Data Science for Public Urban Transit and Mobility

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The Importance of Mobility

- Car ownership in the US
  - best predictor of upwards social mobility

The relationship between transportation and social mobility is stronger than that between mobility and several other factors, like crime, elementary-school test scores or the percentage of two-parent families in a community.

Nathaniel Hendren, Harvard University

The Importance of Mobility

- Transportation and health care

Many low-income people in urban and suburban areas struggle to find reliable transportation. The result is missed appointments and poor illness management, even when care is readily available.


- 3.6 Millions do not obtain medical care because of a lack of transportation in a given year

- Access to Health Care and Nonemergency Medical Transportation Two Missing Links. By Wallace & al, 2005
The Importance of Mobility

- Transportation and Healthy Food

  Accessing healthy food is a challenge for many Americans—particularly those living in low-income neighborhoods
  - The Grocery Gap, 2010

- Lack of supermarkets
  - 23 millions have no supermarket within a mile
  - predominance of convenience stores

- Lack of transportation access to stores
  - residents in many urban areas have few transportation options to reach supermarkets
The First/Last Mile Problem
Congestion

- The cost of congestion
  - in 2013, 124 billions
  - predicted to be 184 billions in 2030
  - affected large and small cities
Greenhouse Gas Emission


- Agriculture: 9%
- Commercial & Residential: 12%
- Industry: 21%
- Transportation: 26%
- Electricity: 30%
Greenhouse gas Emission

- Passenger Cars: 34%
- Light-duty Vehicles: 63%
- Heavy-duty Vehicles: 21%
- Light-Duty Trucks: 28%
- Medium and Heavy-Duty Trucks: 20%
- Buses: 17%
- Other Aircraft: 7%
- Commercial Aircraft: 7%
- Rail: 7%
- Pipelines: 1%
- Ships and Boats: 1%
- Other Non-Road: 7%

Pascal Van Hentenryck 2017
Urban Sprawl (peri-urbanization)

- Air Pollution
  - increased greenhouse emission
- Water overconsumption
  - landscaping
- Health consequences
  - more reliance on cars
- Social consequences
  - increased racial and economic disparities
- Safety
  - over 30,000 deaths a year (2010)
- Loss of wildlife habitat
Connectivity
Automated Vehicles

[Images of automated vehicles]
Data Science and Analytics

Prescriptive Analytics
What should I do?

Diagnostic Analytics
Why did it happen?

Predictive Analytics
What will happen?

Descriptive Analytics
What has happened?

Analytics Focus
Past Present Future

Source: http://ibm.co/1gJyfl3
Can we reinvent public transit for millions of people?
On-Demand Multimodal Transit

- High-Frequency buses/trains between hubs
- Passengers travel to/from hubs in cars/shuttle
On-Demand Multimodal Transit

- Mobile application to book the entire trip
On-Demand Multimodal Transit System

- **Goal**
  - inventing novel public transit systems
- **multiple fleets of vehicles**
  - buses, shuttles, cars, light-rail, bicycles, segways
- **on-demand**
  - address the first/last mile problem
- **human-centered mobility**
  - one click to order and trip tracking
- **congestion management and quality of service**
  - real-time routing and dispatching and traffic control
- **pricing and incentives**
  - differentiated service
UM Transit System

- Some figures
  - 50,000 commuting trips a day
  - 7.4 millions a year
  - 75% capacity utilization
  - increasing congestion issues
OnDemand Multi-Modal Transit System
OnDemand Multi-Modal Transit System

DYNAMIC SHUTTLE
FORD SMART MOBILITY PLAN
Shuttles
OnDemand Multi-Modal Transit System
OnDemand Multi-Modal Transit System
The Analytics Pipeline

- network design
- routing and dispatching
- pricing

- travel demand
- mode prediction
- asset conditions

- activity-based model
- infrastructure utilization
- asset utilization

Past | Present | Future

Source: [http://ibm.co/1gJyfl3](http://ibm.co/1gJyfl3)
The Research Team

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UM Buses (Commuter North)
UM Mobility Data
Campus Transit System

South: 3 Buses

Medical: 3 Buses

B. Baits: 5 Buses

North: 4 Buses
Campus Transit System

Statistics on trips depending on the number of legs

- Number of trips
- Time in minutes

Number of legs within a trip:
- 1: 10000
- 2: 15000
- 3: 20000
- 4: 25000

- Trip time
- Waiting time
- Number of trips
System Cost

Total System Cost:
~$13,000,000
Conclusion

- Unique opportunity to transform mobility
  - address fundamental societal challenges
  - RTA is a great potential case study

- Data science as an engine for mobility
  - understanding mobility
  - predictive models
  - network design
  - real time routing and dispatching
  - many more

- Come to talk to us
  - we love deploying solutions