A Deep-Learning Approach for Transportation Network Companies Trip-Demand Prediction Considering Spatial-Temporal Features

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STUDY QUESTIONS

Unique questions explored in this study:
- What are the most relevant variables (e.g., time of day, weather, and zip code) affecting transportation network company (TNC) trip demand?
- How can TNC trip demand be predicted in small and mid-sized cities?

RIDEAUSTIN DATASET

By the numbers:
- Sample duration—6 months
- Period—7/24/2016 to 2/6/2017
- Total trips—820,816
- Average trip duration—12 minutes
- Average trip distance—8 kilometers
- Average hourly pickups—173/hour

DAILY TRIP DEMAND

TRIP DEMAND BETWEEN ORIGINS AND DESTINATIONS

DEMAND VARIATION BY HOUR

Trip Demand by Hour

DEMAND VARIATION WITH TEMPERATURE

Demand Variation with Temperature

DEMAND VARIATION BY DAY OF WEEK

Trip Demand by Day of Week

DEMAND VARIATION WITH PRECIPITATION

Demand Variation with Precipitation

LONG SHORT-TERM MEMORY

A special recurrent-neural-network architecture designed to learn time-series data with long time spans and high dimensions

TRIP-DEMAND FORECASTING

Objective:
- Predict the future pick-up counts in the next hour for seven zip code zones in Austin, Texas

Model:
- Deep learning—long short-term memory
- Model input
  - Past six hours of pick-up counts in each zip code zone
  - Day of week, hour of day, weather, holiday or not
- Model training—data from 7/24/2016 to 1/6/2017
- Model testing—data from 1/7/2017 to 2/6/2017

ZIP CODE ZONES FOR TNC PREDICTION

NEXT STEPS

- Apply the methodology to more zones with higher spatial granularity
- Compare with more advanced baseline models
- Build prediction models for special trip generators (e.g., airports)