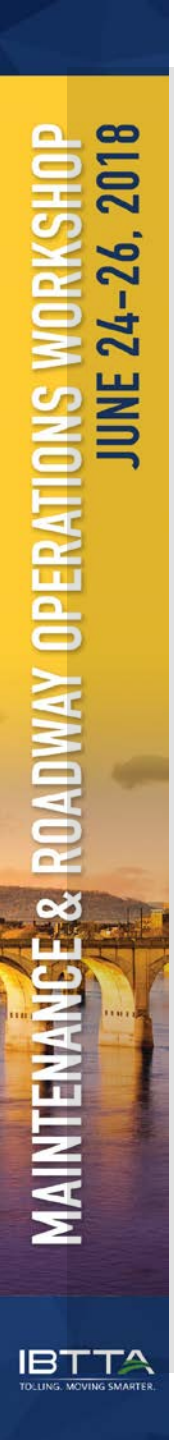

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Using Machine Learning to Forecast TaaS Adoption

The Problem

- Anticipating and preparing for changes in how people travel on roadways
  - TaaS/MaaS
  - CAVs
  - Individuals less likely to own a vehicle
- What does that mean for a toll operator?
  - Road design, technology, capacity, congestion

The Solution

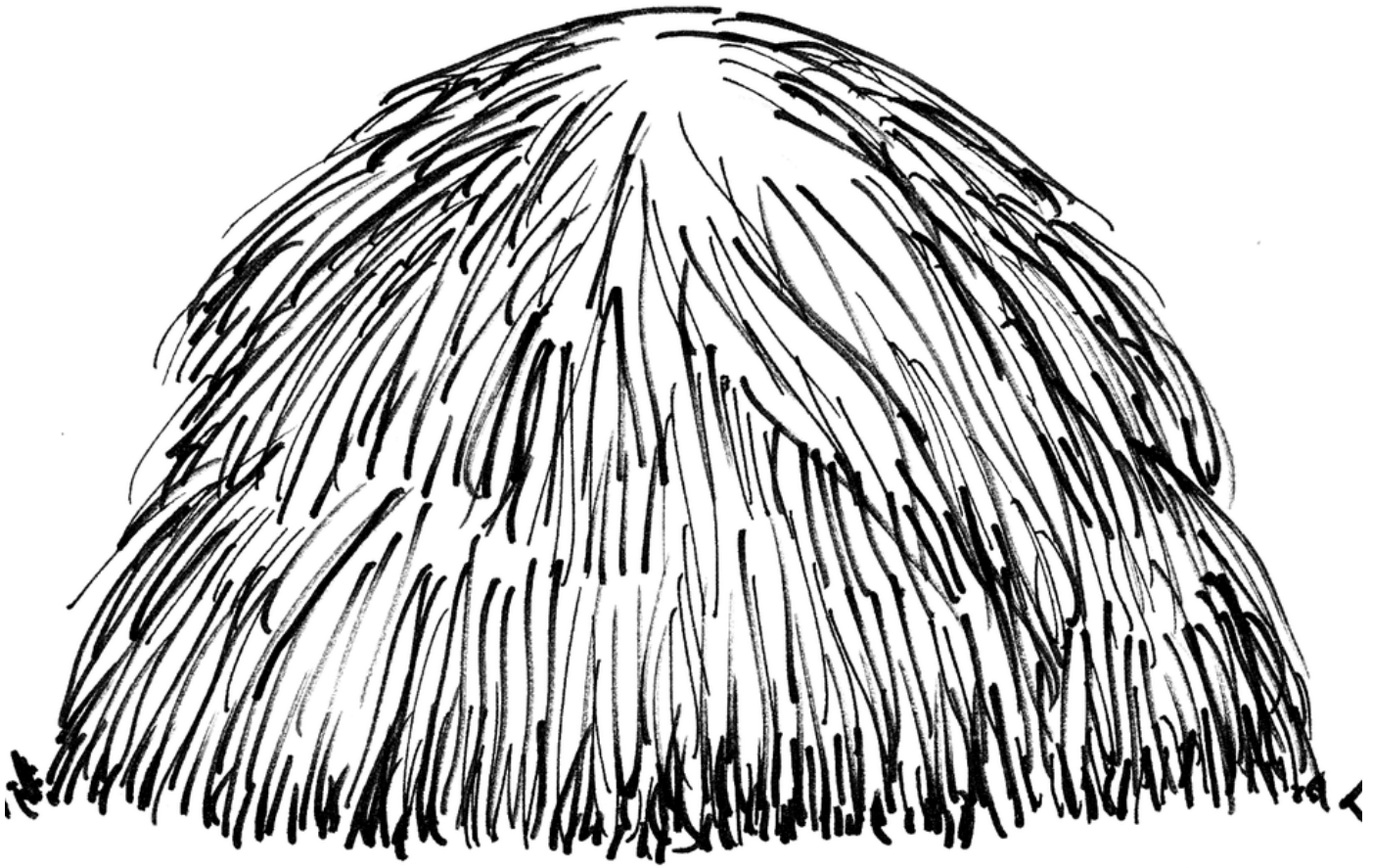
- Understand past and current customer behavior to predict future behavior
  - Where will CAVs and TaaS-directed traffic arrive first?
- Utilize machine learning to handle the Big Data processing and decisioning

The (Big) Data

- Trip transaction data
  - Calculating and classifying trips
- Account data
  - Account type
    - Commercial/Personal
    - Transponder/LPR
- Geographic data
  - Location of customers and toll plazas
- Demographic data
  - Age, income, family status, price sensitivity, tech savviness, hobbies and interests

Trip Transaction Data

- Examining all trip transaction data



Evaluating Trips

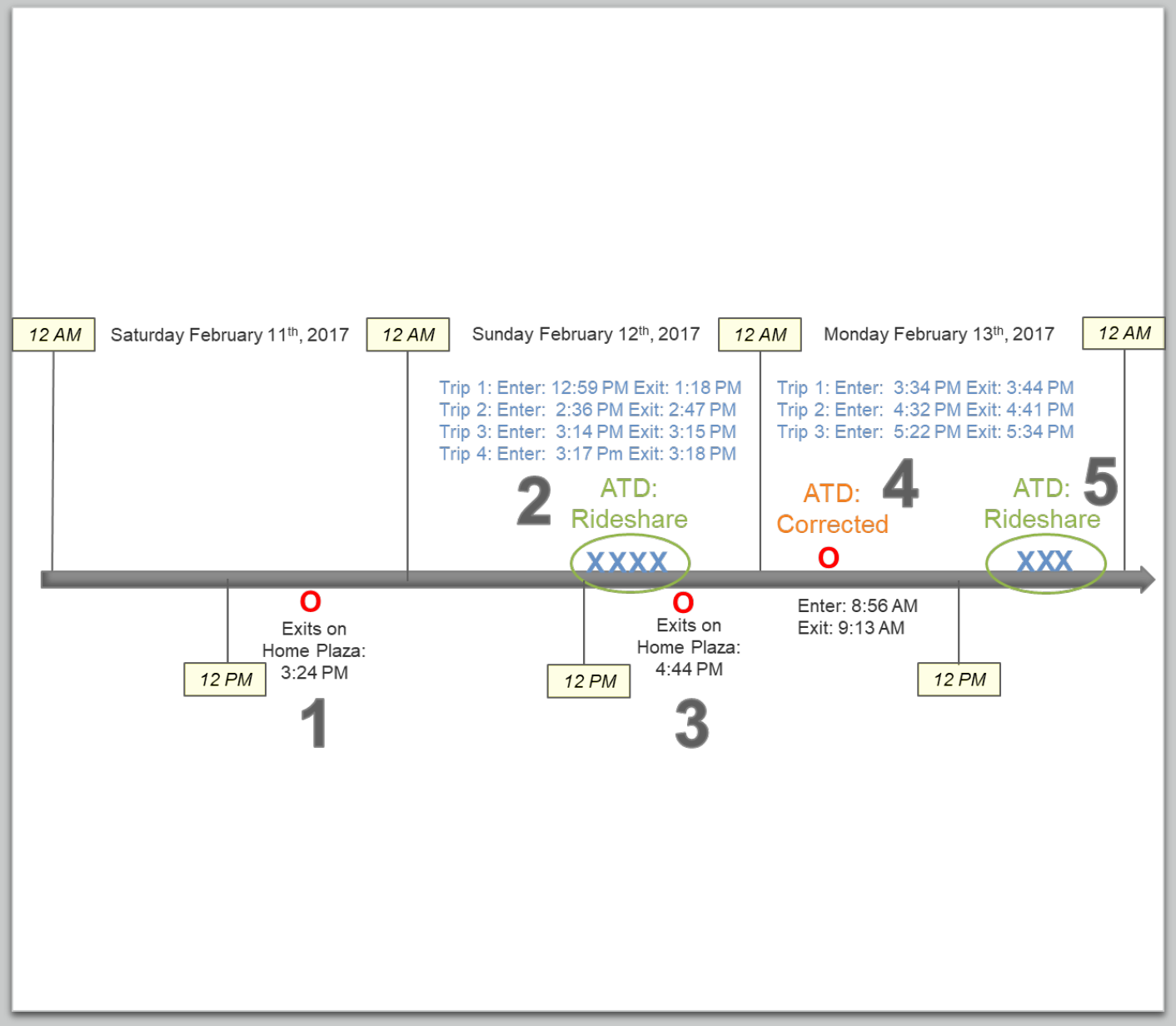
- For each trip:
  - Unique customer ID
  - Timestamp
  - Origin and Destination (O/D)

- Aggregate trips to the customer level

Classifying Trips

- Determine:
  - Consistency
  - Frequency
  - Day of week
  - Time of day
  - “Home” plaza
  - “Work” plaza
  - Nearest plaza
  - Most frequently used plazas

- The ATD (Abnormal Trip Detector)
  - Evaluates whether these are likely Rideshare trips



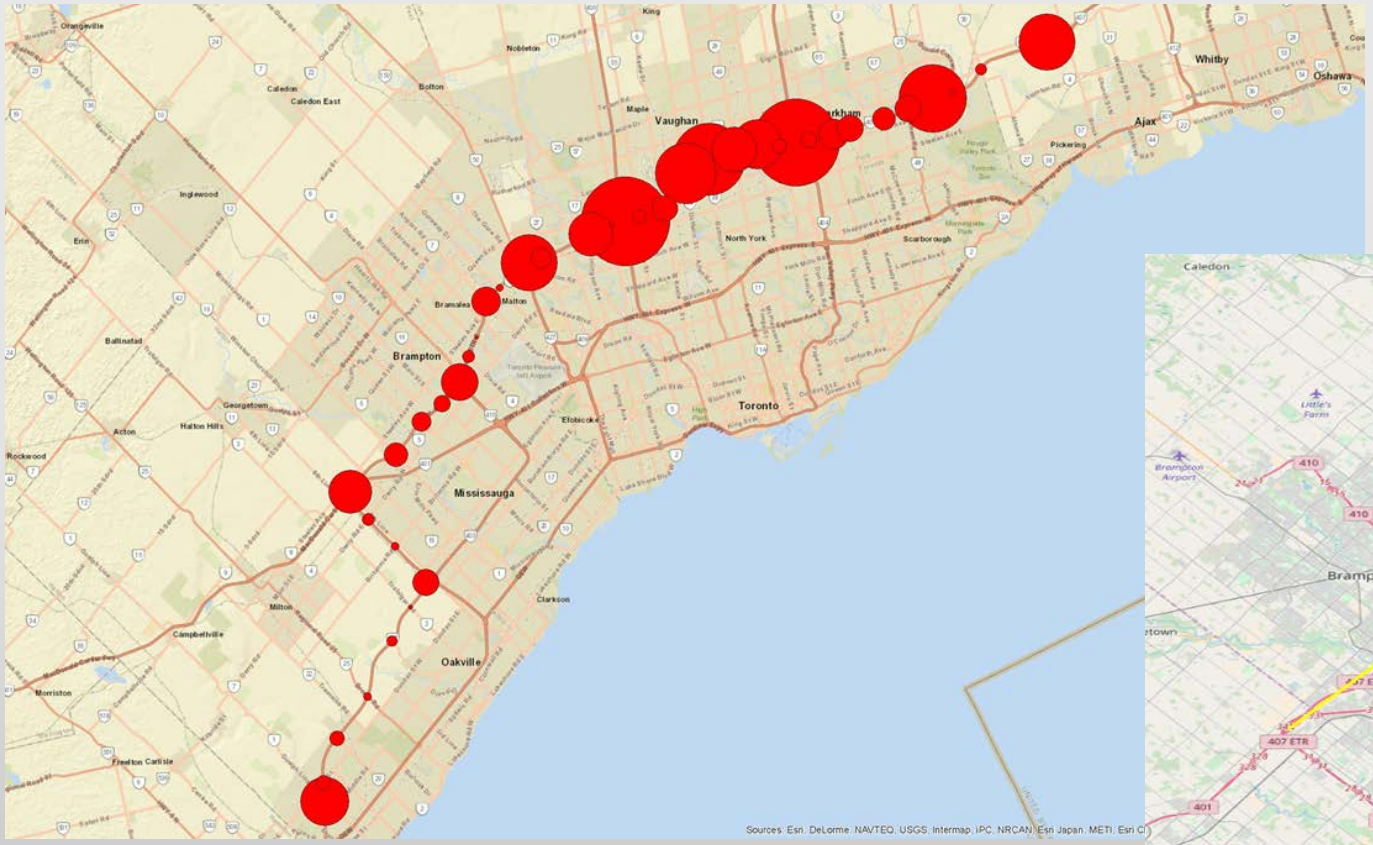
How do you classify 1 billion trips?

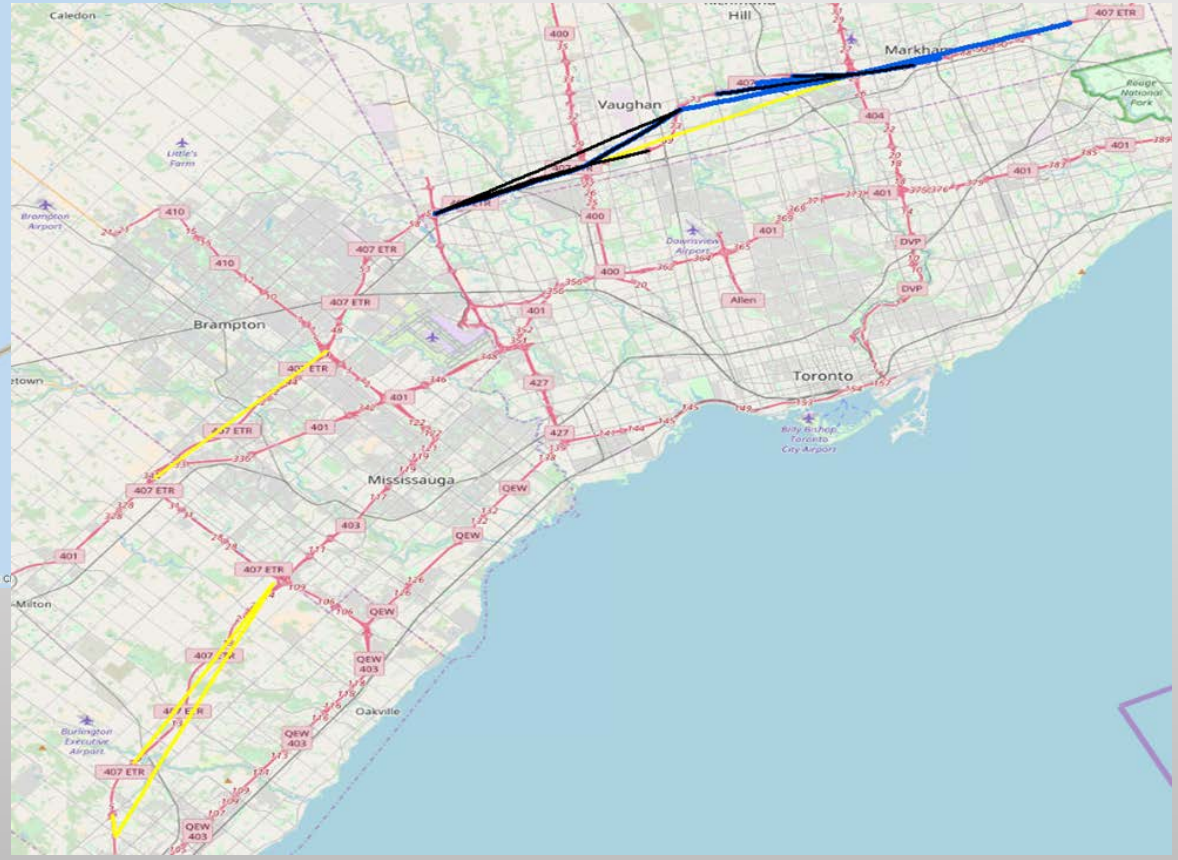
Machine Learning

- Machine Learning
  - *artificial intelligence that allows a computer to identify patterns and learn from data with little human intervention*

- The MLRA (Machine Learning Rideshare Algorithm) evaluates every trip and every customer to identify which are rideshare

Mapping Rideshare Usage





*Note: **Black** = Top Rideshare Routes; Blue = Top Personal Routes by Rideshare Drivers; Yellow = Top Non-Rideshare Driver Routes

Implications for Tollways

- Predict where CAV and TaaS adoption will first impact tollways
- Plan for CAV and TaaS-enabled roadway needs
  - Lane markings and rumble strips
  - Signage
  - Smart roadways
    - Amount of broadband needed
  - Lane width
  - Congestion points and peak times
  - CAVs providing road maintenance/conditions data to toll agency

Next Steps

- Continue to train the MLRA
  - More data, more tollways, more cities
  - Primary research
- Identify/infer rideshare customers
  - Insights into behavior, preferences, transportation needs
- Implement roadway updates/changes based on MLRA

Thank you!

"Vince", Cogensia's MLRA server

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