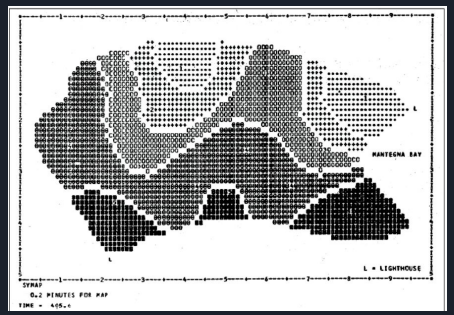
4000 BC [1]

1500s [2]

1850s [3]

1950s [4]



TrailBlazer:
Navigating Made Easier

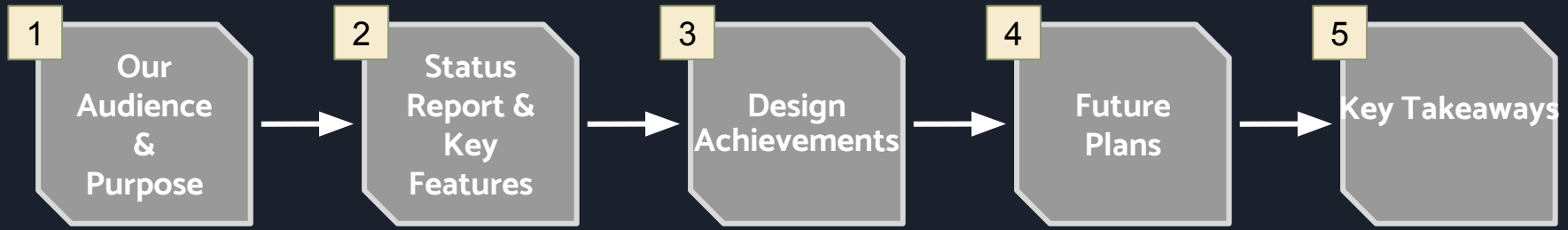
Our Team

Sarah Siddiqui

Yanni Alevras

Paarth Kashyap

Topics of Discussion



Our Audience: **Young Navigators**

Young People's Needs:

- Dark Mode [5]
- User-Interface Personalization [6]
- Vibrant and Refined Visuals [5]

Navigator's Need:

- Contrasting Colours in a Map
- Intuitive Design
- Efficient Routes And Paths

Interactive & Intuitive Design

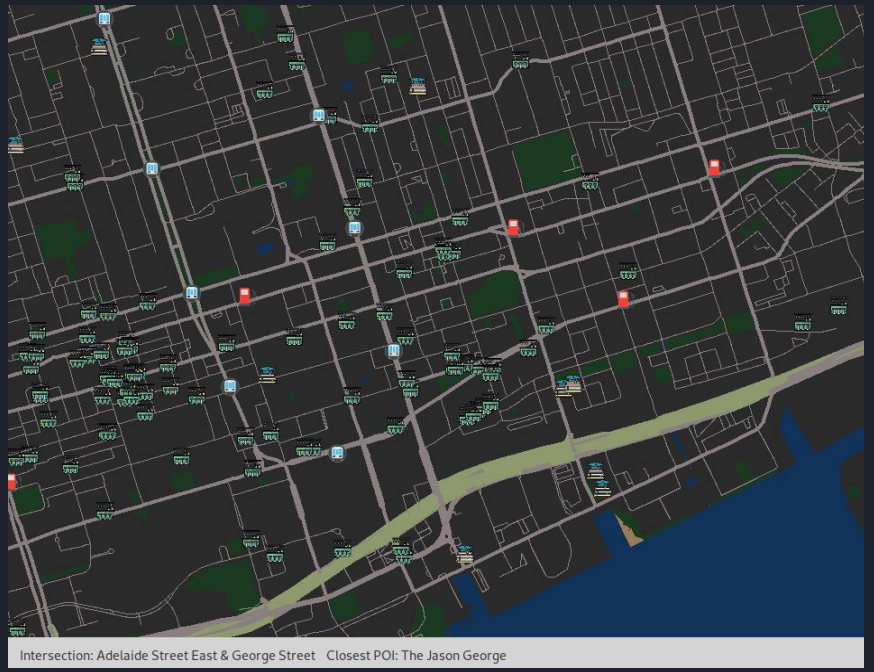
Fast and Efficient Navigation Using Advanced Algorithms

Personalized Features

“TrailBlazer empowers young explorers to navigate cities with a *personalized*, *intuitive*, *responsive* and *efficient* tool.”

Unique Landmarks Ensure User-Friendly Map Visuals

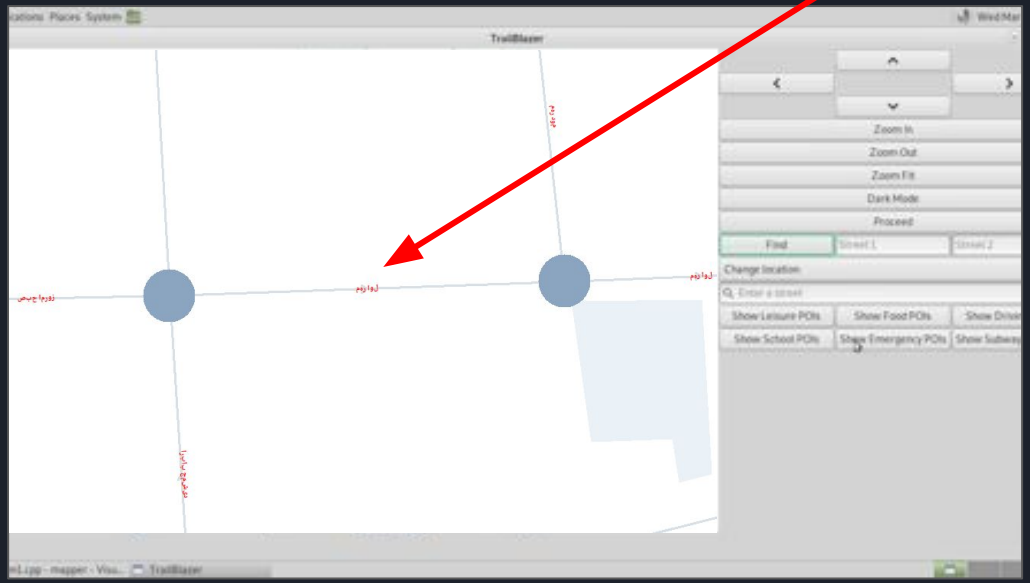
Show Leisure POIs	Show Food POIs	Show Driving POIs
Show School POIs	Show Emergency POIs	Show Subway Stations



Personalized ✓

Drop Down Menu to Change City Map Creates an Easy-to-Use UI

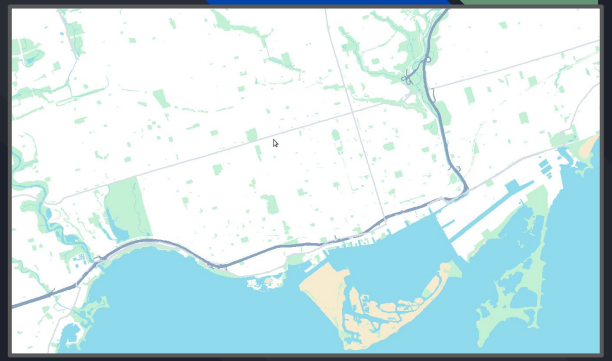
Street Names in Non-Latin Characters



Intuitive ✓

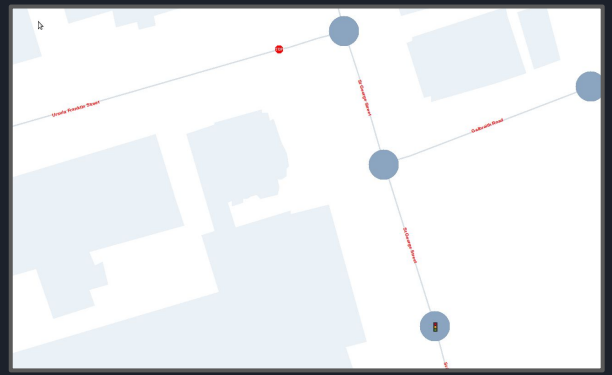
Change location
beijing_china
boston_usa
cape-town_south-africa
golden-horseshoe_canada
hamilton_canada
hong-kong_china
iceland
interlaken_switzerland
kyiv_ukraine
london_england
new-delhi_india
new-york_usa
rio-de-janeiro_brazil
saint-helena
singapore
sydney_australia
tehran_iran
tokyo_japan
toronto_canada

Dynamic Map Provides Varied Information Across Zoom Levels



~20km side to side

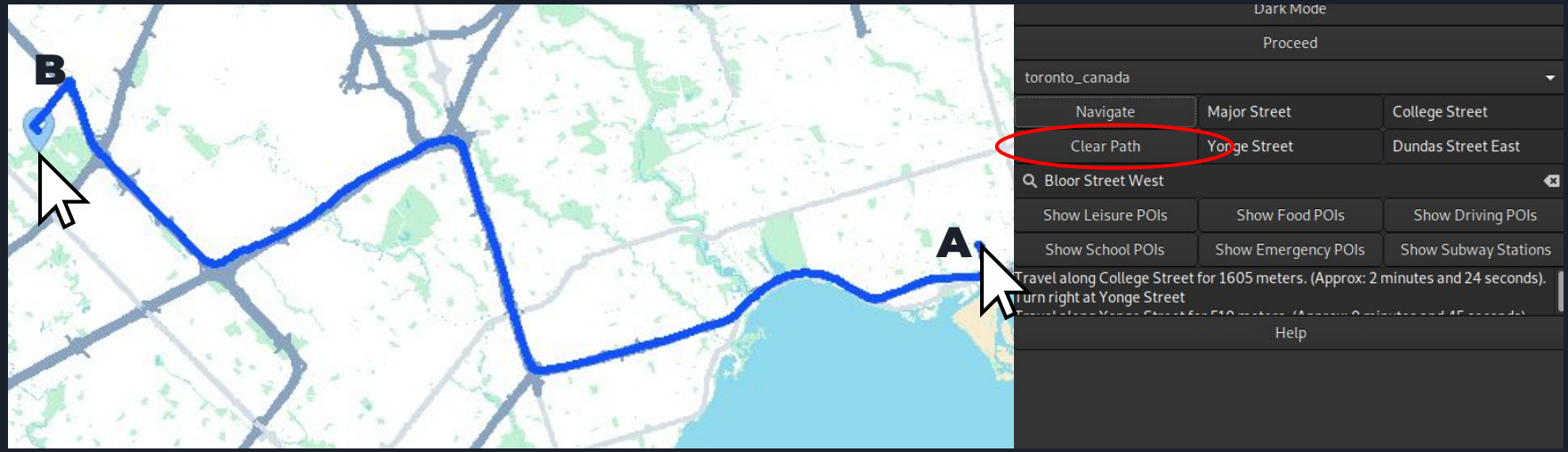
~4km side to side



~250m side to side

Responsive ✓

Highlighted Optimized Route Can Also Use Mouse Clicks



Efficient ✓

Highlighted Optimized Route Can Use Intersection Inputs & Navigate Button

Efficient ✓

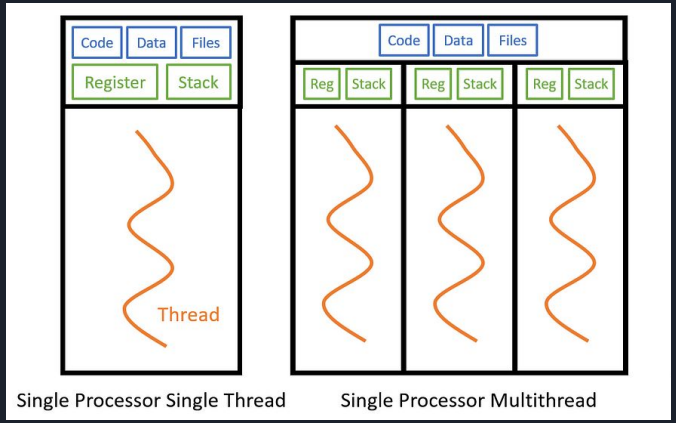
How Our Design Achievements Succeeded

Multithreading Quickly Prepares Our Map

We use a data type called a vector to **efficiently** store:

- Features
- POIs,
- Street segments
- Intersections

These vectors are populated at the same time using multithreading resulting in high **responsiveness**.

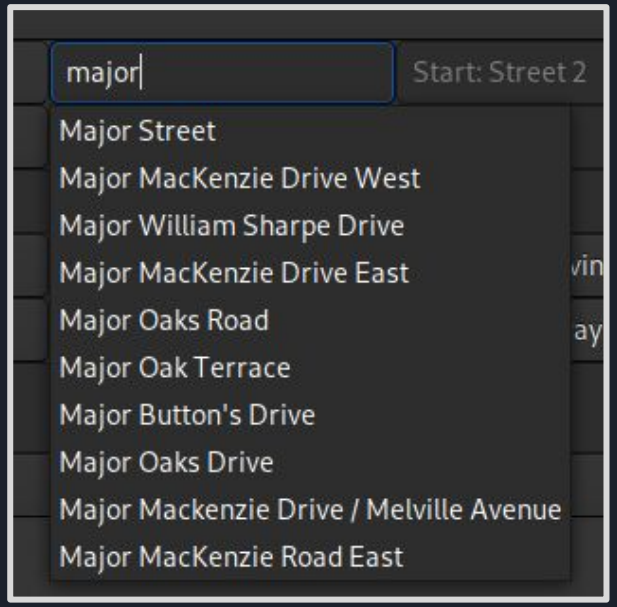


[7]

```
Draw dark Canvas redraw time: 4.694e-06
Draw features Canvas redraw time: 0.012112
Draw segments Canvas redraw time: 0.0141464
Draw intersections Canvas redraw time: 0.000127698
Draw POIs Canvas redraw time: 0.00241579
Draw details Canvas redraw time: 9.4e-08
Draw Main Canvas redraw time: 0.0289099
34.5902 fps
```

Organizing Our Map

Features are drawn in terms of size and are stored in the vector that way.

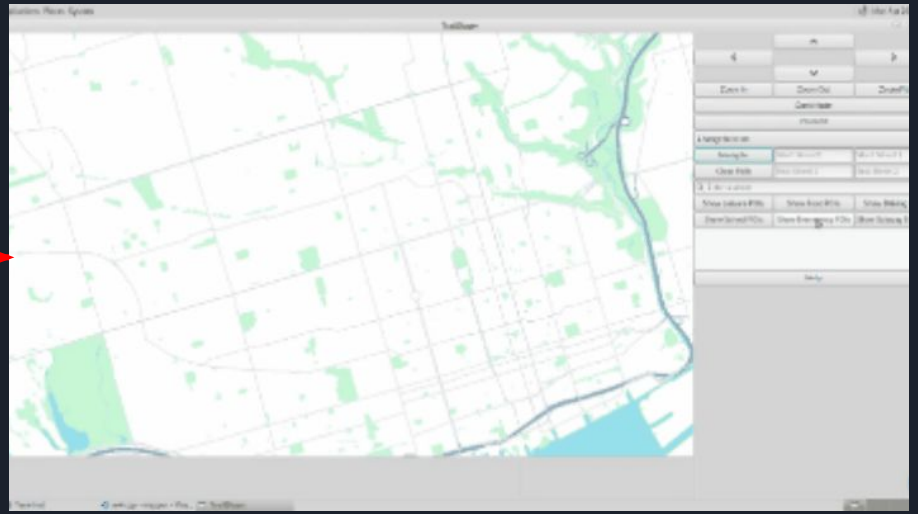


A partial street name vector is used for searching.

A Responsive and Efficient Solution to Navigation

Dijkstra's Algorithm was used as a base. **Guarantees** fastest solution.

A* **improves** Dijkstra using an overhead time heuristic to find a route faster.



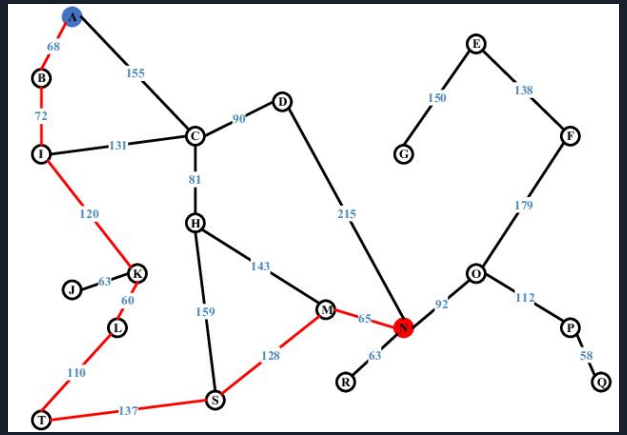
Efficient Pathfinding is Essential

Precomputed distance matrix for storing all pathway combinations for further use.

Basic greedy algorithm to create an **intuitive** solution by finding closest legal nodes.

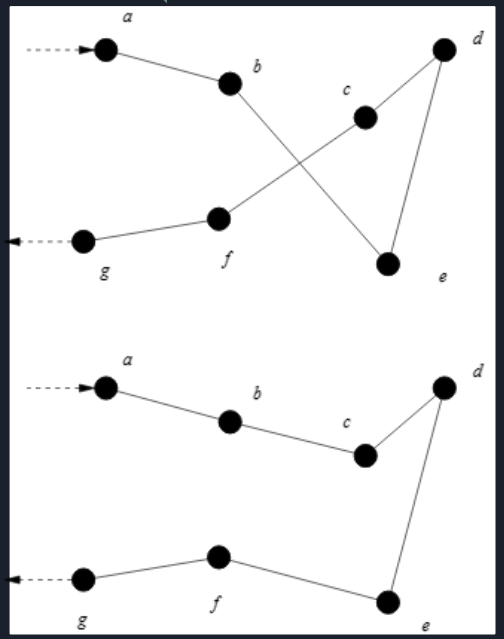
	1	2	3	4	5	6	7	8
1	0	12	3	23	1	5	32	56
2	12	0	9	18	3	41	45	5
3	3	9	0	89	56	21	12	49
4	23	18	89	0	87	46	75	17
5	1	3	56	87	0	55	22	86
6	5	41	21	46	55	0	21	76
7	32	45	12	75	22	21	0	11
8	56	5	49	17	86	76	11	0

[8]



[9]

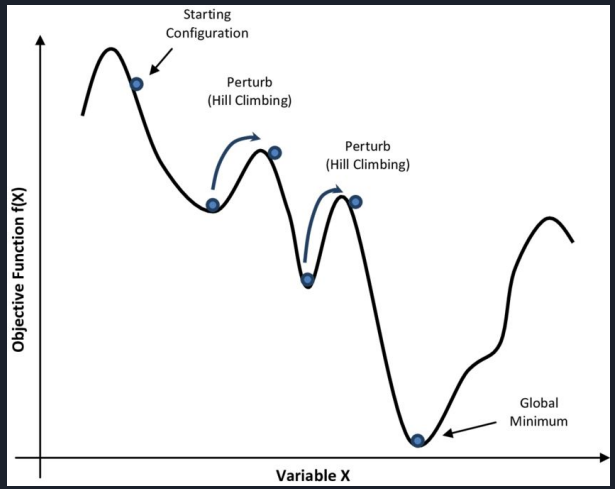
Iteration Improves Pathfinding



[10]

Two-Opt was implemented to replace two pathways with each other to find a **faster** path **iteratively**.

Perturbations using simulated annealing was used to generate solutions and **hill climb**.



[11]

Trail Blazer 2.0

The Future Plan


Key Update
Opportunity for Innovation
Implementation

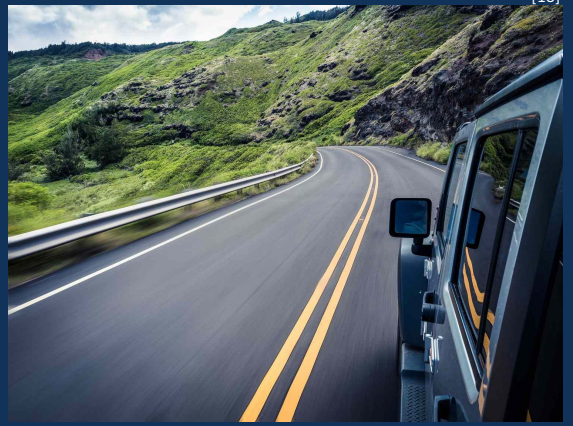
Key Updates

Trip Budgeting

[12]

Road Trip Mode

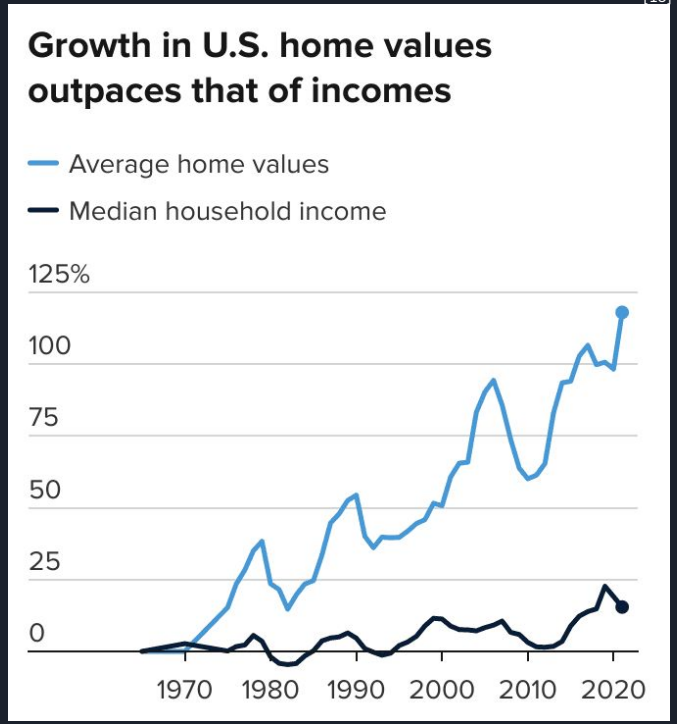
[13]



Do You Budget?

Over 50% of the young adults dread budgeting [14]
Poor money habits leads to increased stress as cost of living increases [15]

[16]

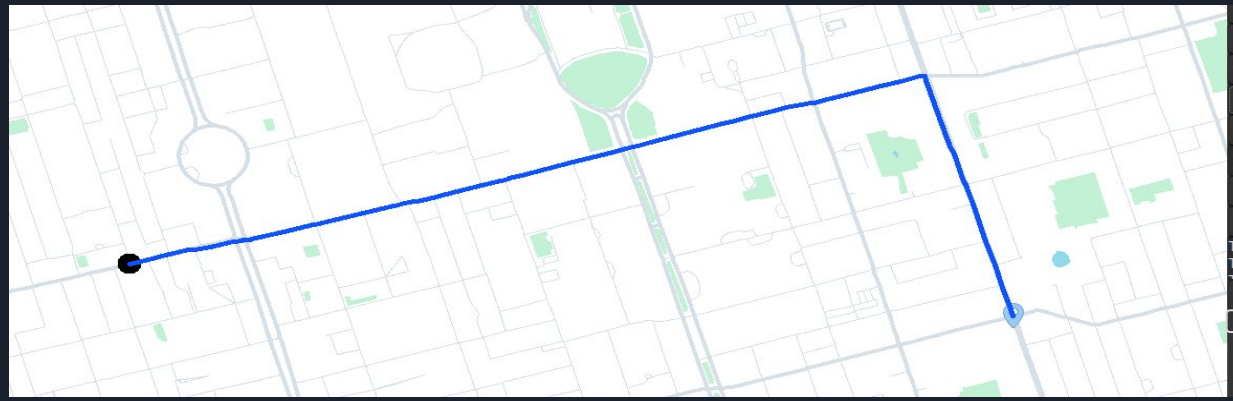


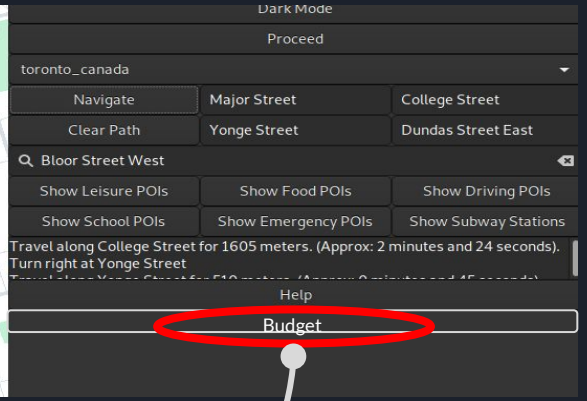
What is Trip Budgeting?

Built-in feature that keeps track of how much you travel, when you travel

Have an accurate transportation budget every month automatically

Implementing *Trip Budgeting* in TrailBlazer





Trip Number	Distance (km)	Fuel Consumption (liters)	Estimated Fuel Cost (CAD)
1	30	6.2	$9.67
2	25	5.2	$8.12
3	35	7.1	$11.08
4	20	4.1	$6.41
5	40	8.1	$12.66
6	25	5.2	$8.12
7	30	6.2	$9.67
8	20	4.1	$6.41
9	35	7.1	$11.08
10	20	4.1	$6.41
Total	**280**	**57.4**	**$89.93**

Example of weekly trips cost

Key Updates

Trip Budgeting

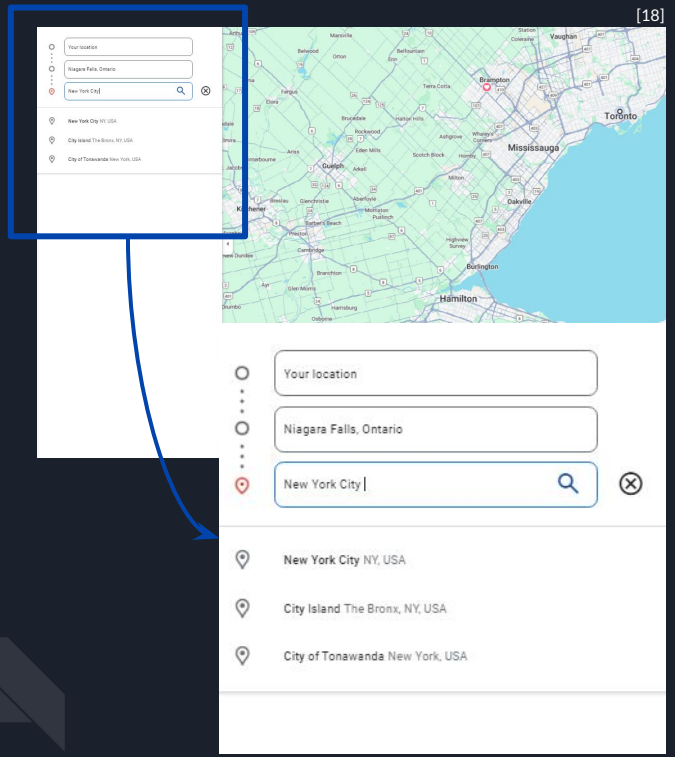
[12]

Road Trip Mode

[13]

The Problem with Planning

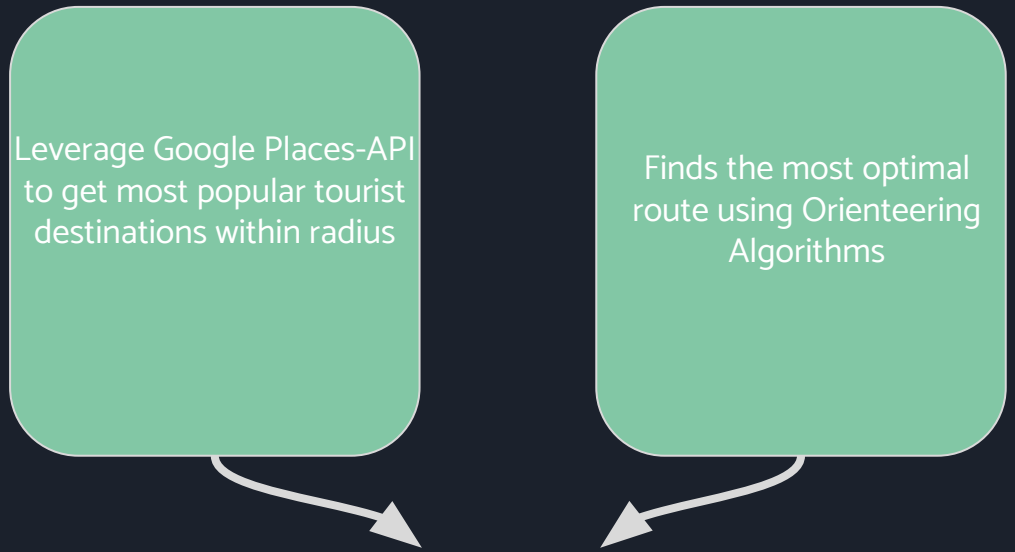
64% of young people want to travel and explore [17]



- Manually create a road trip
- Where to go?
- 68% of people think planning a trip is too complex [19]

What is Road Trip Mode?

Takes in road trip duration and radius and creates a fun adventure



A hassle free roadtrip personalized just for you

Implementing *Road Trip Mode* in Trailblazer

[18]

What can you do with the Places API

You can use the Places API to include the following features in your applications:

- Provide place search results from different types of users queries, such as text input, nearby locations, and ambiguous or categorical user queries.
- Enable autocomplete features for different search types, either specific text queries or categorical queries.
- Refine the type of details returned about a place, such as operating hours, a summary, user reviews, and a photo.

Curate a list with most popular destinations using Google Reviews and location

Create a well balanced itinerary using the Max-Min Orienteering Multi-Tour Algorithm [20]

Algorithm 3: MaxMinOrienteering

Input: Graph $G = (V, E)$, budget per tour B, number of required tours k, start/end node s, target value T
Output: Set of tours $\mathcal{P}$, visit times τ
// Stage 1: Extract high utility nodes into tours
$\mathcal{P} \leftarrow \emptyset$
for $\forall v \in V : u_v \geq T$ **do**
  $\left(P, \tau^P\right) \leftarrow$MakeTwoNodeTour$(s, v)$
  $\mathcal{P} \leftarrow \mathcal{P} \cup \{P\}$
  $\tau \leftarrow \tau \cup \{\tau^P\}$
  $G \leftarrow$RemoveNodeFromGraph(G, v)
$q \leftarrow |\mathcal{P}|$
if $q \geq k$ **then**
  return $\left(\{\mathcal{P}_1, \ldots, \mathcal{P}_k\}, \{\tau^{\mathcal{P}_1}, \ldots, \tau^{\mathcal{P}_k}\}\right)$
// Stage 2: Iteratively run single-tour and truncate
for $i = 1, 2, \ldots, k - q$ **do**
  $(P, \tau^P) \leftarrow$SingleTourOrienteering(G, B, s)
  $(P, \tau^P) \leftarrow$TruncateTour(P, τ^P, T)
  $\mathcal{P} \leftarrow \mathcal{P} \cup \{P\}$
  $\tau \leftarrow \tau \cup \{\tau^P\}$
  $G \leftarrow$RemoveNodesFromGraph$(G, V(P))$
// Stage 3: Check the output and return
if $\forall P \in \mathcal{P}, U(P, \tau^P) \geq T$ **then**
  return $\left(\{\mathcal{P}_1, \ldots, \mathcal{P}_k\}, \{\tau^{\mathcal{P}_1}, \ldots, \tau^{\mathcal{P}_k}\}\right)$
else
  return $(\emptyset, \emptyset)$

[21]

Key Takeaways

- UI Design
  - Personalized POIs
  - Drop Down Menu
  - Dynamic Zoom
  - Path Finding
- Code Design
  - Multithreading and Vectors
  - Travelling Salesman Problem
- Future Plan
  - Trip Budgeting
  - Road Trip Mode

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