OPTIMIZING BIKE SHARING SYSTEM IN DC

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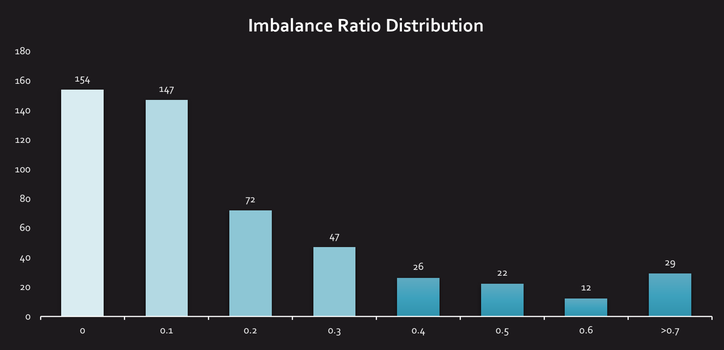
MAKE BIKE-SHARING MORE EFFICIENT

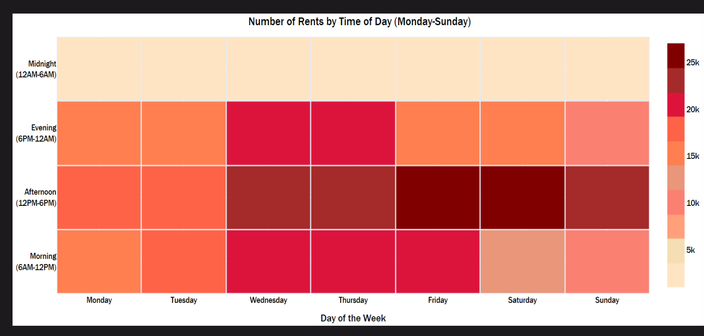
INTRODUCTION

Bike sharing has become an essential mean of transportation in many major cities. To tackle the uneven flow of bikes within the system, bike providers use trucks to relocate bikes during midnight. The traditional manual bike relocation method is irresponsive during the day, and the experience-based path planning for relocating bike is costly and inefficient.

GOALS

We adopt advanced machine learning technique to model the imbalance ratios of bike stations, optimize and visualize routes for prompt bike relocation. The approach we present will result in a more efficient process to maintain a balanced bike sharing system, and subsequently generate more revenue and customer satisfaction.





APPROACH

Clustering — Analyze Imbalance Issue

- K-means & Expectation Maximization
- Explore activity patterns within each cluster

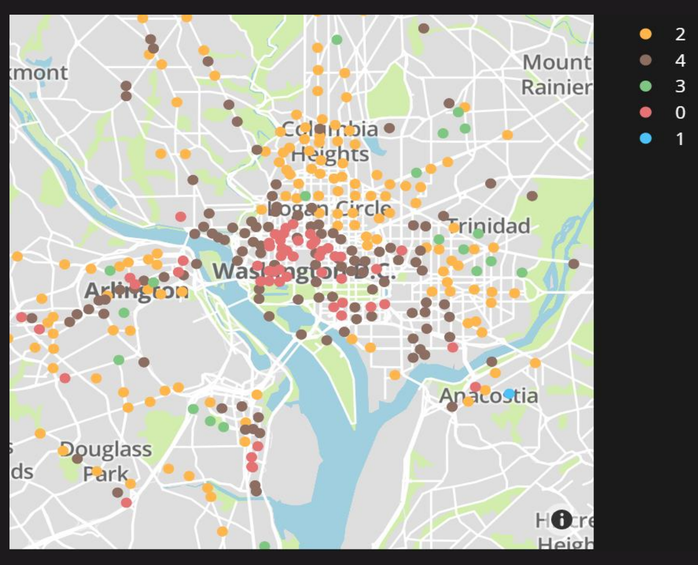
Optimization — Improve Relocate Efficiency

- Build path planning model based on TSP
- Find the optimal routes for bike delivery

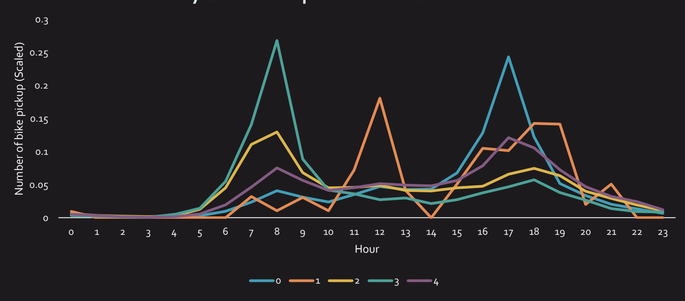
Visualization — D3, Python, R, Mapbox API

- Detect imbalance patterns and other insights

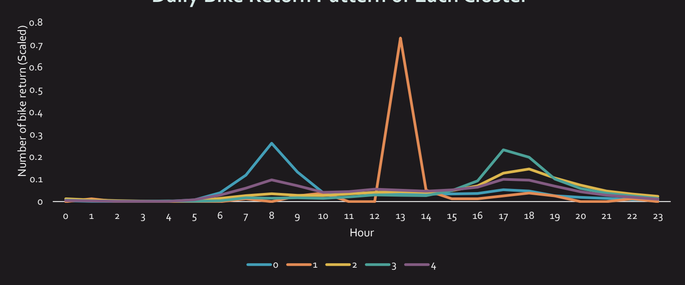
Cluster of Bike Stations



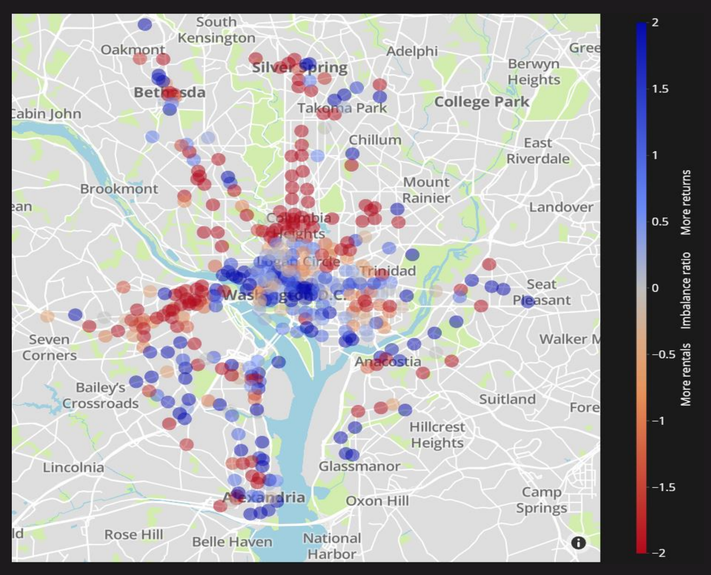
Daily Bike Pickup Pattern of Each Cluster



Daily Bike Return Pattern of Each Cluster



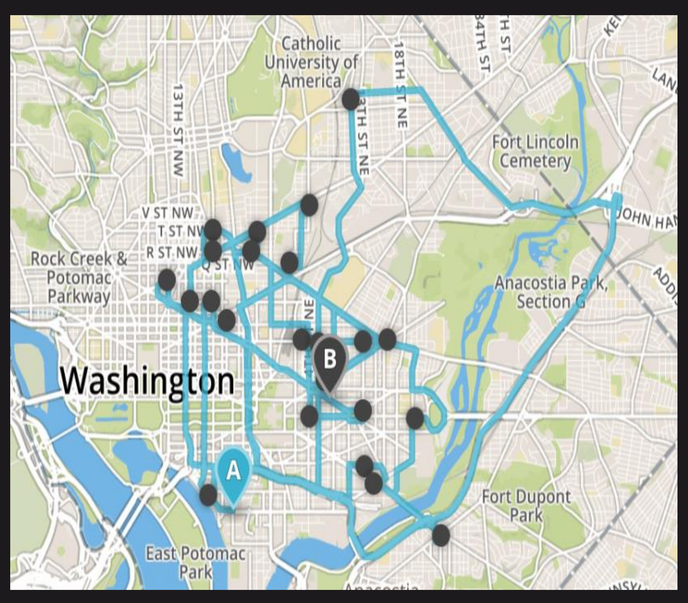
Imbalance Distribution



EXPERIMENT

- **Use k-means cluster to find five classes of bike stations.**
  - Cluster 0: High returns in the morning and high pickups at night
  - Cluster 1: High pickups and returns at noon
  - Cluster 2: Moderate pickups in the morning
  - Cluster 3: High pickups in the morning and high returns at night
  - Cluster 4: Moderate pickups at night
- **Optimize bike relocation routes**
  - Each bike station is passed only once
  - Route is calculated within each cluster
  - Each route has a maximum distance of 40 miles

Optimized Routes for Bike Delivery



EVALUATION

- **Responsiveness**
  Instead of relocating bikes during midnight, we can update relocation route according to real-time data so that improve user experience.
- **Cost-saving**
  Travel distance is minimized based on the optimal routes, which will reduce utility cost and labor cost by 30%.
- **Outlier Detection**
  Based on cluster output the company can consider eliminating isolated imbalance stations or install more stations in business growing areas.

REFERENCE

[1] Vogel, Patrick, Torsten Greiser, and Dirk Christian Mattfeld. "Understanding bike-sharing systems using data mining: Exploring activity patterns." *Procedia-Social and Behavioral Sciences* 20 (2011): 514-523.
[2] García-Palomares, Juan Carlos, Javier Gutiérrez, and Marta Latorre. "Optimizing the location of stations in bike-sharing programs: A GIS approach." *Applied Geography* 35.1-2 (2012): 235-246.

DATASET

Capital Bikeshare trip history data
- Bike No, duration, time, begin and end station
- Coordinates of bike stations
- Data size: 90MB/ year, 400k records/ month