Real-Time Forecasting of Bus Arrivals Using GPS-Data

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Objectives
- Produce an accurate model to forecast bus arrivals in real-time using GPS-data
- Optimize for one line (line 5)
- Mean average error < 70 seconds
- Scalable

Introduction
In collaboration with UL, we intend to produce bus arrival forecasts that can compete with previous work and current systems. Compared to *Are we there yet?* [1], we use real-time GPS data, this in order to investigate whether more detailed data will give higher performance for the arrival forecasts.

Neural Network
- 2 Dense layers (each of size 100)
- ReLU activation
- Output – Arrival time in seconds
- Batch normalization
- Custom loss functions
 - Truncated loss
  - Asymmetric loss

Input Parameters
Except GPS-data the model uses various other input parameters. They are used in order to capture other phenomena that influences how long it will take for a bus to travel a specific distance.

- Time since start of trip
- Time of day
- Day of week
- Travel time of previous buses
- Precipitation
- Temperature

GPS-Data Preprocessing
- Extract and clean data from files
- Extract line 5
  - Geofence GPS-coordinates to first and last bus stop in line 5
- Convert GPS-coordinates to trip progress
  - Project bus position to closest line segment
  - Calculate distance on that segment
  - Sum previous segment lengths and how far the bus has traveled on the closest segment
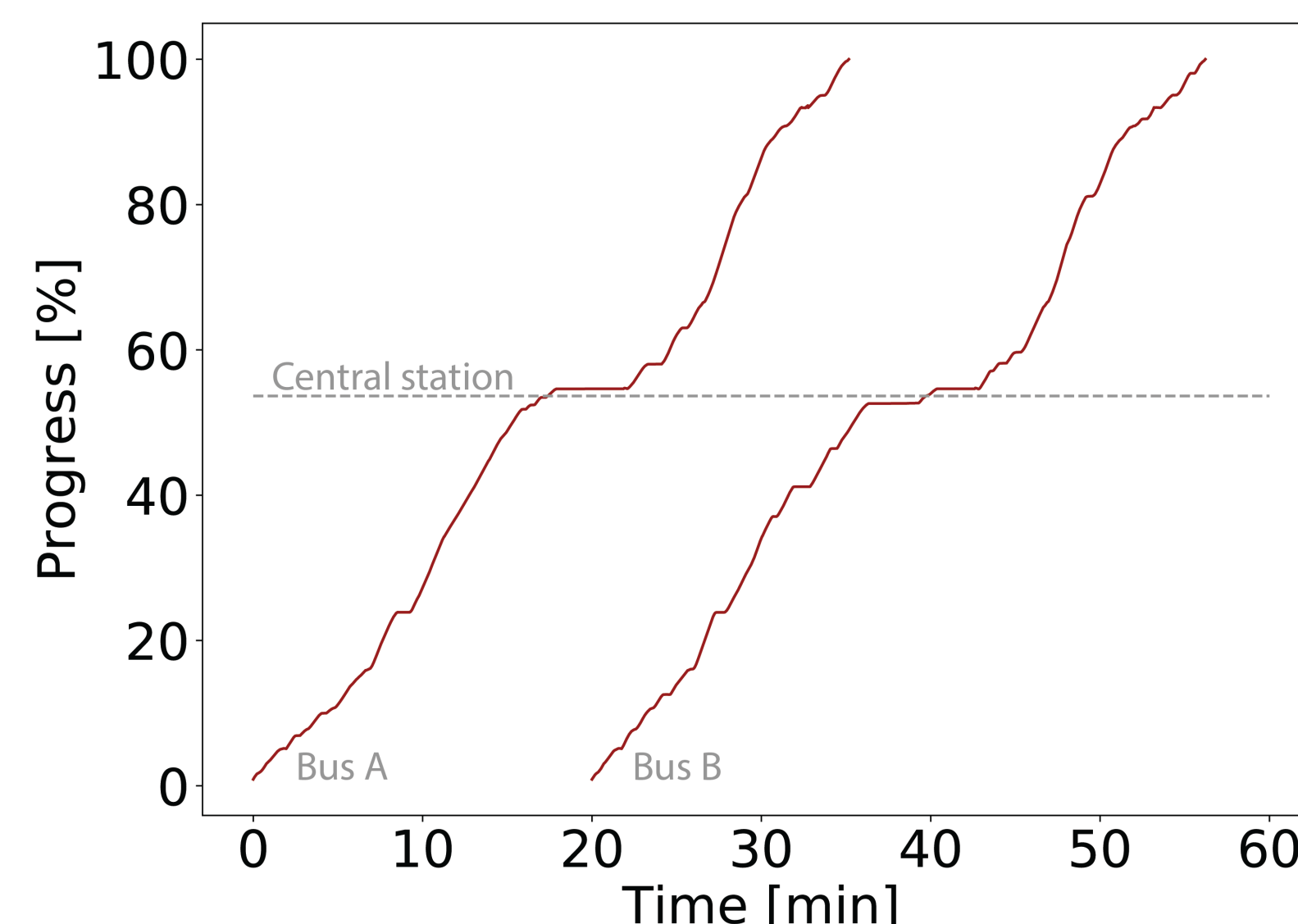
Prediction Results
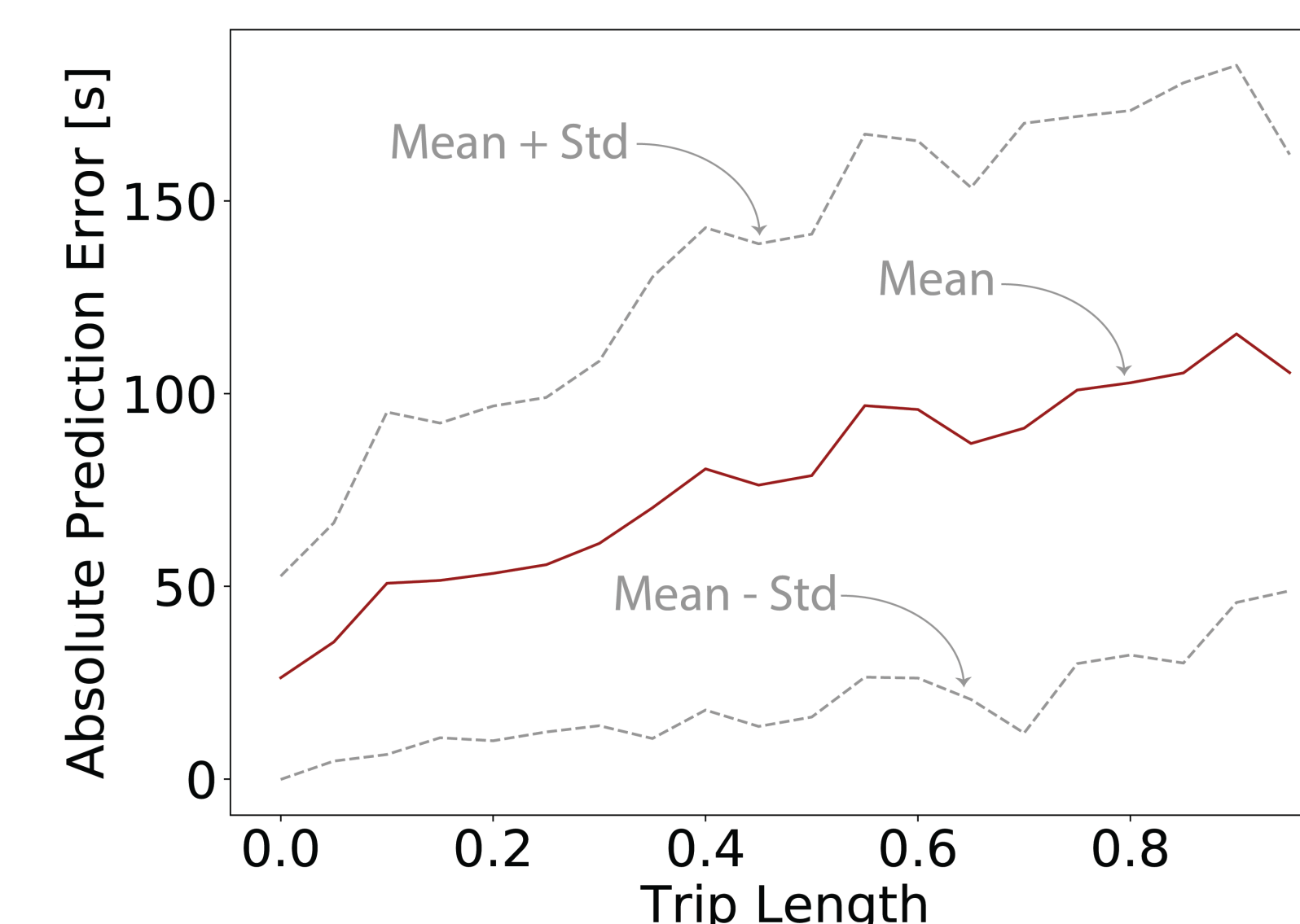
	Neural Network	Random Forest	Linear Regression
MAE (seconds)	63	69	70
Accuracy* (%)	59	54	55

*A correct prediction is defined as arriving within 60 seconds.

Future Work
- More data
- Recurrent Neural Network
- Additional input features
  - Traffic conditions
  - Number of bus stops
  - Number of traffic lights

References
[1] Johan Rideg, Max Markensten, 2019, 'Are we there yet?: Prediciting bus arrival times with an artificial neural network', (Unpublished Bachelor Thesis), Uppsala Universitet, Uppsala, Sweden