Livability Analysis for Neighbourhoods in Toronto through Web-GIS

Group 2

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TORONTO LIFE

You define your livability.

OUTLINE

Introduction

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Introduction

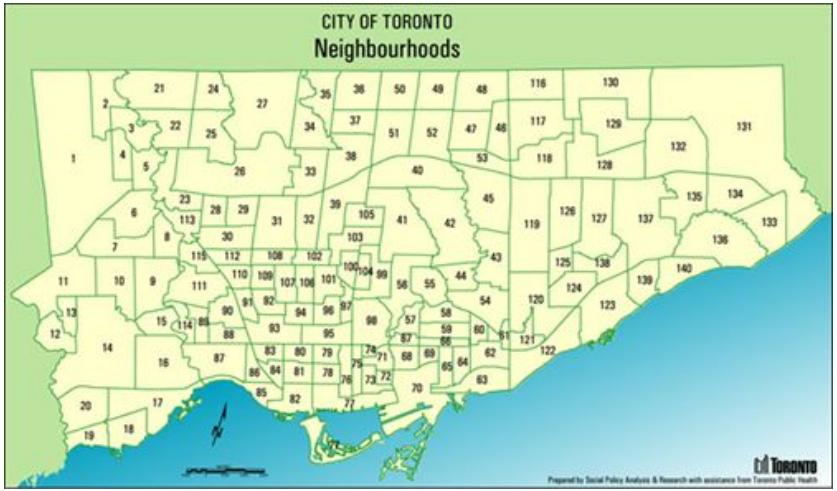
- Livability - A people-oriented concept
- High livability means:
  - Cities: new business, investment, more prosperous and proud
  - Citizens: higher living standard, quality of life
- Problems:
  - Constant weights
  - Static model
  - Considering factors unfairly
  - Cannot meet variable needs
  - Large scale (city, country)

Objective

- To assess the relative livability of the 140 neighbourhoods in Toronto
- Web application for users to determine their unique livability scores depending on their preferences and lifestyle
- Specific goals for the web application:
  - Near-instantaneously
  - Visual communication
  - User-friendly
  - Interactive

Study Area: City of Toronto

- Population of 2,956,024 (Statistics Canada 2016 Census)
- 51.5% visible minorities and 51.2% immigrants
- 4th in the world and 2nd in Canada for Livability
- 140 neighbourhoods in the City of Toronto

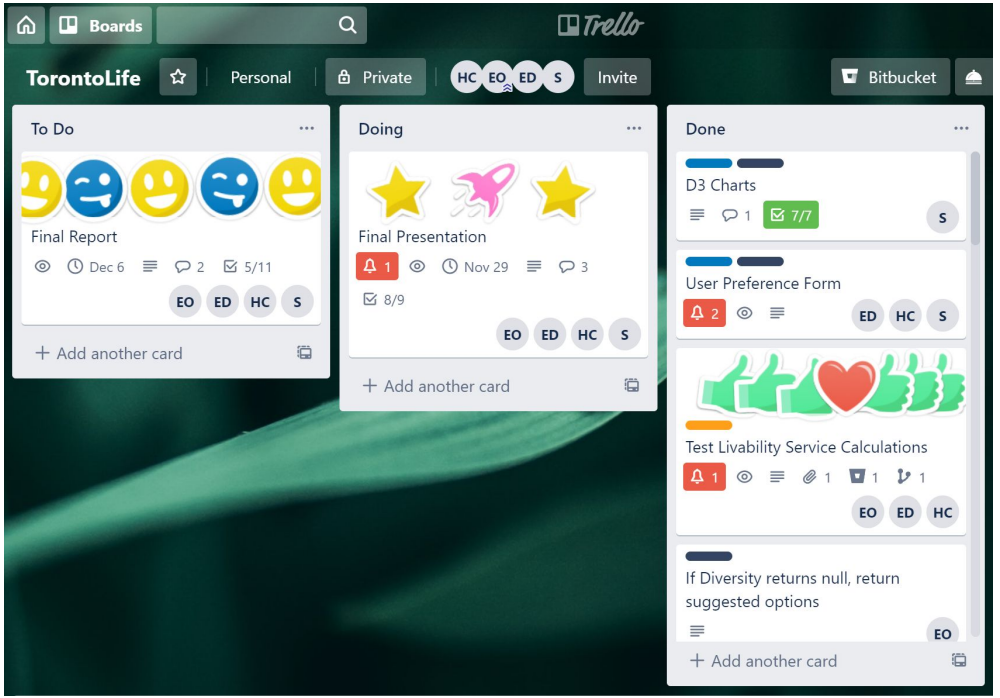


Data Sources

- Source: City of Toronto Open Data
- Extent/Scale: City of Toronto
- Layers:
  - Neighbourhood boundaries
  - 9 factors: Census, schools, fire stations, fire incidents, police stations, ambulance stations, parking lots, bicycle parking, parks and community area, places of worship, retirement homes, transportation wellbeing, health wellbeing
- Data Type:
  - SHP
  - CSV, GeoJSON, JSON

Work Plan

- General steps:
  - Gather Datasets
  - Process Data
  - Develop Ranking System
  - Build Application
  - Deploy
- Helpful productivity tools:
  - Trello
  - SourceTree



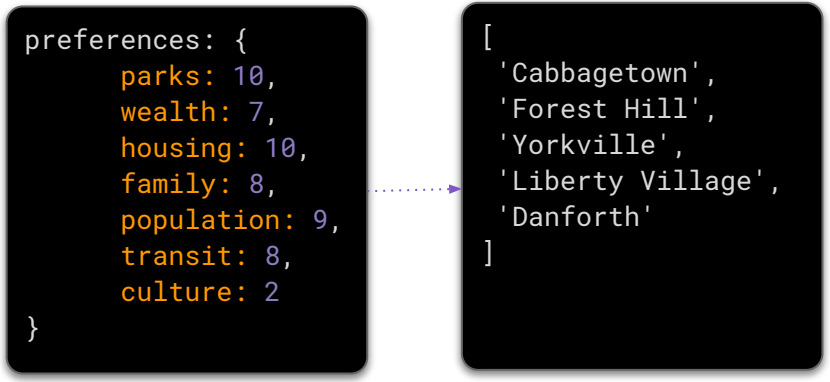
Methodology

Goal:

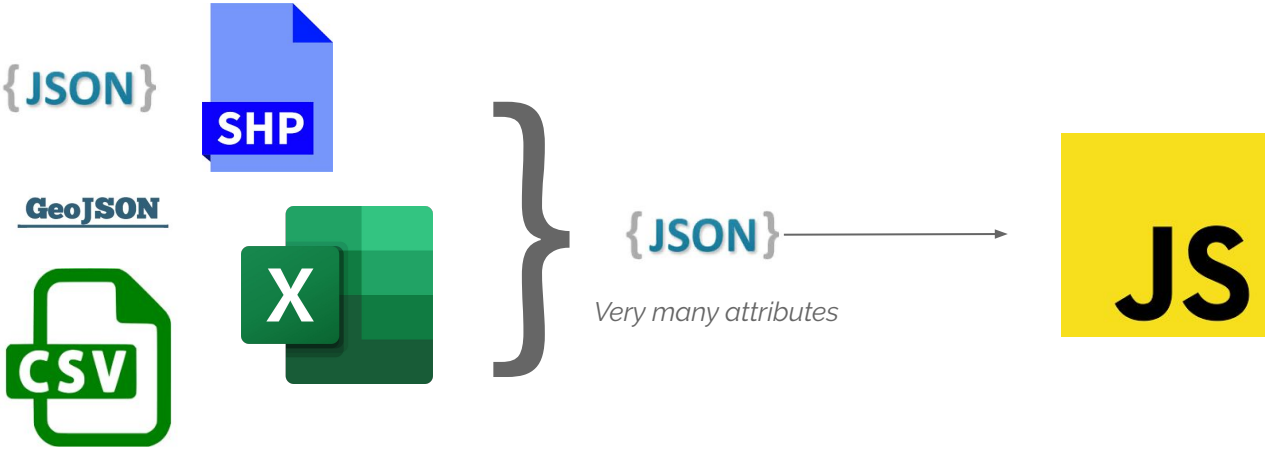
Calculate the suitablity of neighbourhoods based on a user's preference.

How?

1. Gather lots of data about Toronto
2. Reshape data into standard format
3. Create neighbourhood models
4. Generate vector representation of models
5. Generate vector based on user preferences
6. Calculate similarity between user vector and neighbourhood vectors



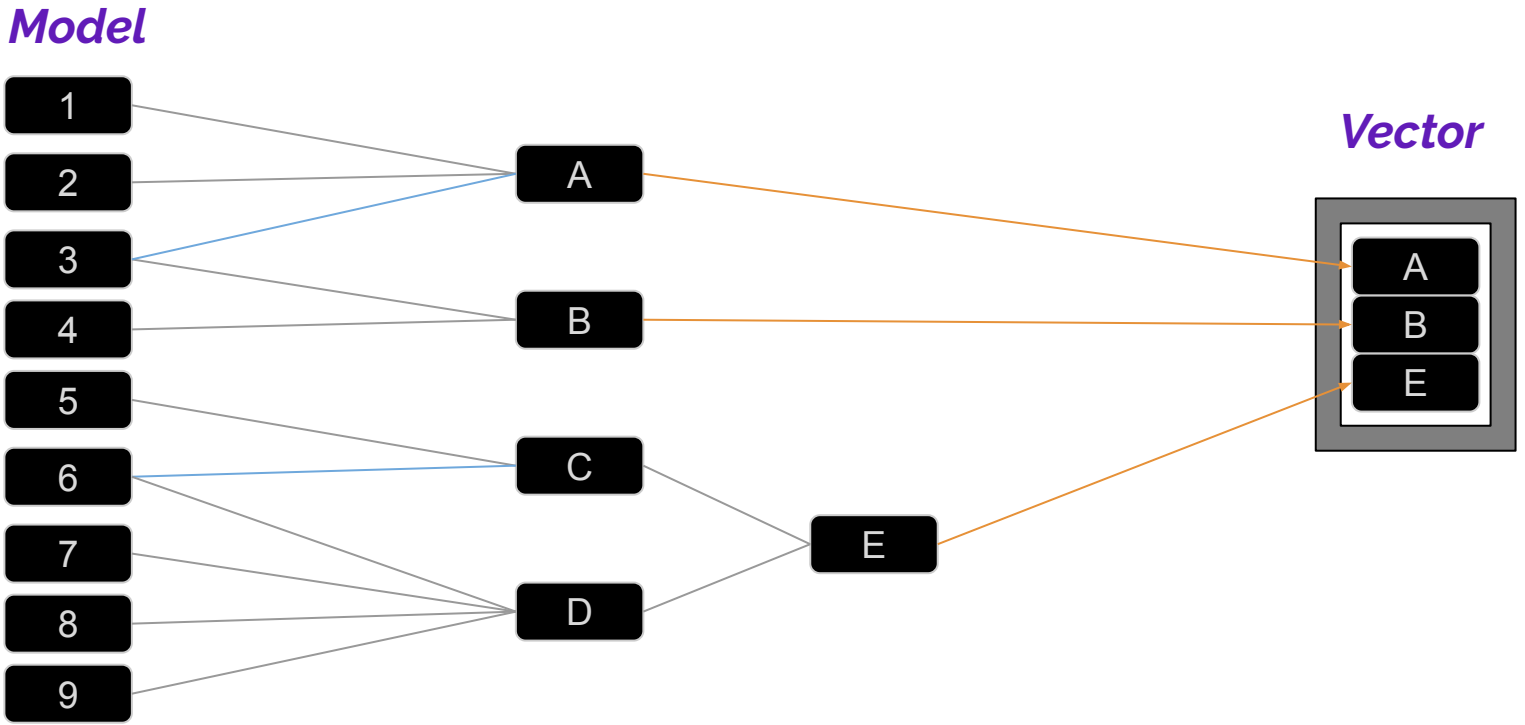
Methodology - Creating the Model



Model

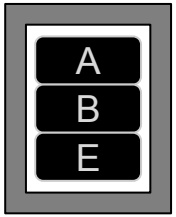
The final neighbourhood model is represented as a Javascript Class, with attributes and methods that support the characteristics of the model.

Methodology - Generating the Vector

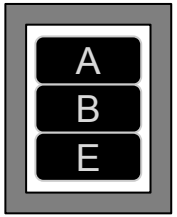


Methodology - Similarity

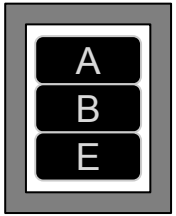
Vector A



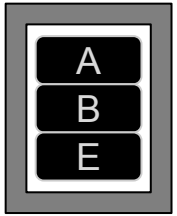
Vector B

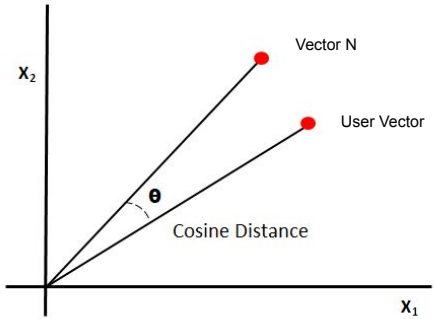


Vector C



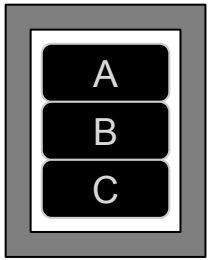
Vector D





$$\text{similarity} = \cos(\theta) = \frac{\mathbf{A} \cdot \mathbf{B}}{\|\mathbf{A}\|\|\mathbf{B}\|} = \frac{\sum_{i=1}^{n} A_i B_i}{\sqrt{\sum_{i=1}^{n} A_i^2}\sqrt{\sum_{i=1}^{n} B_i^2}},$$

User Vector



Methodology - Testing

- Backend Testing - algorithm
  - Created a test file for backend algorithm testing
  - Designed more than 60 test cases
  - Compared the results with original data

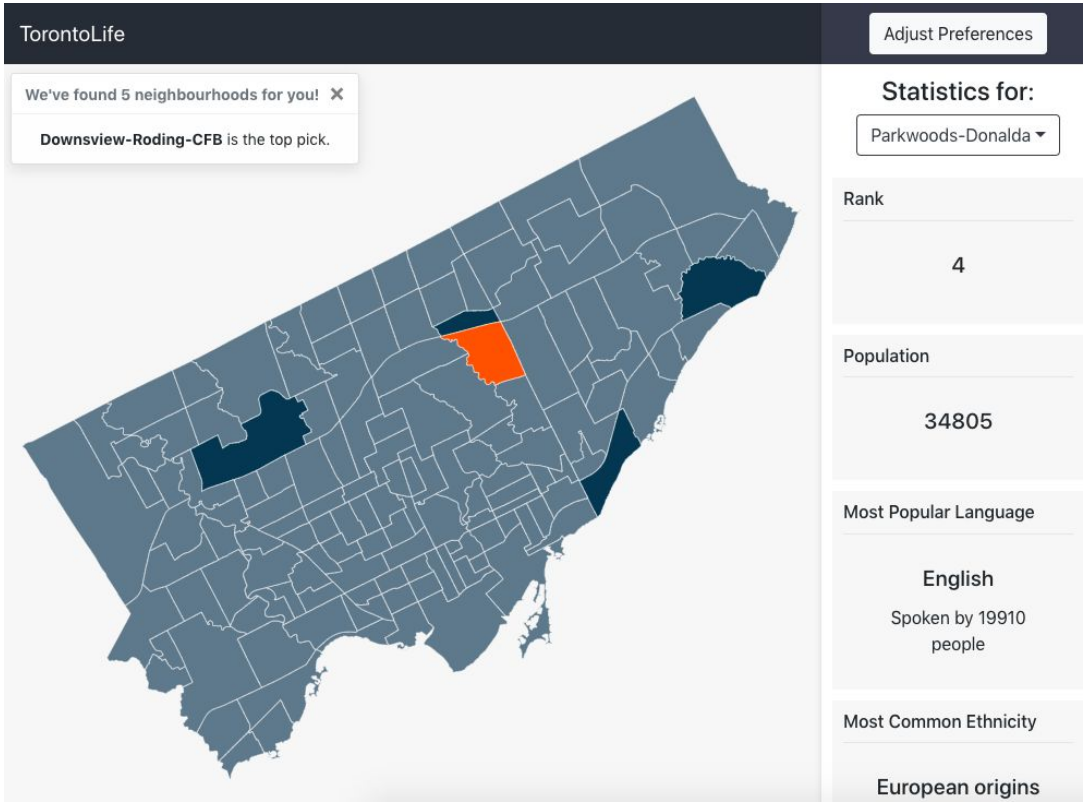
```
{
  input: [10,9,2,8,9,5,10,9,5,5],
  desc: 'Wealthy neighbourhood with high park coverage and great transit, great services and good family life, prefer own',
  result: null,
},
```

```
Wealthy neighbourhood with high park coverage and great transit, great services and good family life, prefer own
{ couldFilterByDiversity: true,
  neighbourhoods:
   [ { id: '136', name: 'West Hill', similarity: 0.9718229470169674 } ] }
```

- Whole App Testing - user experience

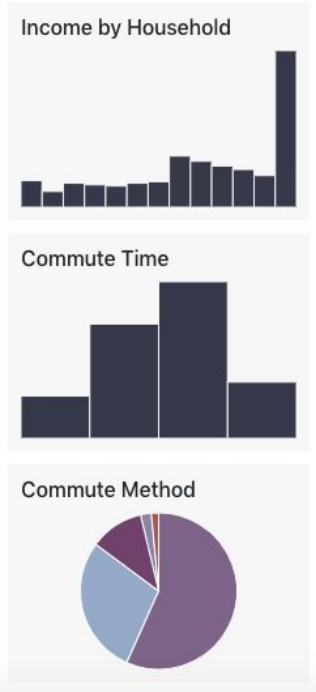
Result

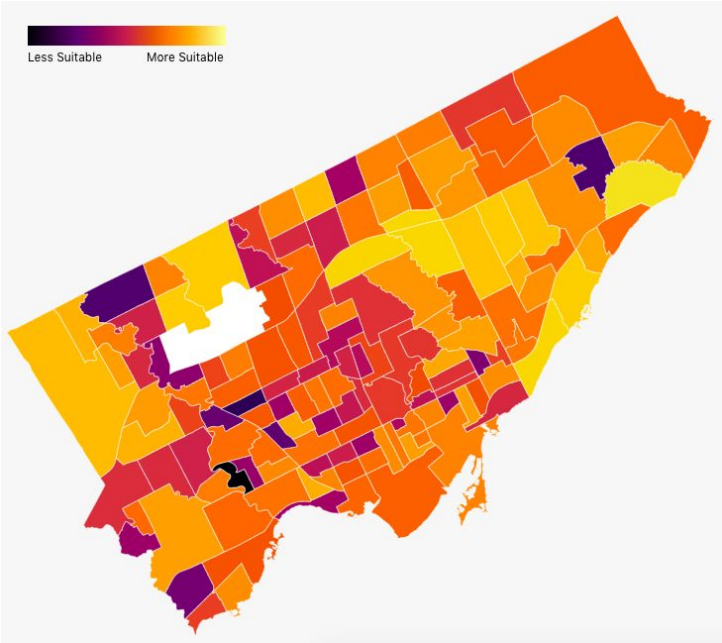
- Working web application deployed
- Is accessible to all
- Interactive neighbourhood map page
- Statistics sidebar
- Responsive web page built on React and D3



Result (cont.)

- Neighbourhood stats such as income and commute time
- Toggleable heat map to represent livability values

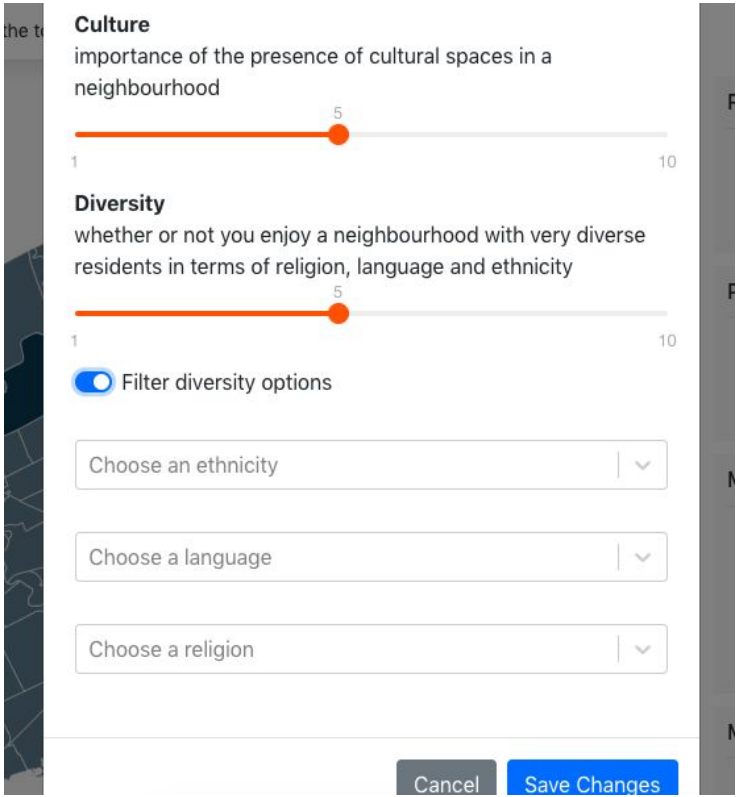




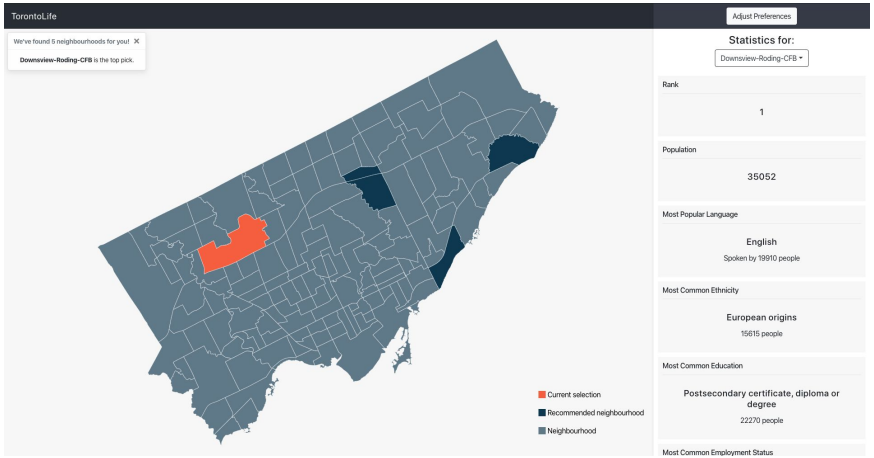
Result (cont.)

- User preference form
- Filterable diversity options
- 1 to 10 user rating for factors

https://torontolife-481.web.app



Future Directions



- Algorithms
  - Improvement on livability ranking.
  - Tuning preference matching
- Data
  - More data points to be considered for neighbourhood profiles
  - Evolving database - Data which can grow and update
- Product/Deliverable
  - Improvements to preference options
  - Displaying statistics based on user preferences
  - Narrowing the scale of results (e.g. recommendation on specific property)

Thanks for your attention.

Question Time!