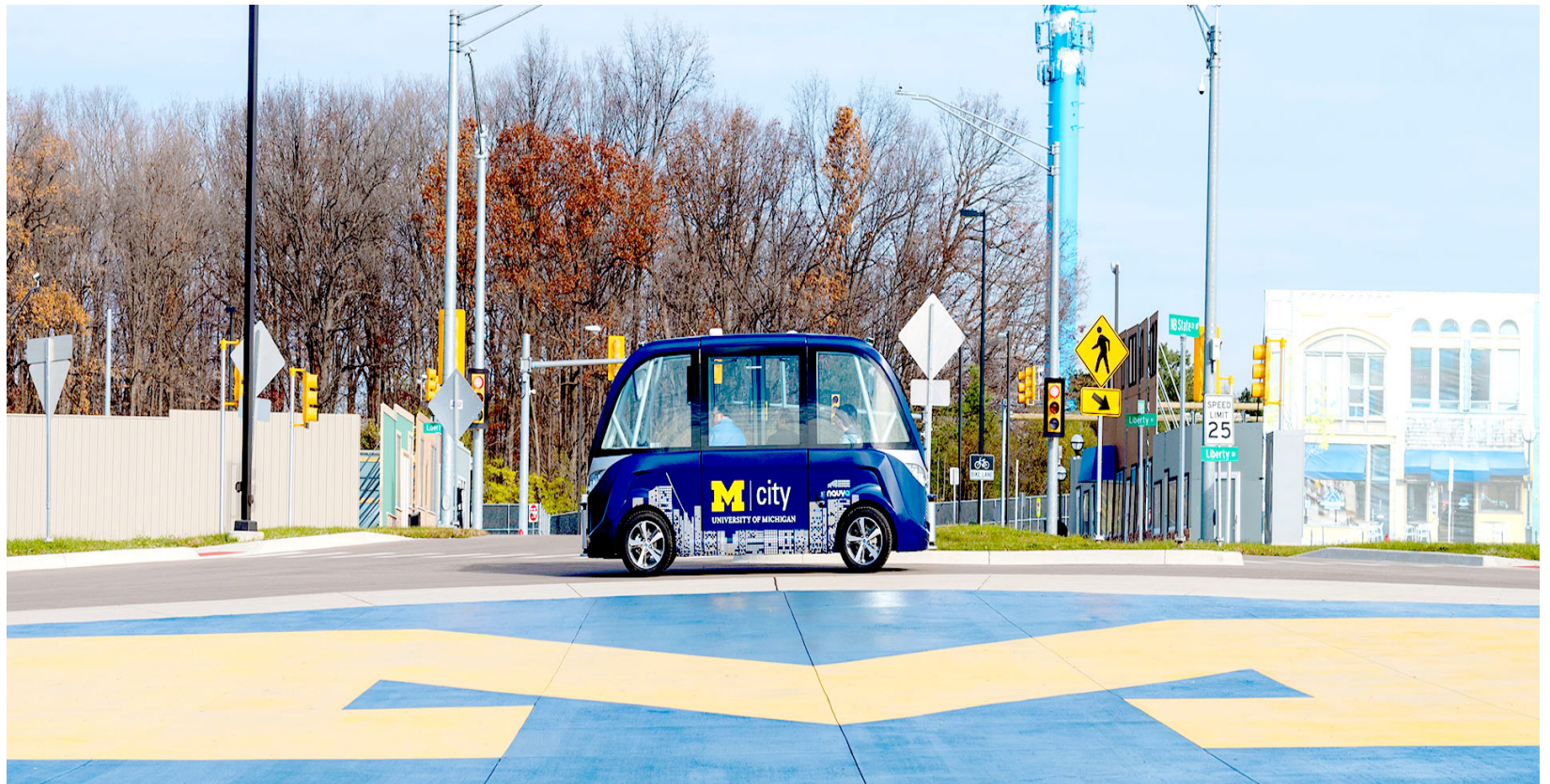


## Forecasting User Demand of Uber with Wavenet

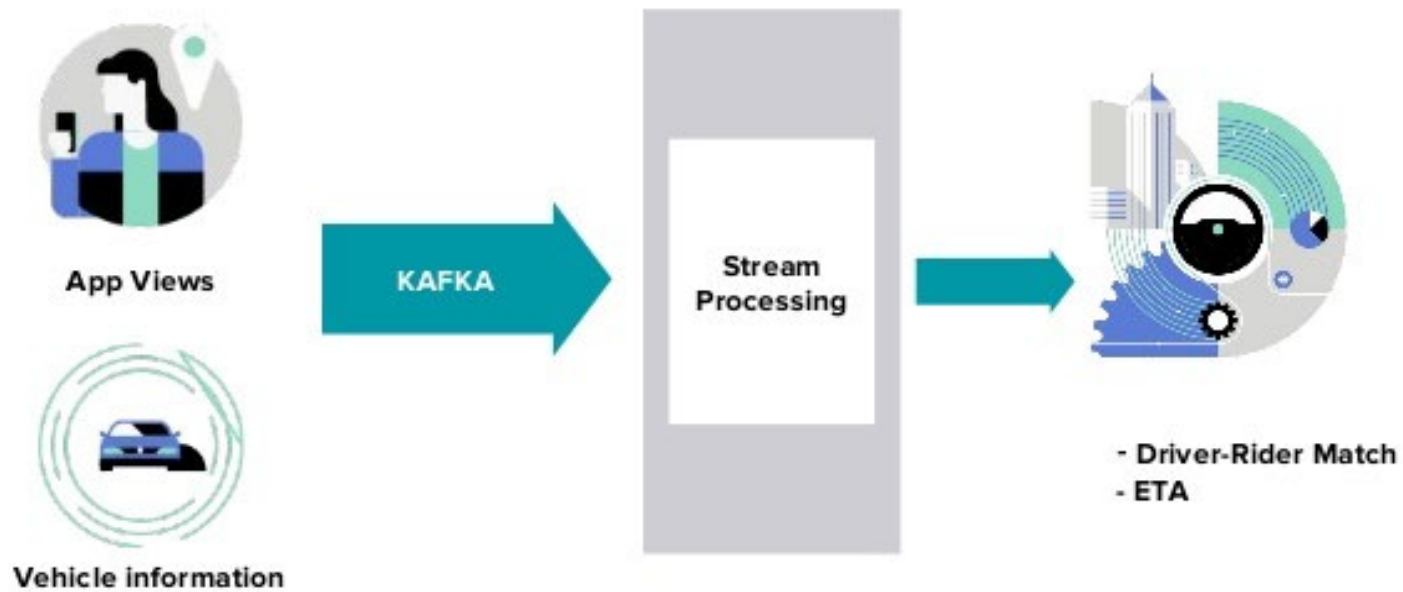
Long Chen

28/11/2018



## Real-time Driver-Rider Matching

UBER



How does the Uber Matching algorithm works?

- Live traffic at specific times
- Distance to the rider
- Driver rating
- Customer rating
- Ride acceptance rates
- Destination
- Dynamic pricing

Why is the User Demand Forecasting so important?

- Intelligent Transportation System
- Surge Price Search
- Dynamic Pricing

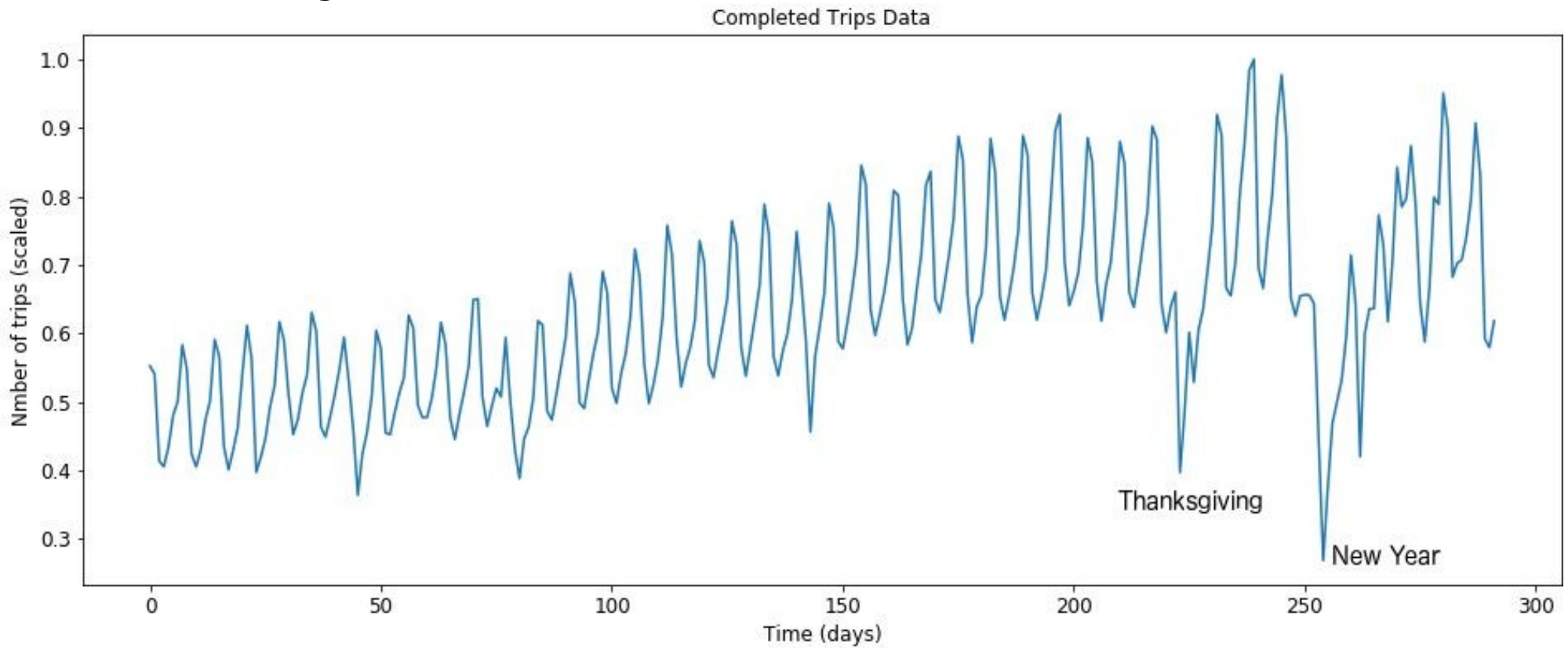
- Dataset

Over 20 million Uber pickups in NYC

Public Available at:

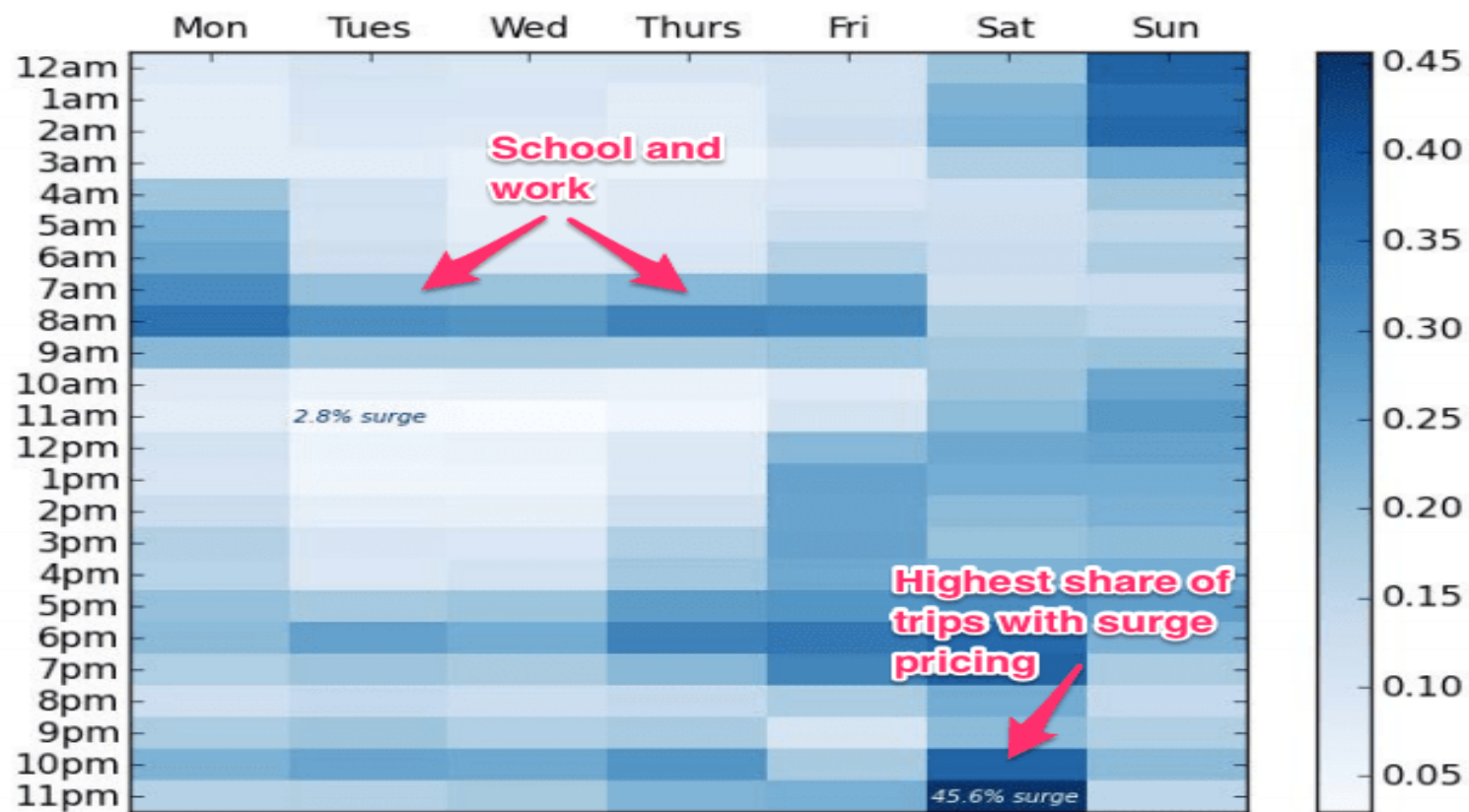
<https://github.com/fivethirtyeight/uber-tlc-foil-response>

# Problem Statement: User Demand Forecasting



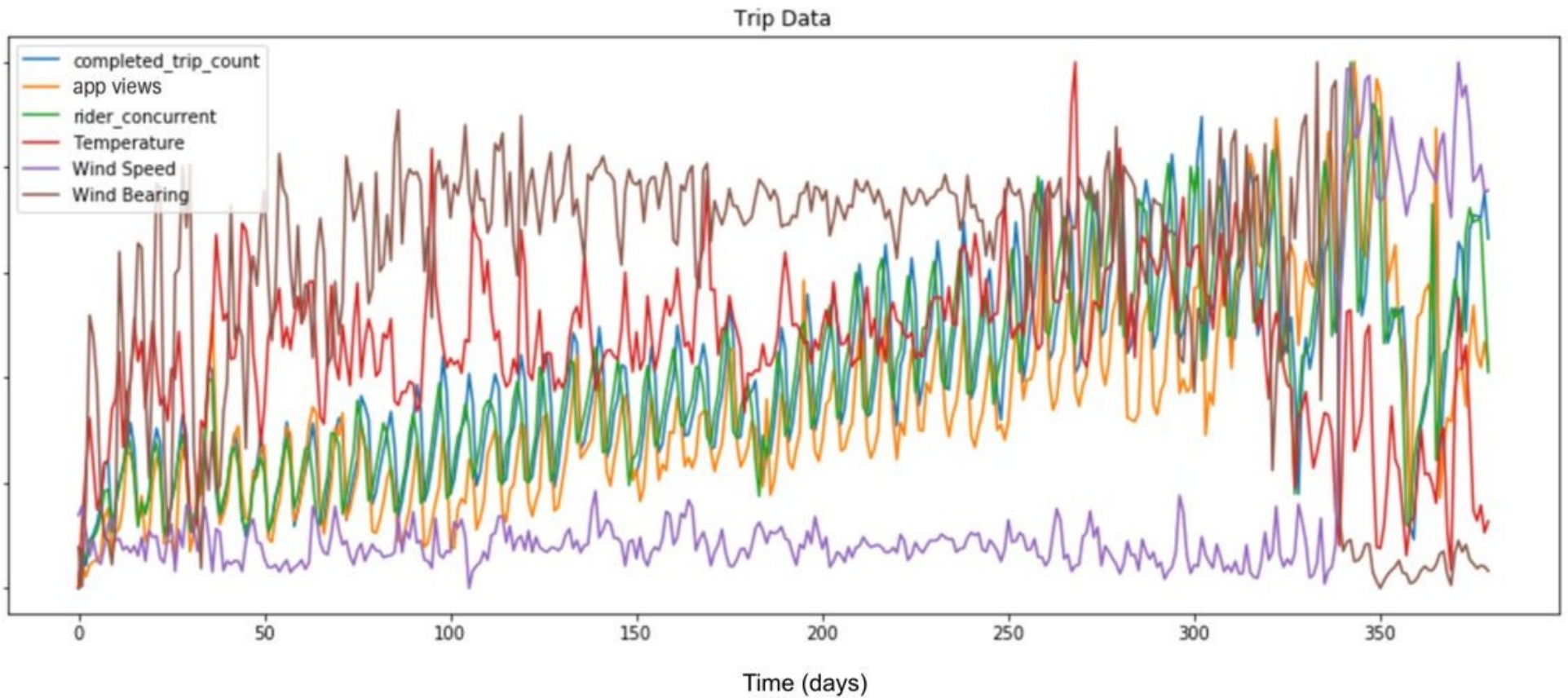


# Frequency of surge by hours of day



*Note: This figure shows the frequency of surges by hour of day and day of week for UberX. Darker rectangles identify times and days when riders are more likely to face surge pricing. Tuesday at 11am represents the time and day combination when surge pricing is least common, and Saturday at 11pm represents the time and day combination when surge pricing is most common.*

## Data: External Features





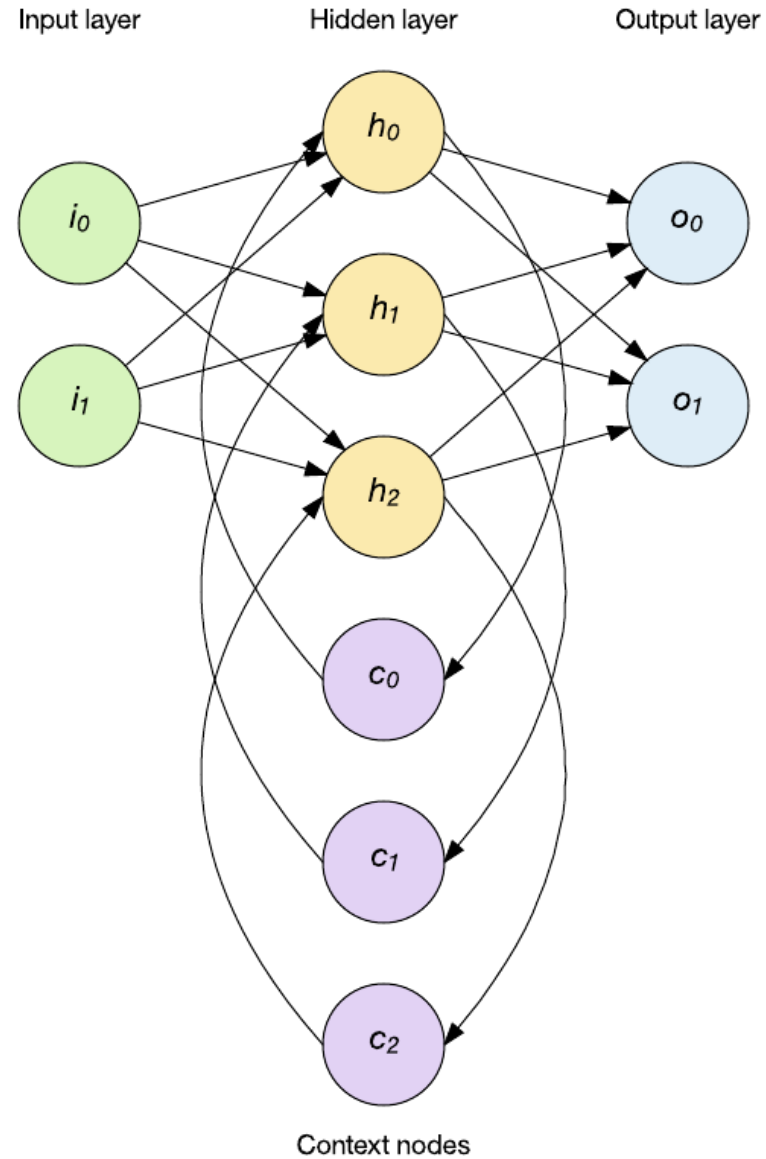
## Current Solution: Cons

- **Classical forecasting methods**
  - ARIMA: Seasonality, Trend, Spikes
  - Exponential smoothing (Holt-Winters)
- **Cons of classical approaches**
  - Stationarity assumption
  - Accelerating trends, repeated irregular patterns

# RNN

- **Deep learning methods**
  - RNN: Recurrent Neural Network
- **Cons of RNN**
  - Gradient Vanishing Issue
  - Computationally expensive

# RNN



# CNN

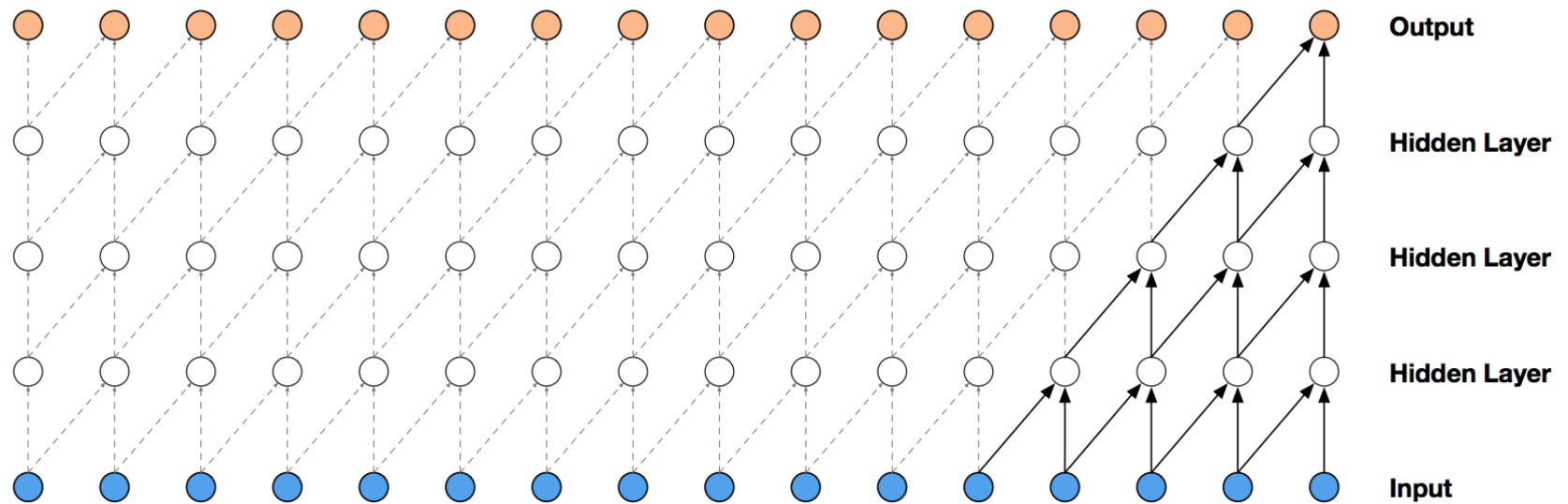
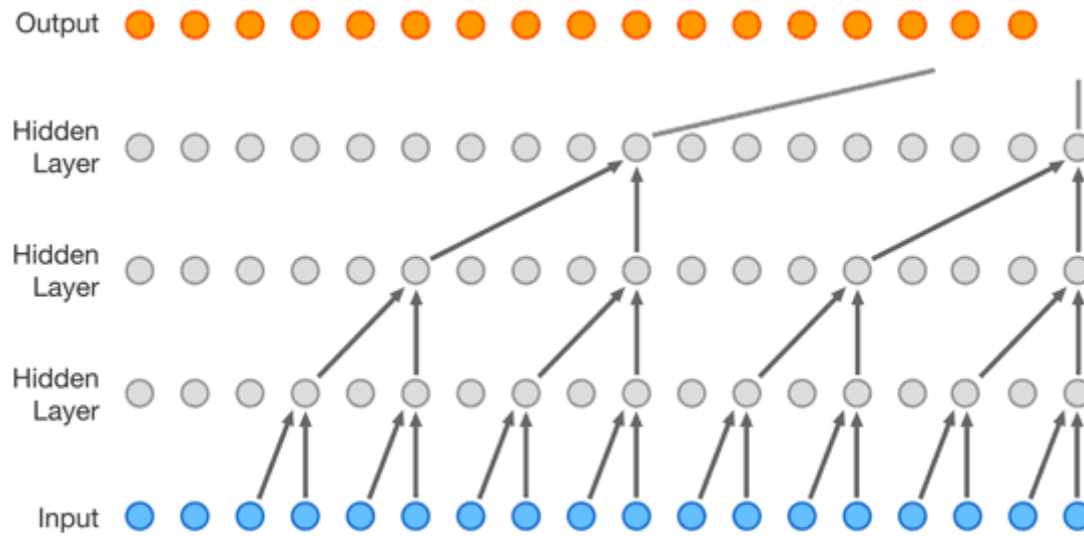


Figure 2: Visualization of a stack of causal convolutional layers.

# WaveNet



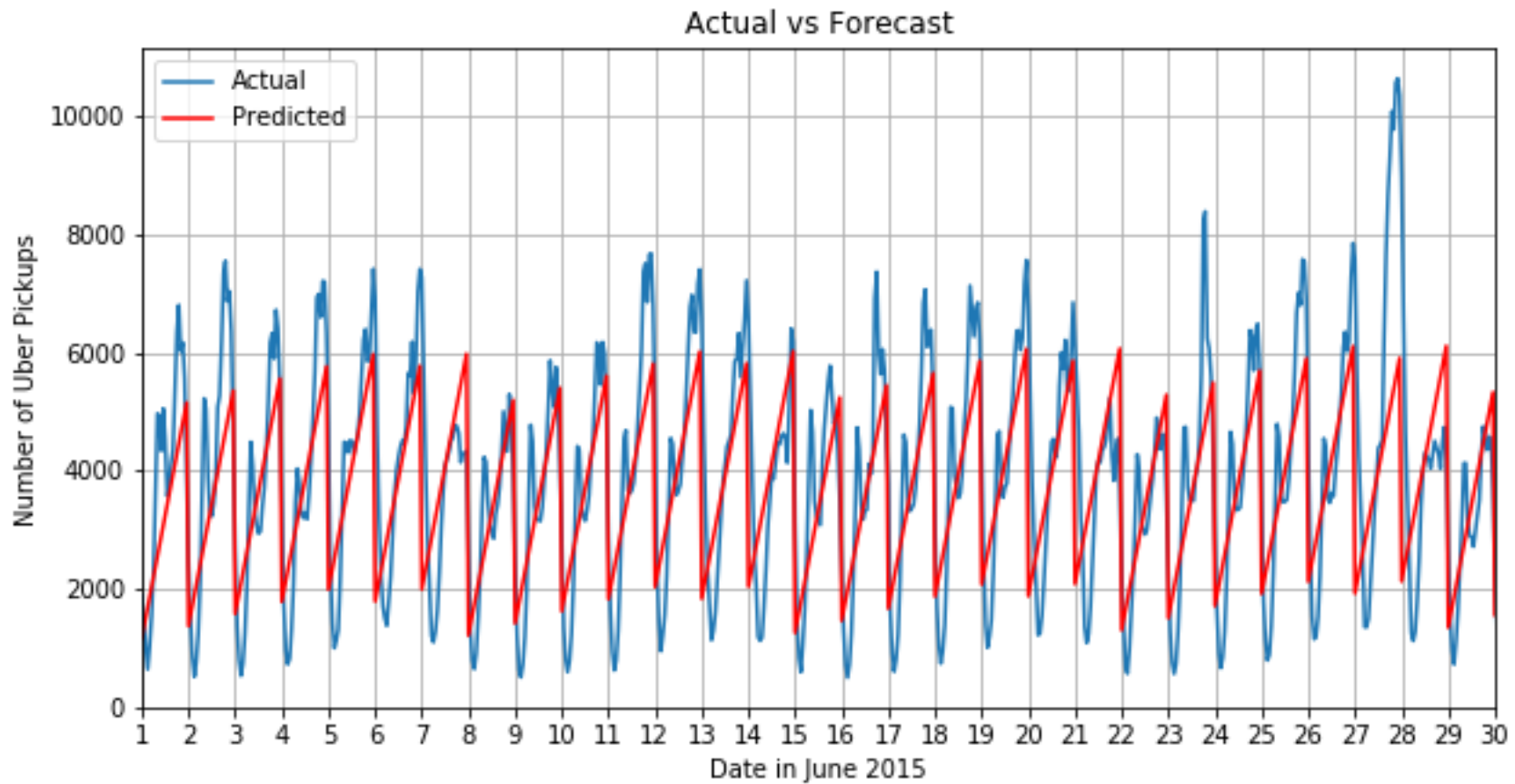


## Results: Experiments & Methodology

- Internal and public datasets
- Two years of data from NYC
- Target variable is completed trips.
- Records for holidays, weather
- Forecast is done one hour ahead.
- Measure SMAPE(Symmetric Mean Absolute Percent Error ):

$$\text{SMAPE} = \frac{100\%}{n} \sum_{t=1}^n \frac{|F_t - A_t|}{(|A_t| + |F_t|)/2}$$

## Results: Example of a forecast (Testing)



## Results: Special Event Prediction Performance (SMAPE)

	<b>WaveNet</b>	<b>ARIMA</b>
Christmas Day	11.1	29.2
MLK	8.7	20.2
Independence Day	2.8	17.6
Labor Day	2.9	6.9
New Year's Day	6.8	7.8
Veteran's Day	4.7	8.9

## Resources:



MIT Uber Study:

<https://qz.com/1222744/mits-uber-study-couldnt-possibly-have-been-right-it-was-still-important/>

WaveNet:

[https://jeddy92.github.io/JEddy92.github.io/ts\\_seq2seq\\_conv/](https://jeddy92.github.io/JEddy92.github.io/ts_seq2seq_conv/)

**Thank you !**

.... Questions ?

