

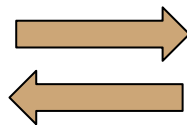
Incorporating Public Transit into Measures of Accessibility



UBCO 2021 Capstone Project



THE
UNIVERSITY OF
BRITISH
COLUMBIA



Statistics
Canada



Statistique
Canada

Graham Kerford

Rain Shen

Yuxuan Cui

Luka Vukovic

Joseph Kuchar

Bjenk Ellefsen

Graham

*BSc Earth Science, minor Ocean Science,
Dalhousie University*



Rain

BSc in Food Science and Technology, UBC



Luka

*BSc Biomedical Sciences, uOttawa
Grew up in Ottawa*

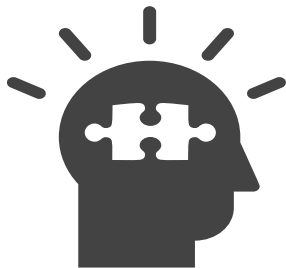


Yuxuan

*BSc in Economics &
statistics(Econometrics), SFU*



Motivation



- 22.3% of commuters use public transport in large Canadian cities (ie. it's important in the urban system)
- There is no standardized metric for measuring and visualizing public transit accessibility across urban centres in Canada.



Last year: proximity to points of interest via **walking/driving** (distance measure)

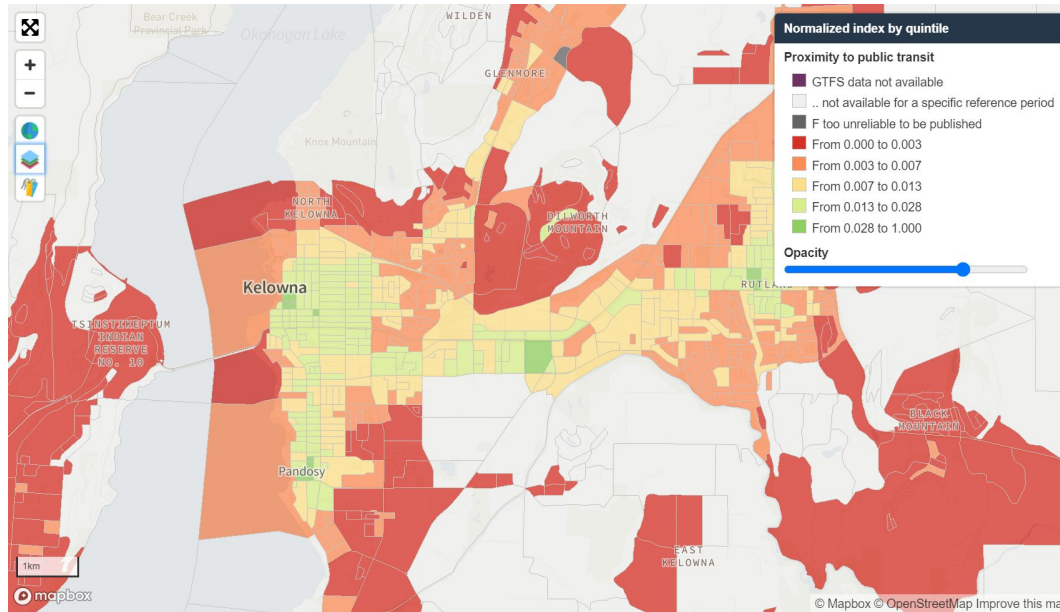


Figure 1. Dissemination block proximity to public transit in Kelowna.
Proximity Measures Database (June 2020).

Note 1: Dissemination blocks (**DBs**) are uniquely identifiable block areas in Canada.

Note 2: Points of Interest (**POI**) can be any type of amenity (healthcare, cultural, transportation, educational, etc.).

This year: proximity to points of interest via **public transit** (time measure).

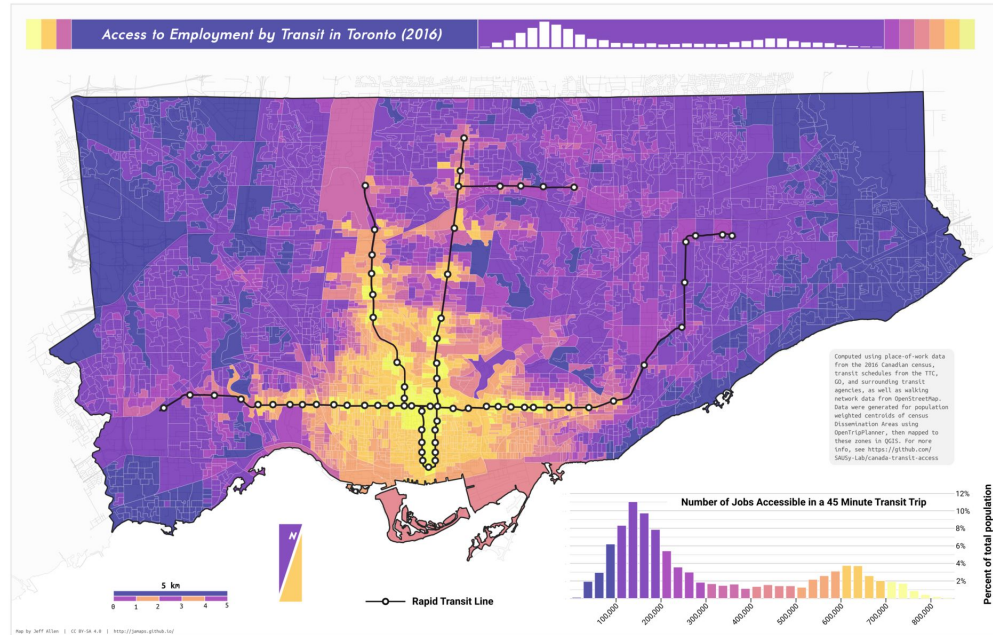


Figure 2. Isochrone map of DB access to employment by public transit in Toronto.
(<https://sausy-lab.github.io/canada-transit-access/map.html>)

Note 1: Dissemination blocks (**DBs**) are uniquely identifiable block areas in Canada.

Note 2: Points of Interest (**POI**) can be any type of amenity (healthcare, cultural, transportation, educational, etc.).

Aims and Objectives



- To map and visualize **Vancouver's** measure of accessibility to **cultural points of interest** such as museums and art galleries as determined by **public transit travel time**.
- To **establish methodologies** of data collection, data wrangling, and statistical algorithms that are easy to implement and **scale** to other municipalities and points of interest.



How accessible are Vancouver's cultural points of interest via the current transit system?

Chosen City:

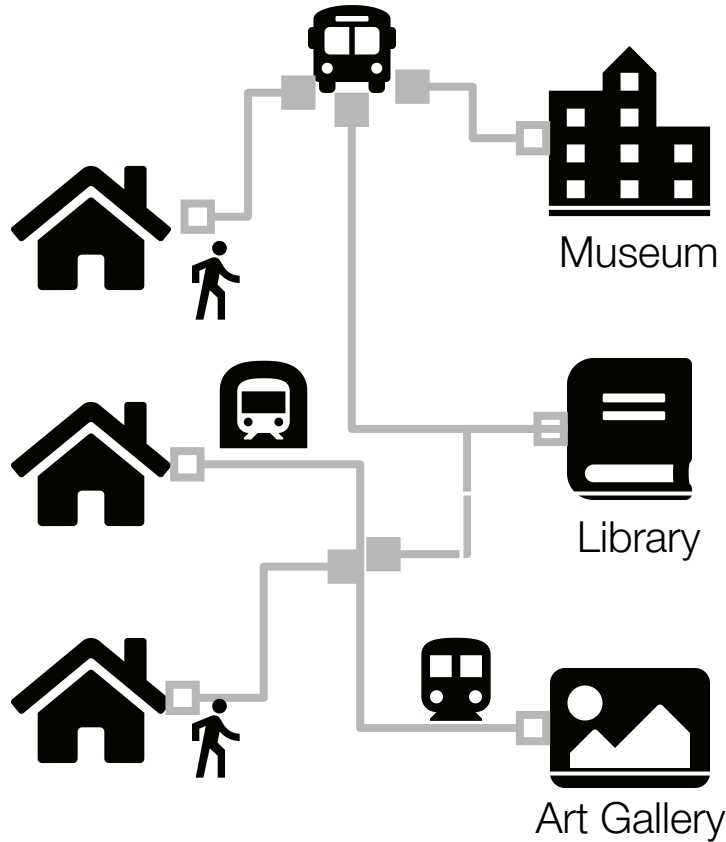
Vancouver

Chosen Points of Interest:

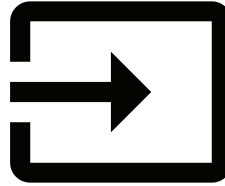
Cultural and Art facilities → Museums

DBs

POI



Open Trip
Planner



r5r

Shortest Travel
Time To Each
Amenity

Accessibility
Index

40 mins
60 mins
80 mins

0.4

50 mins
25 mins
15 mins

0.75

98 mins
78 mins
25 mins

0.2

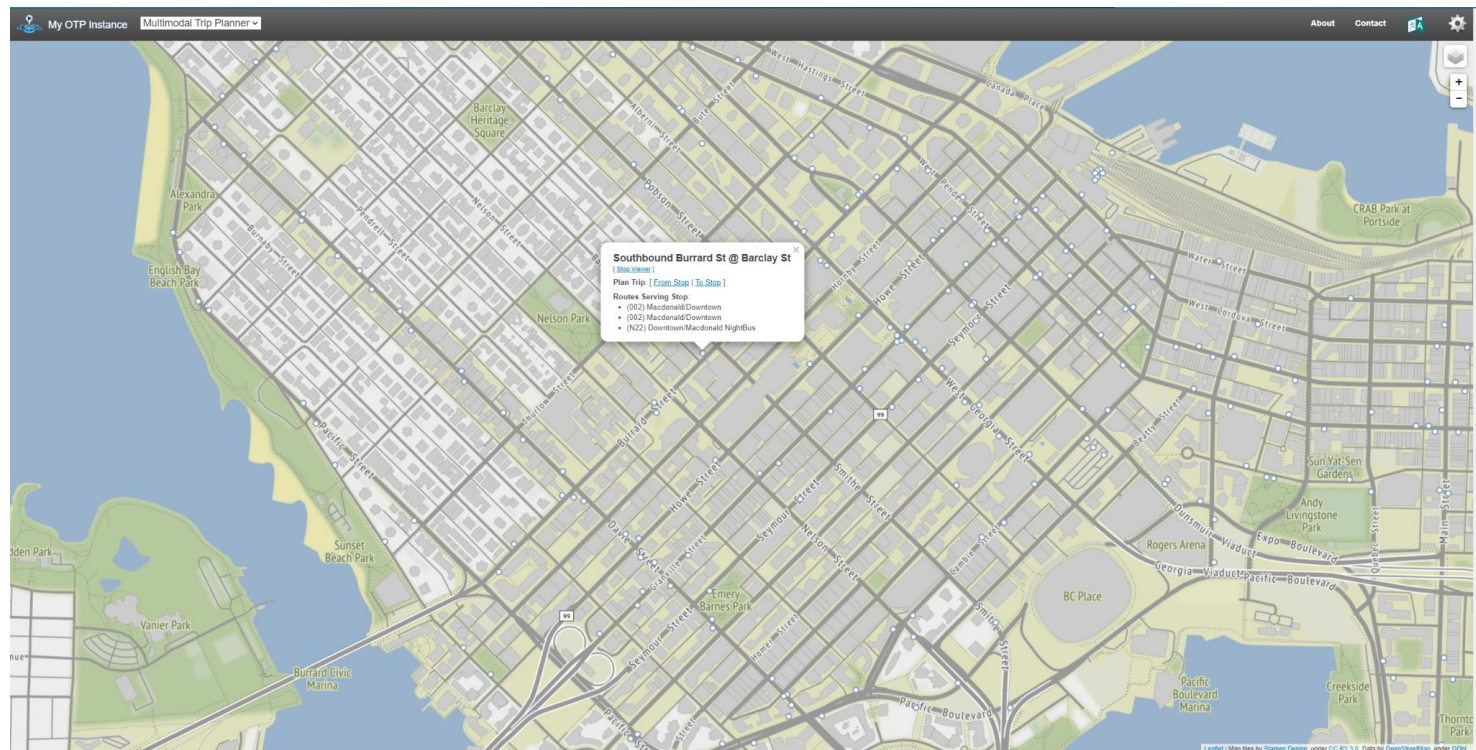
Data Sets

- General Transit Feed Specification (GTFS)
 - Public transportation stops, routes, times, etc.
- Open Database of Cultural and Art Facilities (ODCAF)
 - List of cultural and art facilities
- Census Dissemination Blocks (CDB)
 - Unique block IDs, longitudes, latitudes, population per block, and additional details.
- Vancouver OpenStreetMap (Van-OSM)
 - Street names, street directions, speed limits, road laws, etc.

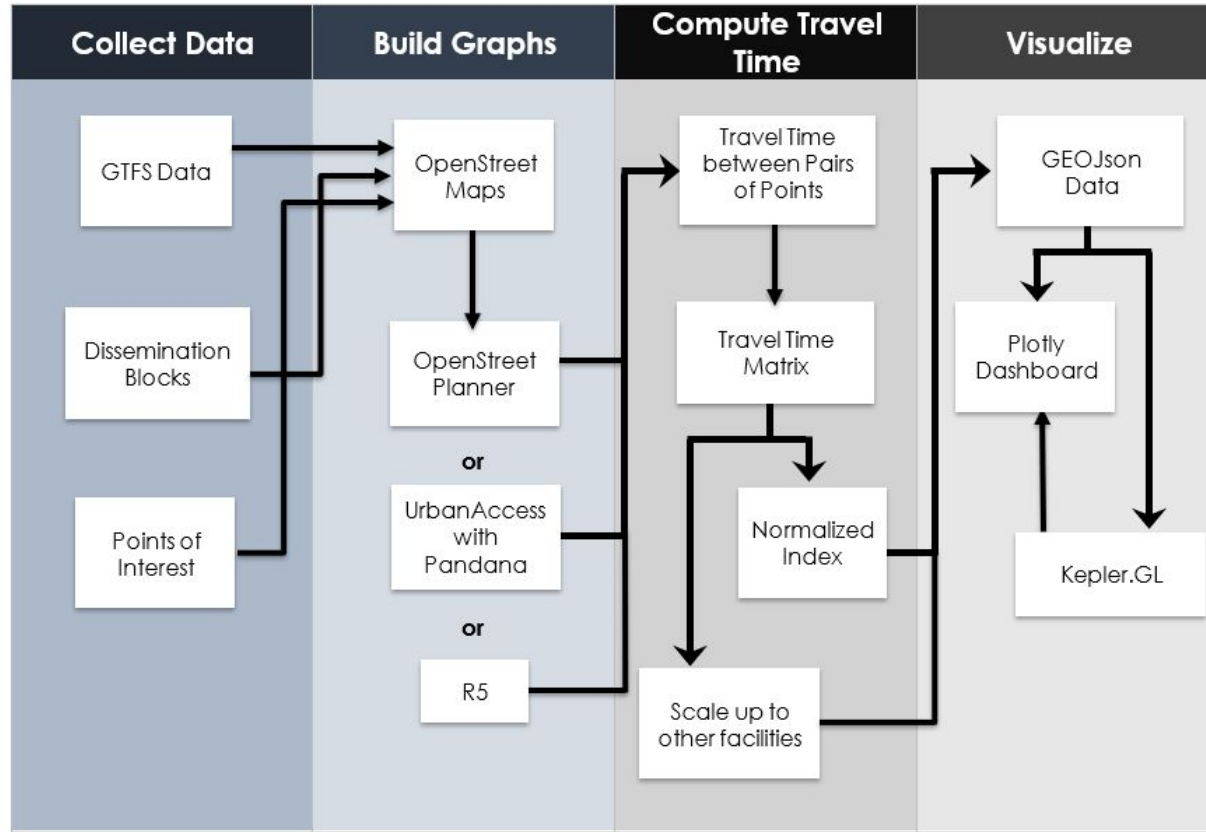
Initial Wrangling

- Pre-wrangled datasets
 - GTFS
 - Van-OSM
- Filtered datasets
 - ODCAF & CDB
 - Selected information only for the Greater Vancouver Area
 - Limited the number of attributes
 - Unique ID
 - Latitude & Longitude
 - Population of DBs

Layered dataset



Overall Workflow



Team Contract



- Decision Making
 - A consensus vote (100% passing vote)
 - 75% majority will be accepted if no reasonable compromise can be reached
- Meeting Expectations
 - Meet with Partners every **Monday** (additional meeting on Friday if necessary)
 - Within group meeting: every Monday, Wednesday, and Friday
- Distribution of Work
 - Decided during group meetings
 - Distributed based on consensus agreements
 - Tracked by using weekly reporting sheet

→ All documents collected in GitHub Repo

Tools

OpenTripPlanner 1	OpenTripPlanner 2
Both layer GTFS and OSM data to create networks for trip planning.	
<ul style="list-style-type: none">• More memory intensive <i>(shortest path algorithm)</i>• One-to-Many Analysis• Only accounts for 1 departure time	<ul style="list-style-type: none">• Extremely efficient <i>(resembles the R5 conveyal approach)</i>• One-to-One Analysis• Accounts for multiple departure time

R5 = Rapid Realistic Routing on Real-world and Reimagined networks

→ **r5r** = library for R using this algorithm ←

Tools

Current choice: r5r (R library)

To consider:

- OTP1 (likely to be too slow)
- OTP2 (queries 1 trip at a time - will end up being slow)
- UrbanAcces with Pandana (Python library)
- ArcGIS

Final Deliverables

Final Deliverables

1. Accessibility Score Data for each DB in Vancouver

Final Deliverables

1. Accessibility Score Data for each DB in Vancouver
2. An interactive, 3D Vancouver Heatmap visualizing the accessibility scores to cultural and art facilities.

Final Deliverables

1. Accessibility Score Data for each DB in Vancouver
2. An interactive, 3D Vancouver Heatmap visualizing the accessibility scores to cultural and art facilities.
3. A standardized mathematical model for converting one-to-many travel times to a single 0-1 score.

Final Deliverables

1. Accessibility Score Data for each DB in Vancouver
2. An interactive, 3D Vancouver Heatmap visualizing the accessibility scores to cultural and art facilities.
3. A standardized mathematical model for converting one-to-many travel times to a single 0-1 score.

Grand Finale:

Final Deliverables

1. Accessibility Score Data for each DB in Vancouver
2. An interactive, 3D Vancouver Heatmap visualizing the accessibility scores to cultural and art facilities.
3. A standardized mathematical model for converting one-to-many travel times to a single 0-1 score.

Grand Finale:

**A Nationally scalable methodology
for all urban areas and amenity types.**

Week 1 - Timeline

	Sun.		Mon.		Tue.		Wed.		Thu.		Fri.		Sat.	
	5/2/2021		5/3/2021		5/4/2021		5/5/2021		5/6/2021		5/7/2021		5/8/2021	
Task	Who	Done	Who	Done	Who	Done	Who	Done	Who	Done	Who	Done	Who	Done
Group meeting			All	Done							All	Done		
Draft Proposal + Statement of work			All		All		All		All		All		All	Done
City Selection							All	Done			All	Done		
Cultural Point of Interest Counts														
Raw Data Collection									All	Done				
Data Cleaning / Filtering											Graham + Rain	Done	Graham + Rain	Done
Integrate Van-OSM data and GTFS data and test OTP trip planning									Luka	Done				

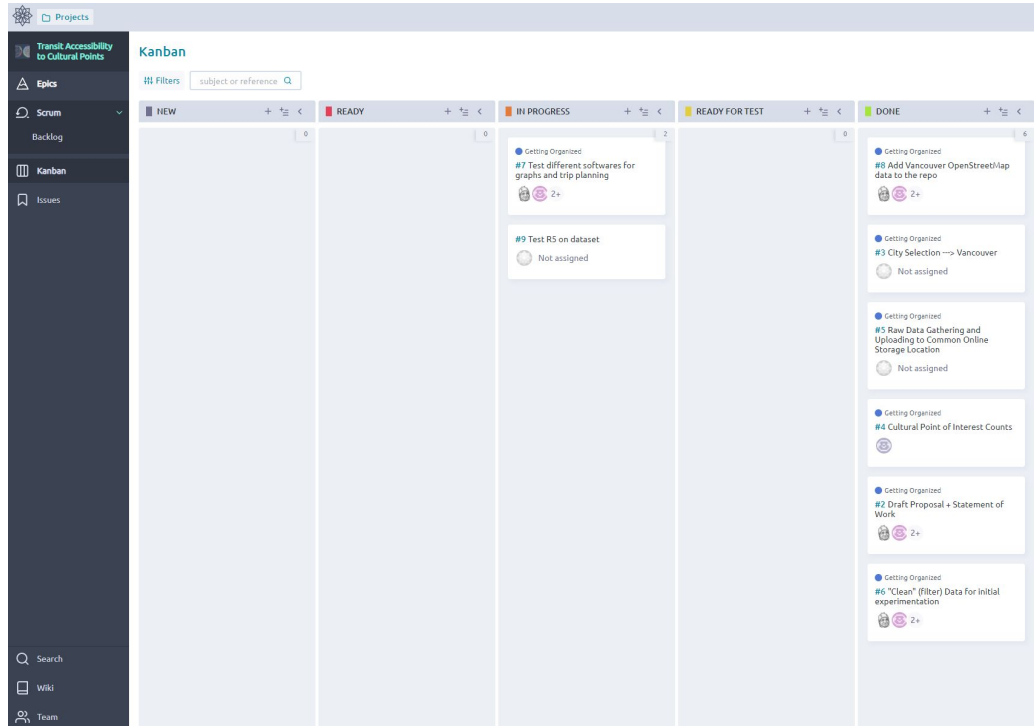
This Week..

	Sun.		Mon.		Tue.		Wed.		Thu.		Fri.		Sat.	
	5/9/2021		5/10/2021		5/11/2021		5/12/2021		5/13/2021		5/14/2021		5/15/2021	
Task	Who	Done	Who	Done	Who	Done	Who	Done	Who	Done	Who	Done	Who	Done
R5			All		All									
Determine preferred software			All		All									
Discuss mathematical model for score assignment					All		All							
Construct webscraper to get popularity / capacity / review data for cultural sites (Yelp, TripAdvisor, Google revs)							Yuxuan & Rain		Yuxuan & Rain		Yuxuan & Rain			
Clean previous data files									Anyone		Anyone			
Dashboard outline									Yuxuan & Graham		Yuxuan & Graham			
Kepler - Research									Luka		Luka			
UrbanAccess + Pandana							Rain		Rain		Rain			
Develop script to integrate mathematical model to time matrix									Luka or Graham		Luka or Graham			
Get times matrix							All		All		All			

Closing Remarks

We will be using Taiga.io for our logistical base of operations.

It's an open source software resembling Trello but with some unique functionalities.



Closing Remarks

Questions?