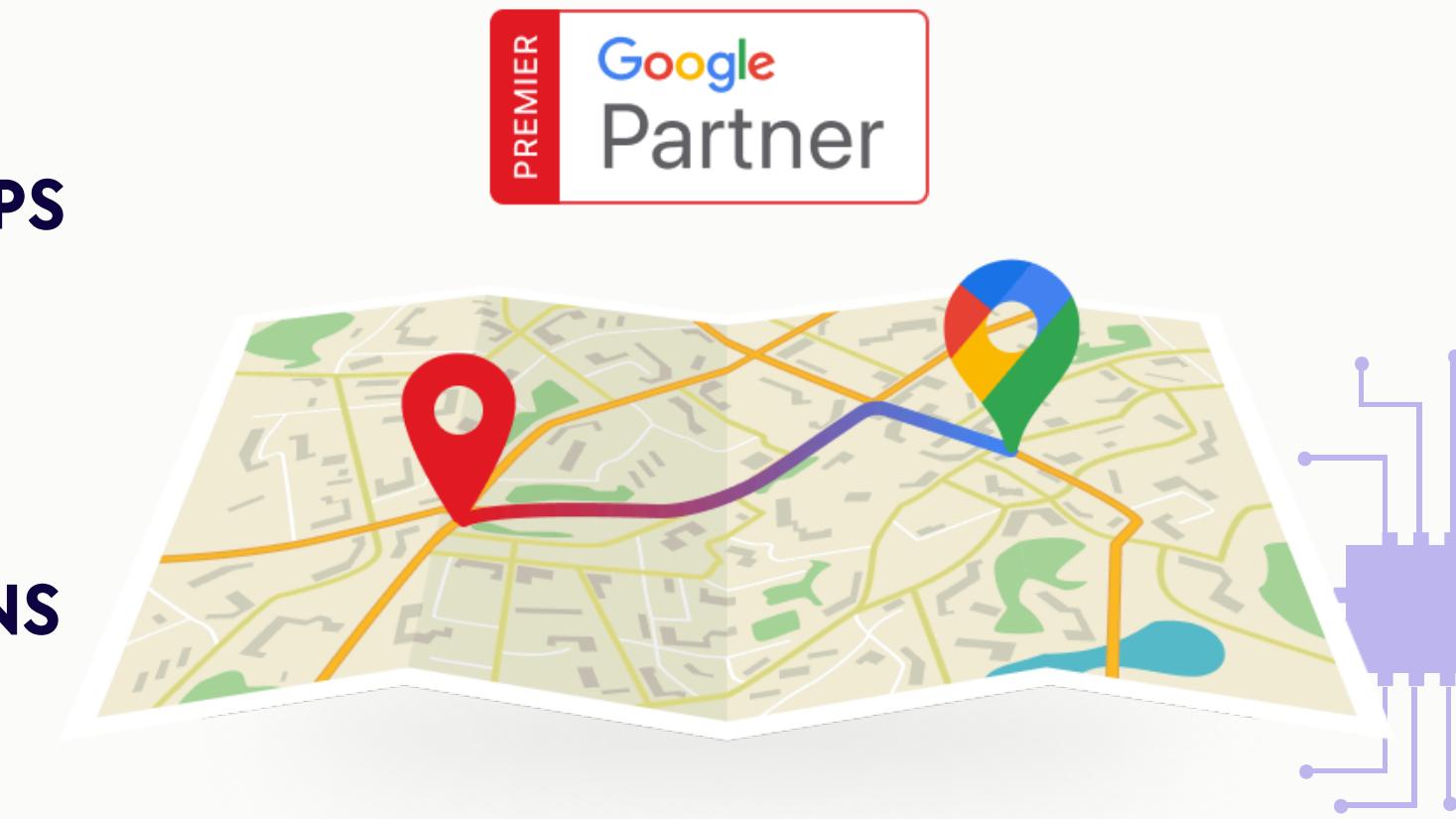
- APPLICATION: TRAVEL ROUTE AS NODES AND EDGES

=> IDENTIFIES THE SHORTEST PATH THAT VISITS ALL DESIRED LOCATIONS.



GOOGLE MAP API

- PROVIDES A SUITE OF TOOLS FOR INTEGRATING GOOGLE MAPS FEATURES INTO APPLICATIONS.
- IT ENABLES OUR APPLICATION TO
 - + OBTAIN DISTANCE & TRAVEL INFORMATION BETWEEN LOCATIONS
 - + GENERATE TURN-BY-TURN DIRECTIONS
 - + RETRIEVE DETAILS ABOUT POINTS OF INTEREST.



Google Maps API

source:cloudaz.io

METHOD AND EXPERIMENTAL DETAILS



ACO ALGORITHM IMPLEMENTATION

PURPOSE

- Find effective paths in large and dynamic environments

- Minimize resource usage

- Handle large and complex datasets efficiently.

- Adapt with real-time changes

1.Initialization:
-Define the number of ants,
number of iterations,
pheromone evaporation
rate , and initial pheromone
levels

2.Path Selection:
-Each ant starts at the
chosen node and chooses
the next node to move to.
-The choice is based on two
things: pheromones and
distances between nodes

3.Pheromone Update:
-Ants leave pheromones on
the paths they took.
-Shorter paths get will more
pheromone
-The pheromone slowly
fades away over time.

**OPTIMAL
SOLUTION**

1. PATH SELECTION:

- EACH ANT STARTS AT A NODE AND CHOOSES THE NEXT NODE TO MOVE TO.
 - THE CHOICE IS BASED ON TWO THINGS: THE TRAIL LEFT BY PREVIOUS ANTS (PHEROMONE) AND HOW CLOSE THE NEXT POINT IS.
-

2. PHEROMONE UPDATE:

- AFTER ANTS COMPLETE THEIR PATHS, THEY LEAVE A TRAIL (PHEROMONES) ON THE PATHS THEY TOOK.
- SHORTER PATHS GET WILL MORE PHEROMONE
- THE PHEROMONE ON ALL PATHS SLOWLY FADES AWAY OVER TIME.

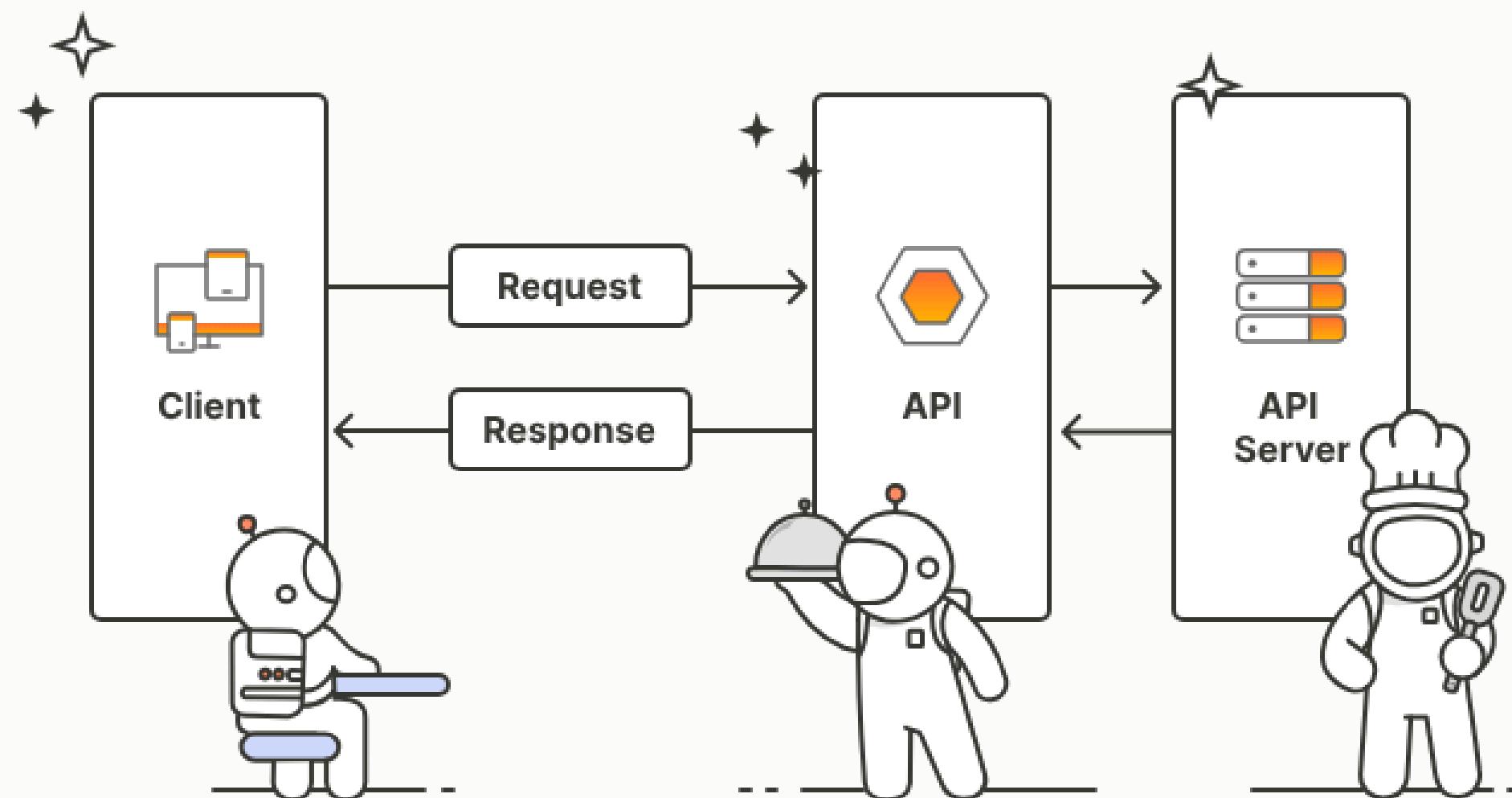
3. ITERATION:

- THESE STEPS ARE REPEATED MANY TIMES.
- OVER TIME, THE ALGORITHM TO CONVERGE TOWARDS THE OPTIMAL SOLUTION.

APIS

An API, or Application Programming Interface, is a set of rules and protocols that allows different software applications to communicate with each other.

APIs provide pre-built functions and operations, which means we don't have to write code from scratch for common tasks

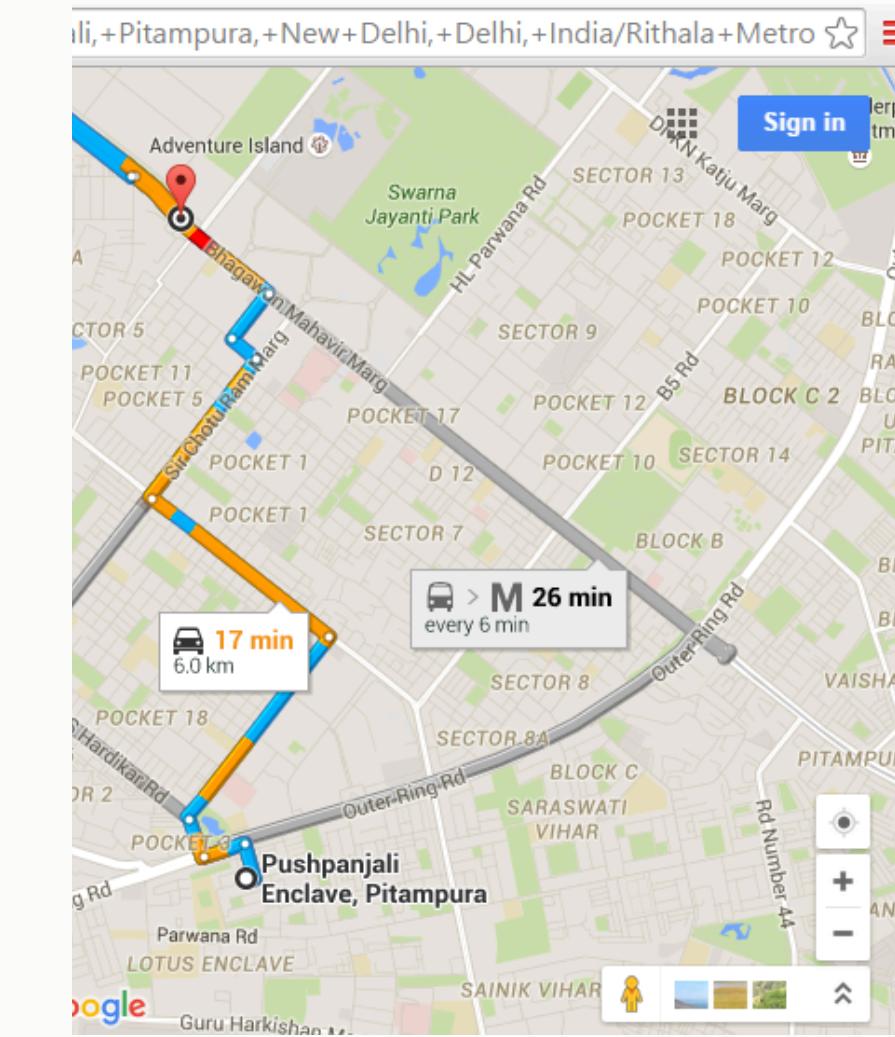


GOOGLE MAPS API

The Distance Matrix API retrieves travel distance and time information for multiple destinations, considering different modes of transportation.

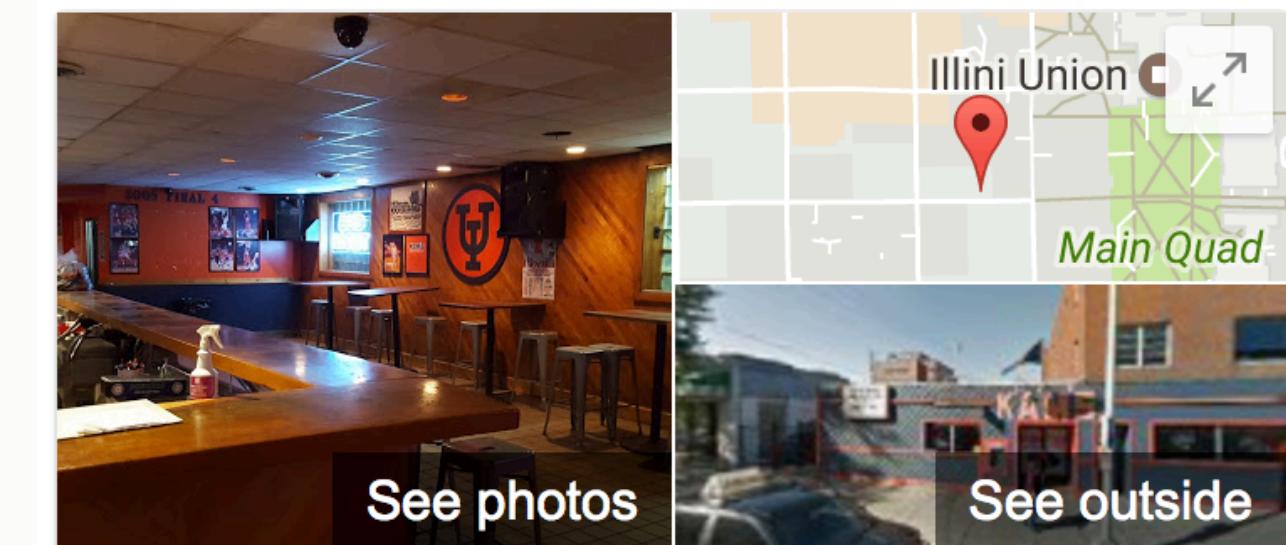
	Chicago	Detroit	Indianapolis	Milwaukee	St. Louis
Chicago		281	184	92	297
Detroit	283		287	382	530
Indianapolis	183	287		280	242
Milwaukee	92	382	279		373
St. Louis	298	531	244	375	

The Directions API provides step-by-step directions for various travel modes, incorporating waypoints and real-time traffic data.



GOOGLE MAPS API

The Places API offers detailed information about places, including addresses, phone numbers, user ratings, and reviews.



Kam's ★

2.9 ★★★★☆ 59 Google reviews

Bar

Boisterous, no-frills nightspot, in business since 1931, offering beer, mixed drinks, DJs & dancing.

Address: 618 E Daniel St, Champaign, IL 61820

Hours: Open today · 3PM–2AM ▾

Phone: (217) 337-3300

MOBILE APP DEVELOPMENT

We chose Thunkable as the platform for developing our mobile application due to its no-code environment, which facilitated rapid prototyping and development.

Using Thunkable's drag-and-drop components, we created screens for entering destinations, displaying optimized routes, showing weather information, and presenting location details.

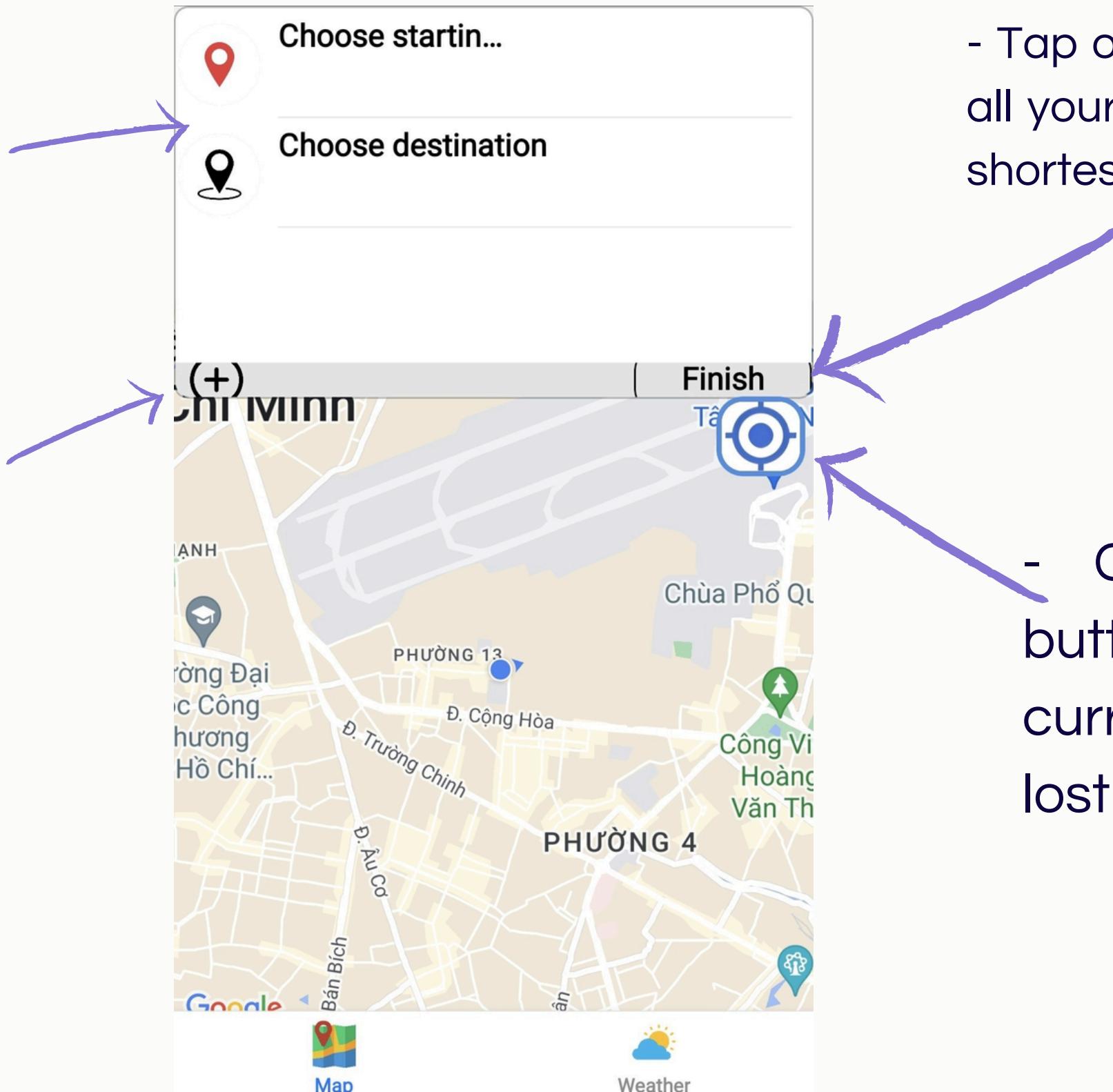


RESULTS AND DISCUSSION

GUIDANCE

- CHOOSE YOUR STARTING POINT AND DESTINATION

- Click on the Add (+) button to add unlimited destinations!

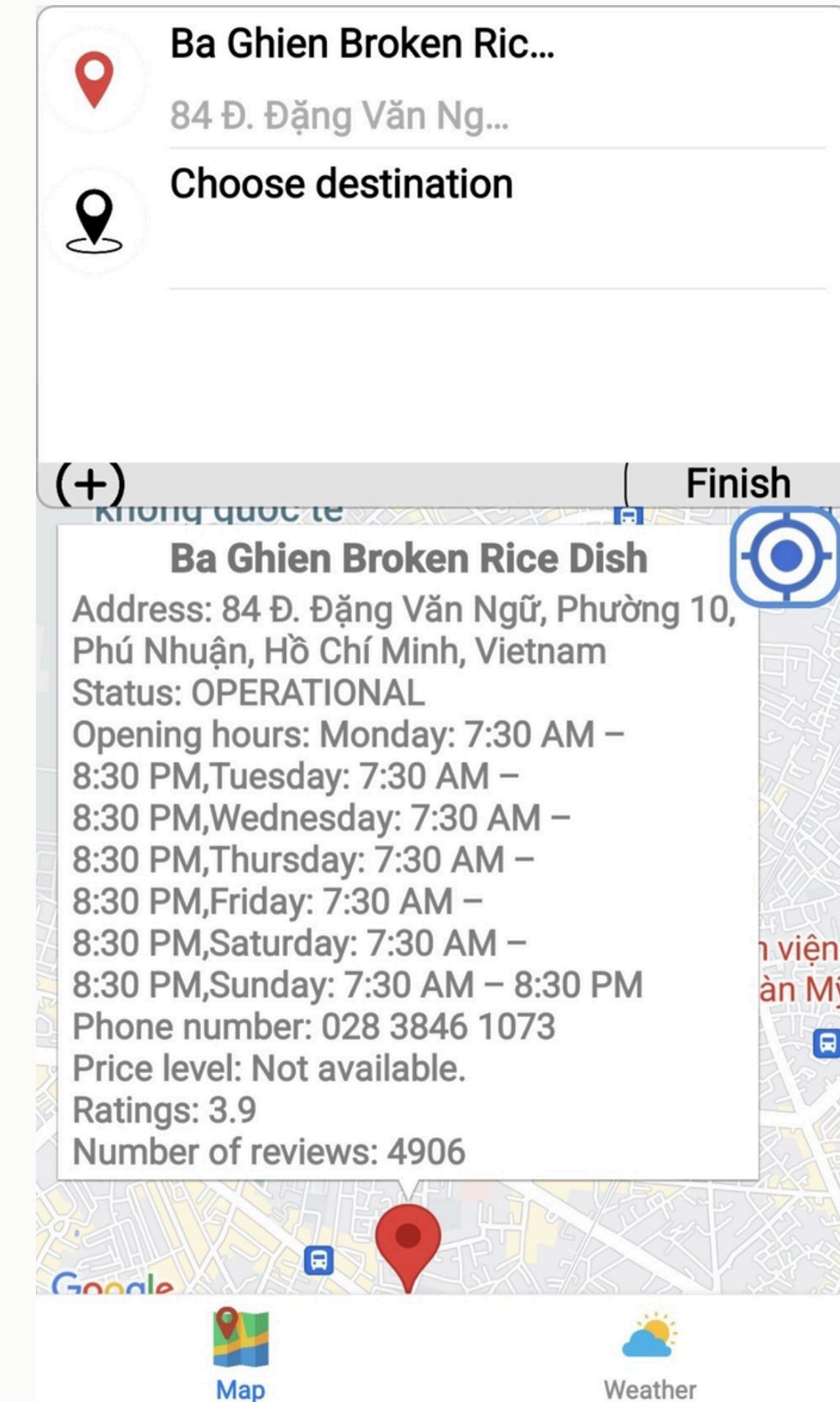


- Tap on Finish once you have included all your destinations. This will return the shortest path briefly.

- Click the blue Relocate button to return to your current position if you ever get lost in the map

GUIDANCE

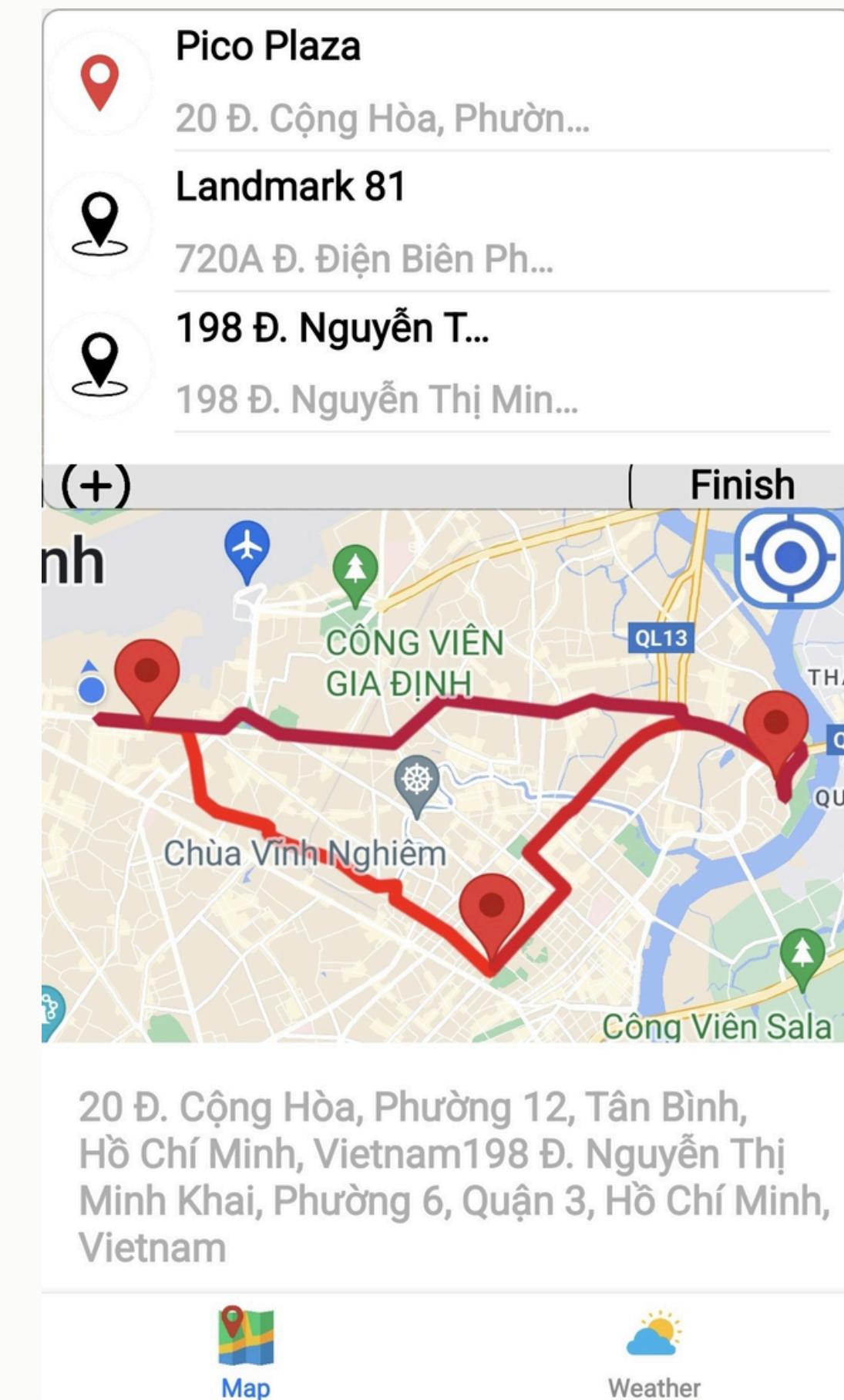
-Tap on the markers on the map to view detailed information about your destinations.



GUIDANCE

-Sample run of the software

**THE SHORTEST PATH
CAN BE FOUND IN
THE WHITE BOX
BELOW THE MAP**



ADVANTAGES AND DISADVANTAGE

ADVANTAGES

- Unlimited destinations: Users can plan routes with any number of desired locations.
- Optimized routes: The ACO algorithm ensures the most efficient path is found.
- Real-time information: Weather conditions and place details are readily available.
- User-friendly interface: The application is designed for ease of use.

DISADVANTAGE

- Reliance on Google Maps: The application is dependent on Google Maps data and services.

CONCLUSION

-> Our application demonstrates the potential of combining ACO with Google Maps API to create a powerful route optimization tool.