Algorithims and Analyses to Advance Boston's Progress Towards Carbon Neutrality

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Abstract

The City of Boston has pledged to be a zero emission city by 2050. We are looking at Boston's data on the eco-friendly services and facilities it currently offers. Specifically, this project focuses on three different objectives: **calculating a green score for each neighborhood, finding correlations between eco-friendly facilities/services, and simulating the improvement of green scores through constraint satisfaction algorithms.**

Datasets

Analyze Boston
- Neighborhood Data
- Hubway Sation Data

Boston Maps Open Data
- Bike Network Data
- Charging Station Data
- Open Space Data

Calculating a green score for each neighborhood

Objective: Calculate a green score for each of Boston's 26 neighborhoods

$$\text{Score} = \begin{cases} \dfrac{\sum_{i=1}^{n} \frac{F_i}{4} + \left(\text{Item}_i - \frac{F_i}{4}\right) \times (.2)}{10} & \text{if } \text{Item}_i > \frac{F_i}{4} \\[2ex] \dfrac{\sum_{i=1}^{n} (\text{Item}_i)}{10} & \text{if } \text{Item}_i < \frac{F_{i*}}{4} \end{cases}$$

*we define items as charging stations, hubway stations, bike network points, and open space points

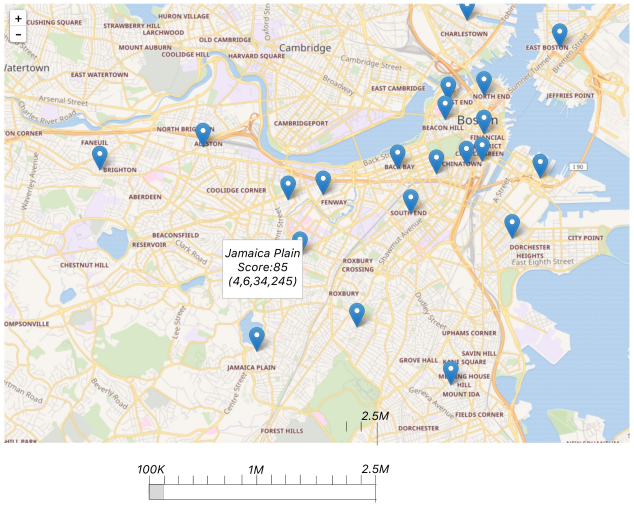
where F is the average number of each item per neighborhood

Visualising Budgets as Constraint Satisfaction

Objective: Allow user to interact with a visualisation that contains a set of budgets from $100,000 to $2,500,000 for each neighborhood.

Technique: Transform each problem into a constraint satisfaction problem and use the z3 solver to obtain corresponding results.

Key: Neighborhood, Score: X, (No. of Charging Stations, No of. Hubway Stations, No of. Bike Network Point, No of. Open Space Point)



Correlation between green developments

Objective: Find correlations between eco-friendly facilities and services across neighborhoods

Technique: Pearson product-moment correlation
$\rho(x, y) = \text{cov}(x, y) / (\sigma(x) \cdot \sigma(y))$

X	Y	Correlation Coefficient	P Value
Charging Stations	Hubway Stations	0.4066	0.0392
Charging Stations	Bike Networks	-0.2419	.2336
Charging Stations	Open Spaces	-0.2611	0.1974
Hubway Stations	Bike Networks	-0.1785	0.3827
Hubway Stations	Open Spaces	0.0503	0.8071
Bike Networks	Open Spaces	0.6459	0.0003

Future Work

Tweak formula for calculating green score to include more dimensions.

Expand green score algorithm and budget visualisation to include neighborhoods in Cambridge, and the Greater Boston area.

Implement a green score and budget allocator platform for the city of Boston using machine learning