CS 3110 Final Project Milestone 3

System description

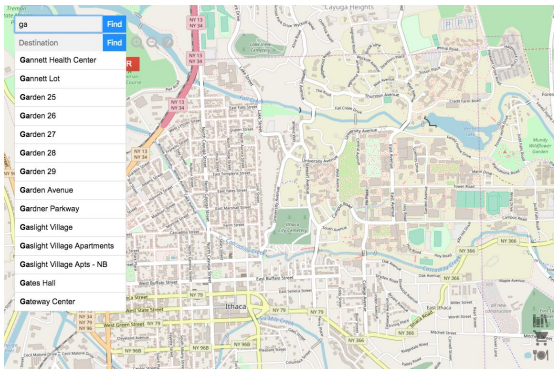
Core Vision： Ithaca Map is a location based map services that resembles Google Map, including zooming in and out the map, moving the map, auto-completion enabled search, finding shortest path, and category search.

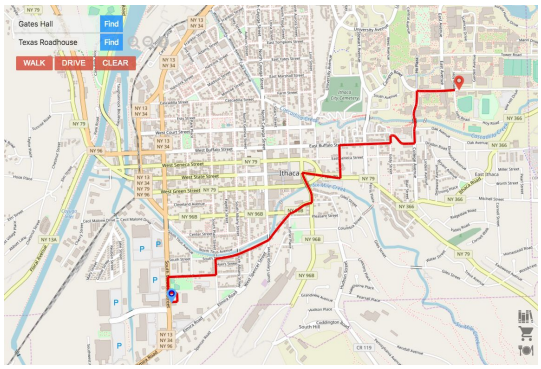
Key features: GUI, Ithaca based map, Server, Networks

Description: The project is a Ithaca-based map service inspired by Google Map. The user can click on a point on the map and the image corresponding to the location will pop up. The user can further zoom in or zoom out to see a more detailed image or a more general image with that location as the center. We download the tile images and map feature data from OpenStreetMap, whose real-world mapping data are updated weekly and free for access.

The location pinning will be implemented through calling remote APIs on the client side. The map images will be provided by the client application through connecting and requesting information from the server. The server side is responsible for storing images, parsing and storing route information fetched from OpenStreetMap, a non-profit organization releasing map data under open license. We will use a graph tree to store the images. Algorithmic efficiency on searching, routing, map displaying is also an important part to make data fetching faster, providing a smooth user experience. We will use AWS to host the server.

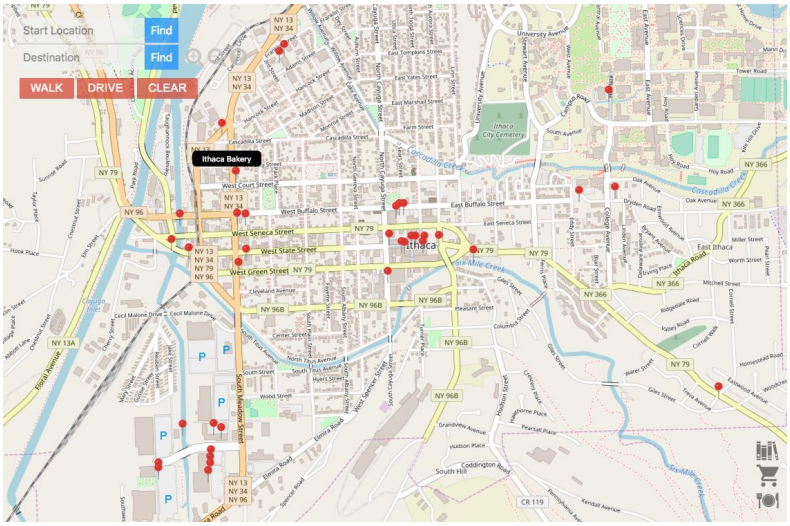
The auto-completion feature has enabled user to type in first several letters and all the names beginning with those letters will pop up.





Another feature is that clients can search path between two locations in our Ithaca Map. We will work with real-world mapping data, and we will return the shortest path that starts from the closest connected node to the start point and ends at the closest connected node to the endpoint.

The application will also provide a key location search system that enables user to type and search key locations, such as libraries, eateries, gas stations, etc. The locations will be represented as related icons, and when users click on the icons, the name of the place will be displayed.



All restaurants displayed on the map.

System design

Module 1: Server

Purpose: The server is located on a VM on the cloud that actively receives client connection and send them relevant information upon request.

Sub-Module 1: Map Tree

Purpose: The Map Tree component of our system is used to efficiently locate the map image the client requests in order to minimize response time. The tree is created such that maps with lowest resolution is placed near root and each (non leaf) node has 4 children with higher resolution representing the map of the same area, using the a spatial data structure, **QuadTree**

Sub-Module 2: Graph

Purpose: A graph representation of the map information parsed from the XML file with nodes denoting locations and edges denoting paths. Graph module will also include the algorithm of finding the shortest path between two nodes. **A* algorithm** will be used to calculate the shortest path between two locations.

KD tree algorithm will be used to find the closest node of a given point.

Module 2: Client

Purpose: This part of this module is stored on the client's computer that interacts directly with the client and request information from the server.

Sub-Module 1: GUI

Purpose: GUI module is the user interface for the interaction between the user and the server. It has the following functions: 1. Display the map of suitable size; 3. Including Zoom In and Zoom Out buttons; 4. Display a search bar where user can type in the destination; 5. Shortest path on the map; 6. Autocompletion, etc.

Sub-Module 2: Trie

Purpose: Trie module is the ordered tree data structure to store a dynamic set of strings to enable the "auto-complete" search function. For example, we have a number of place names and when the user types "Co", it can

automatically displays “Colgate”, “Cornell”, etc, for the user to choose from.

Changes:

Change 1: Before, when the user wants to find the shortest path between two locations, he can only click on the map to indicate the starting or ending point. Now, the user can indicate a starting place / ending place by either typing its name into the search box or directly click on the map.

Reason: This gives users more freedom to find places and also adds more functionality to our system.

Change 2: When user type in the name of a place, all the places with that name will be tagged on the map. Then the user can click the Starbucks he wants and all the other tags of Starbucks will disappear.

Reason: This change make more sense for users since if the user wants to find “Starbucks”, he will want to see all the Starbucks to choose which he wants.

Change 3: Shortest route finding supports two kind of transportation: on foot or by car.

Reason: Since most people will only search for one kind of transportation, this change enables users to make more use of our system. We also store a tag with each road, indicating whether it’s a walkable road, a car road, or both.

Change 4: Server uses cohttp library instead of unix socket.

Reason: Since we are using js_of_ocaml for our gui, and since javascipt can’t connect with unix socket, we instead choose to implement server using cohttp.

Testing:

- Trie data structure unit testing
- Map image rastering unit testing
- Route finding between two places interactive testing
- Graph function unit testing
- KD tree unit testing
- Server interactive testing
- GUI interactive testing

Division of labor:

Yuntian Lan:

Implemented the graph module for coordinate / name / location translation and route finding. Later worked together with teammates to implement the HTTP server module and part of GUI. Spend around ~85 hours for this project.

Xinzhe Yang:

Worked on raw tile image preprocessing, Image module and Trie module with testing; worked on the HTTP request and client state part of GUI and helped connect between GUI and server development. Spent ~85 hours on this project.

Xinqi Lyu:

Mainly implemented the GUI of the project, including the autocompletion of the textbox, rendering of the canvas, dragging and zooming, and the category search. Later worked with teammates to connect server and gui together. Spent ~75 hrs on the project.

Hanqing Jiang:

Worked on parsing xml file; worked on building Graph module with testing; implemented KD tree; implemented some GUI functions; worked on server handling request.
Spent ~65 hours on this project.

Acknowledgements:
The CSS styles for GUI are borrowed from the skeleton code of a class project but our GUI is entirely coded in OCaml. The tile images are made possible by OpenStreetMap under Creative Commons Attribution-ShareAlike 2.0 licence.