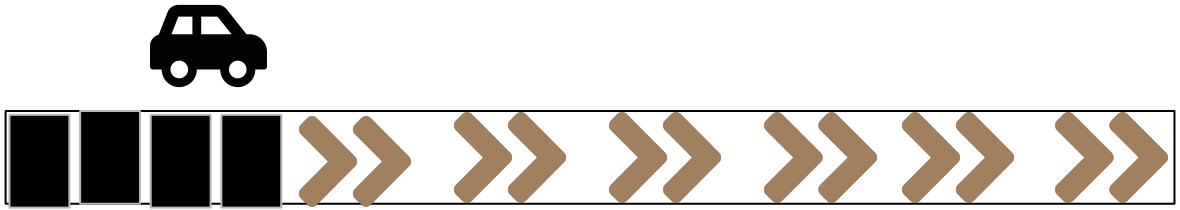
Incorporating Public Transit into Measures of Accessibility

UBCO 2021 Capstone Project

Overall progress

Week 2



Overall progress

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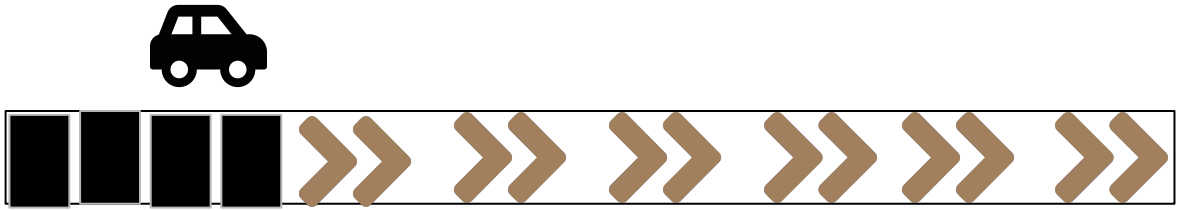
Things that have been tried:

- r5r -> Travel Time Matrix
- UrbanAccess + Pandana -> Network Visualization
- Kepler.gl -> Online 3D Visualization
- Plotly -> Dashboard
- Score model



Last Week’s Tasks

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- Generated the travel time matrix
- Tried UrbanAccess + Pandana for network visualization / alternative computation

Preliminary Results

- Used R5R to compute Vancouver's travel time matrix
  - **All** dissemination blocks to **All** cultural amenities (15,197 x 432) x 36 > 230,000,000
  - Averaging over departures on Fri/Sat/Sun every hour from 7am - 7pm (= 36)
  - Took roughly ~ 2-3 hours

O	D	T	σ_T
fromId <chr>	toId <chr>	avg_unique_time <dbl>	sd_unique_time <dbl>
59150004004	10	99.76316	5.364721
59150004004	15	72.48718	3.401794
59150004004	157	96.69231	3.001349
59150004004	1759	106.82051	4.388213
59150004004	1760	46.58974	2.642944
59150004004	1822	76.64103	3.990035
59150004004	1839	76.15385	2.680715
59150004004	1840	75.15385	2.680715
59150004004	1916	99.07692	3.571706
59150004004	1930	86.97436	4.923024

o_i — d_i — t_{o_i,d_i} — $\sigma_{t_{o_i,d_i}}$

Preliminary Results

- Aggregated on **`fromId`**

Origins // Mean T to all POI // Sigma T to all POI // Mean Sigma T to unique POI // n

o_i	$\mu_{t_{o_i,D}}$	$\sigma_{t_{o_i,D}}$	$\mu_{\sigma_{t_{o_i,d_i}}}$	n_{o_i}
fromId	avg_time_to_allpoi	sd_time_to_allpoi	avg_sd_time_to_uniquepoi	n_accessible_poi
59150004004	78.99412341	19.56542366	3.331569289	366
59150004005	81.6035132	19.50383505	3.078902427	366
59150004006	82.40150685	19.49813063	2.975488154	366
59150004011	79.93396055	19.51775265	3.285977859	366
59150004012	81.6339082	19.47031921	3.103758187	366

$$n_{o_i} = Count(d_i \in D_{o_i})$$

Set of accessible destinations within the constraints

Accomplishments

At the end of week 2

- Derived our first function for accessibility scoring, $S := \{s_{o_1}, ..., s_{o_n}\}$
  - Naive and Weighted Score Conversion

$$s_{o_i} = \frac{n_{o_i}}{\mu_{t_{o_i},D}\mu_{\sigma_{t_{o_i},d_i}}} \qquad n_{o_i,w} = Count(d_i w_i \in D_{o_i})$$

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Longer avg transit time = Smaller score

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Popularity weight

Interactions with the client

Pitfall (save for discussion)

- Different amenity types should be weighed differently or kept separate (ie. museums, libraries, and theatres are very different)

- Accessibility to the nearest 1-3 amenities gives a more realistic score than when considering all amenities

Can be addressed with modifications in aggregation.

Accomplishments

At the end of week 2

- Used Google API to collect the number of reviews and ratings for each POI

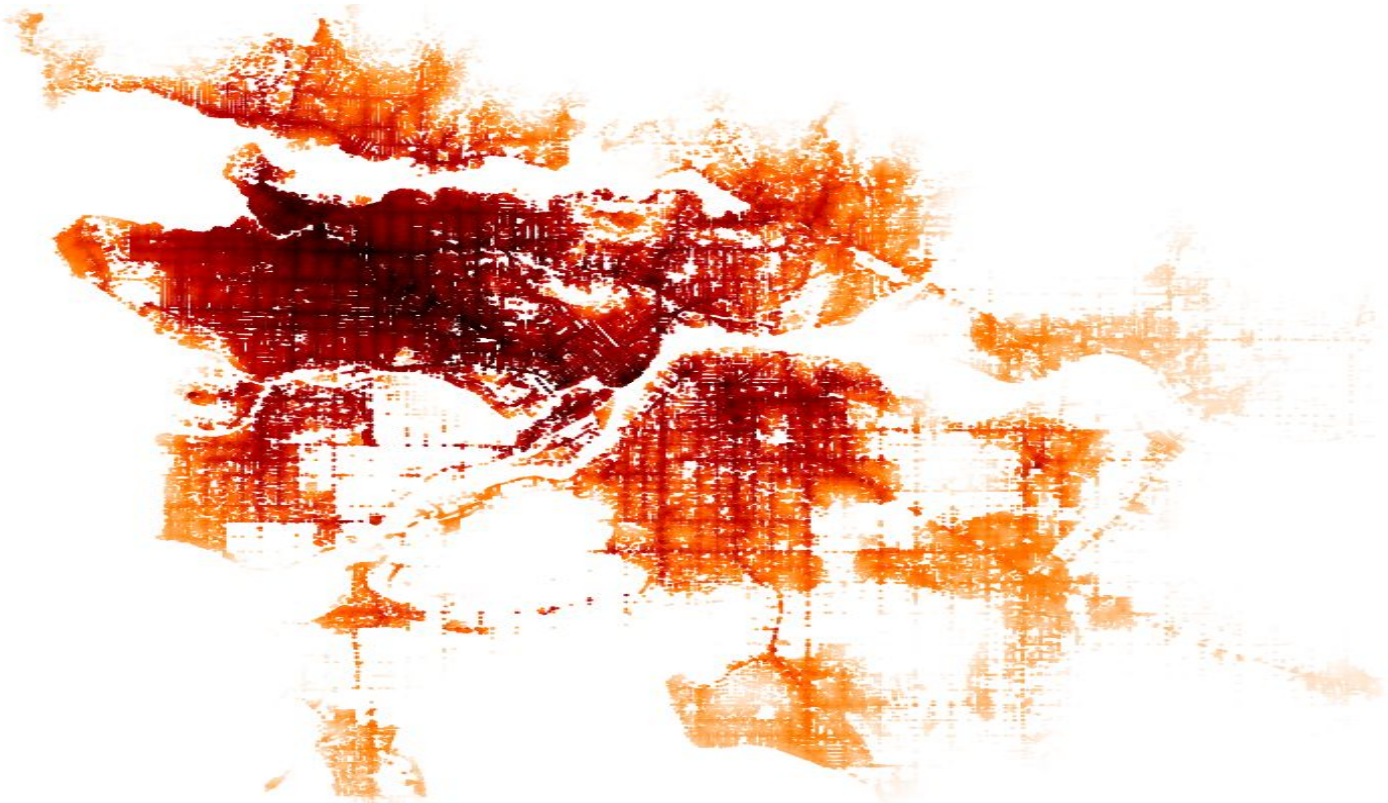
poi_name	Name	pid	Rating	Total_Review
12 Service Battalion Museum	39 Service B	ChIJhwQHwzh1hlQR	5	7
15th Field Artillery Regiment Museu	15th Field A	ChIJpdEUnLBzhlQR0	5	4
221A Artist Run Centre		0		
7302754 Canada Inc		0		
Abc Heritage Preschool And Child Ca	ABC Prescho	ChIJF3ZMao7RhVQR	no data	0
Adamsons Heritage Nursery Ltd	Agriforest Bi	ChIJQfsQ7fOLfVMRc	4.9	8
Agassiz Library	Agassiz Libra	ChIJNaGyl2sThFQRQ	5	8
Ahva Gallery	Ponderosa C	ChIJaUbtlrVyhlQREW	5	1
Aldergrove Festival Days Society	Aldergrove F	ChIJ_2qFN77LhVQRn	5	4
Aldergrove Library	Aldergrove L	ChIJnUQ_GcLLhVQR4	4.9	18
Alliance For Arts And Culture	Alliance for	ChIJ5WClfNVzhlQR1	4.8	8
Amelia Douglas Gallery	Douglas Coll	ChIJyU3u9XHYhVQR	3.9	286

Accomplishments

- **UrbanAccess: integrate 3 networks (transit, pedestrian, headways)**

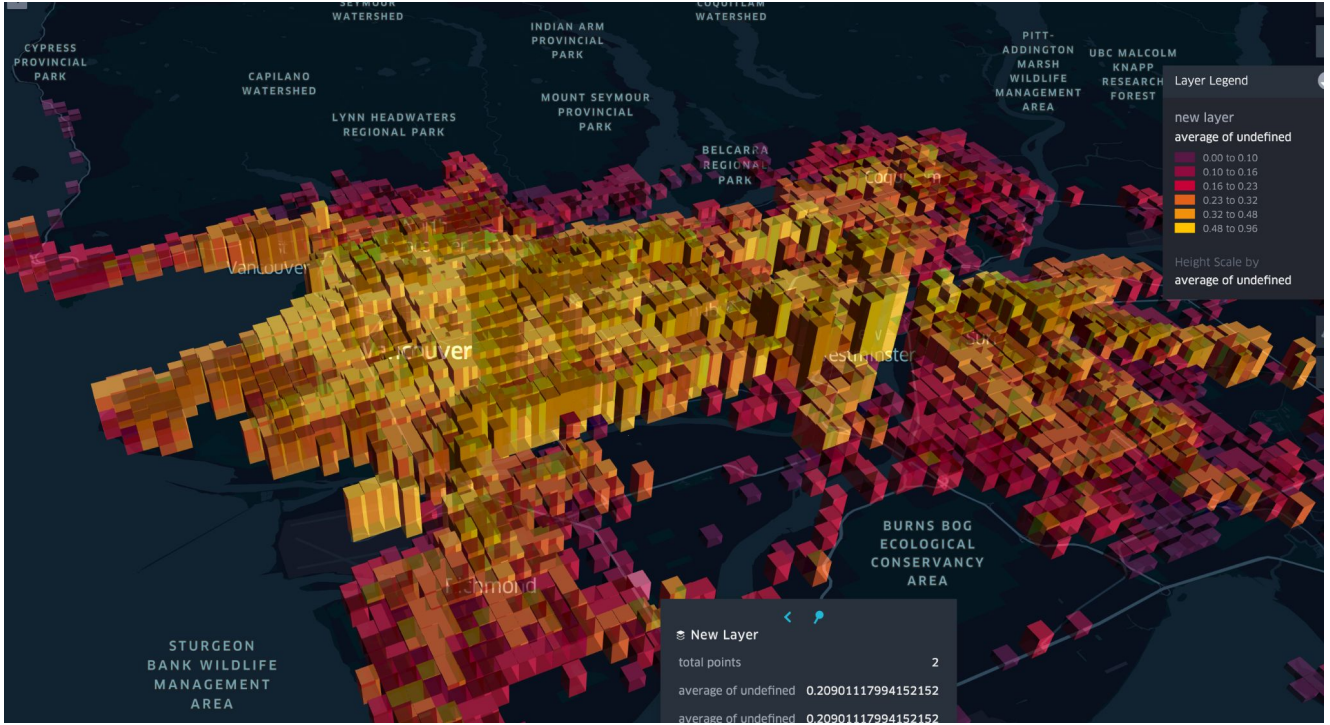
Accomplishments

- **<u>UrbanAccess + Pandana:</u> Within 60 minutes to any amenity**



Accomplishments

- Built 3D heatmap using Kepler with naive score model on great Vancouver area



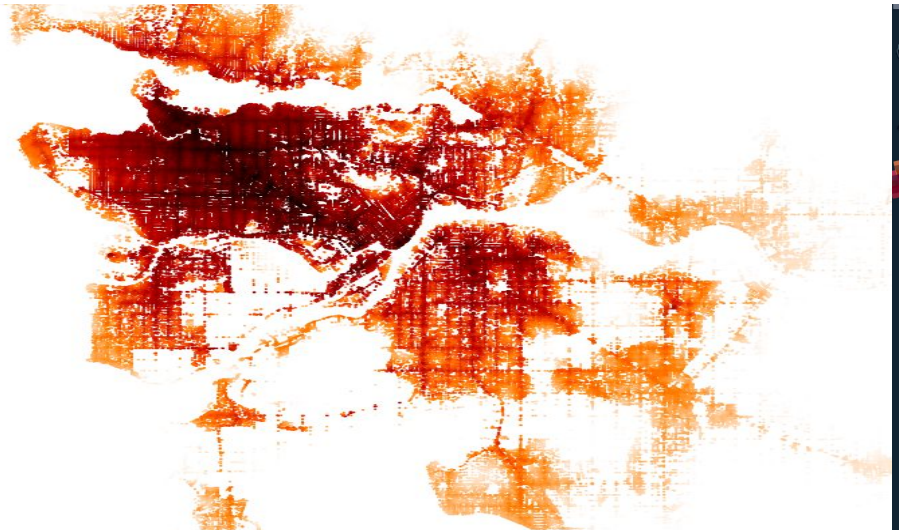
Accomplishments

At the end of week 2

MEASURES OF PUBLIC TRANSIT ACCESSIBILITY TO CULTURAL AND ART FACILITIES IN VANCOUVER

STATISTICS CANADA

Block assessibility map | Transit efficiency map | Accessibility equity map | **Accessibility heat map** | Network optimization



Week 3 Plan

- Deploy first dashboard
- Use UrbanAccess with Pandana for time computation (mostly for methodology comparisons to r5r)
- Interactively visualize accessibility scores (chloropleth map)

  (Python) Plotly + Mapbox + Dash VS (R) leaflet or ggmap or tmap

- Develop the amenity popularity weight index
- Reaggregate to get time matrixes for individual amenity types
- Develop other scoring functions and compare with visualizations

Week 2 - Timeline

	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	Done	All	Done								
Determine prefered software			All	Done	All	Done								
Discuss mathematical model for score assignment							All	Done						
Construct webscraper to get popularity / capacity / review data for cultural sites (Yelp, TripAdvisor, Google revs)							Yuxuan & Rain	Done	Yuxuan & Rain	Done	Yuxuan & Rain	Done		
Clean previous data files							Anyone	Done						
Dashboard outline									Yuxuan & Graham		Yuxuan & Graham			
Kepler - Research									Graham	Done				
UrbanAccess + Pandana							Rain		Rain		Rain	Done		
Develop script to integrate mathematical model to time matrix							Luka	Done						
Get times matrix							All	Done						
Develop code into script											All			
Compare Efficiency models											Graham			

Week 3 Timeline

Weekly Tasks *This week's theme:* **Dashboards and Scoring Models**	Mon. 5/24/2021	Tue. 5/25/2021	Wed. 5/26/2021	Thu. 5/27/2021	Fri. 5/28/2021	Sat. 5/29/2021
Sketch our dashboard outline	Graham ☑					
First Dashboard build with plotly (R or Python?)	Graham ☑	Graham ☐	Graham ☐	Graham ☐		
Interactive plotl visualization of accessibility scores			Graham ☐	Graham ☐		
Using Urban Access + Pandana for Time computation (a second methodology for benchmarking r5r)	Rain/Luka ☑	Rain/Luka ☐				
Using Urban Access + Pandana for visualization	Rain ☑	Rain ☐	Rain ☐			
Add weight factor for different categories (libraries)		Rain ☐	Rain ☐	Rain ☐		
Keplr.gl Visualization Online	Yuxuan ☑					
Keplr.gl in local dash file (deck.gl)	Yuxuan ☐	Yuxuan ☐	Yuxuan ☐			
ggplot2 top down network visualization	Luka ☐	Luka ☐	Luka ☐			
Develop multiple sets of scores to incorporate Joseph's "nearest amenity type" feedback		Luka + Anyone ☐	Luka + Anyone ☐	Luka + Anyone ☐		
Document all models for score computation		Luka + Anyone ☐	Luka + Anyone ☐	Luka + Anyone ☐		
Presentation Slides	All ☑					
Client meeting and feedback	All ☑					
Develop the amenity popuarity weight index using Yuxuan's API data on Google reviews		All ☐	All ☐			
Visualize new score models (to be done on a local Keplr instance and ggplot)				All ☐	All ☐	
Visualizng Transit efficiency by integrating DB populations (not a priority until dashboard and concensus scoring models are build						
Facebook API for popularity weights (not a priority if using nearest amenity score model)			Luka/Rain ☐	Luka/Rain ☐	Luka/Rain ☐	

Roadblocks

- Objective factors for measuring mass of the points of interest
  - Number of Visitors
  - Number of Employees
  - Revenues

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  - Number of Visitors
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  - Revenues
- Counting population of dissemination blocks
  - Efficiency v.s. Accessibility

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  - Number of Visitors
  - Number of Employees
  - Revenues
- Counting population of dissemination blocks
  - Efficiency v.s. Accessibility
- UrbanAccess with Pandana
  - Computationally heavy

Summary of team and individual tasks

	Luka	Graham	Yuxuan	Rain	All
R5r time matrix					
Kepler.gl					
UrbanAccess + Pandana					
Dashboard outline					
Mathematical model for score					

Closing Remarks

Questions?