Traffic Flow Optimization

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Traffic Flow Optimization

Overview

Understanding the problems

Project objective

RNN and LSTM

Dataset and EDA

Project objective

Develop a neural network model for traffic flow prediction trained using historical traffic data to predict future traffic conditions based on the current state of the system. The model should be capable of forecasting traffic flow, congestion, and potential bottlenecks.

Overview

- Cluster based on traffic behavior
- Develop a neural network model for traffic flow prediction.
  - recurrent neural network (RNN) or a long short-term memory network (LSTM) to capture temporal dependencies in traffic data.
- Train the model using historical traffic data, including the features extracted in the previous step.
- Use the trained neural network to predict future traffic conditions based on the current state of the system.
- The model should be capable of forecasting traffic flow, congestion, and potential bottlenecks.
- Evaluate the model

Understanding the problems

01 Apply clustering algorithms (e.g., K-means, hierarchical clustering) to group similar traffic behaviors as input to the neural network

02 Implement optimization algorithms that take the predicted traffic conditions as input and suggest changes to traffic signal timings, lane configurations, or other urban planning interventions. Optimization goals may include minimizing congestion, reducing travel time, or improving overall traffic flow.

03 Model adaptation - Establish a feedback loop where the system continually updates its predictions and optimizations based on real-time data to adapt to changing traffic patterns and environmental conditions.

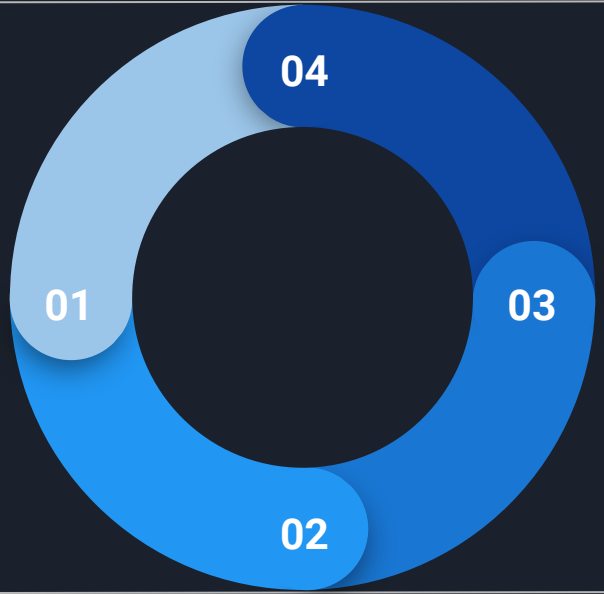
Planned Project Steps

EDA

Explore the datasets to discern which are better suited for our tasks, their distributions, etc

Data Preprocessing

Feature extraction, data cleaning. Clustering based on traffic congestion



Model Evaluation

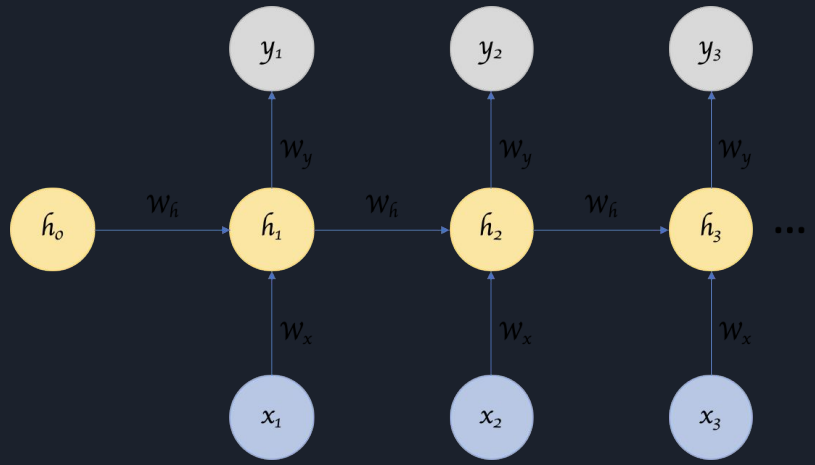
Metrics may include accuracy of congestion prediction

Model Training

RNN and/or LSTM

Recurrent Neural Networks

- RNNs: based on expanding out traditional feedforward neural network architecture to encapsulate some temporal information
  - designed to take series of inputs with no predetermined limit on size
  - "series:" each input of that sequence has some relationship with its neighbors or influences them
  - RNNs remember things learned from prior input(s) while generating output(s) in addition to learning how feed-forward neural nets "remember" from training
- Bi-directional DNN
- LSTM: special kind of RNN made to address **vanishing gradient problem**
  - remembering information for long durations is speciality
  - LSTM neurons have a special branch that allows passing information to skip the long processing of the current cell



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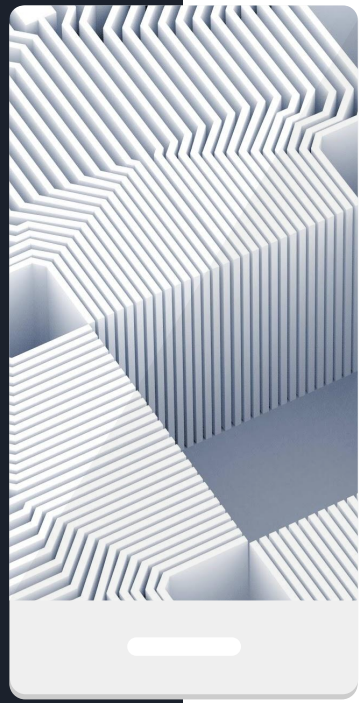

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Spotlight on landscape view on mobile

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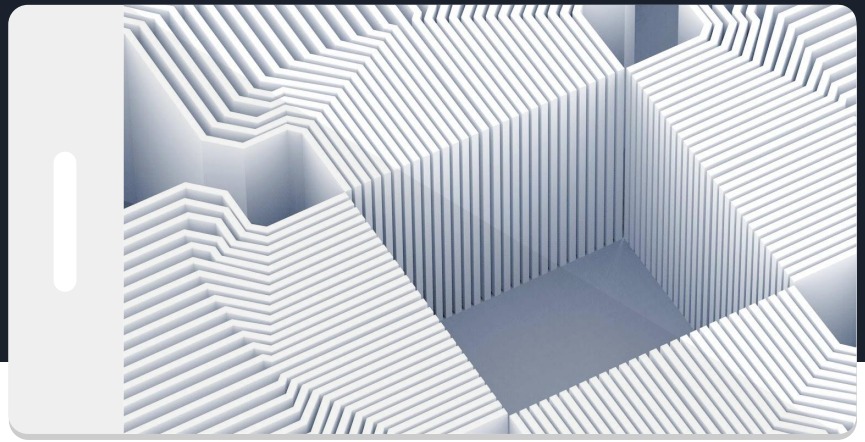

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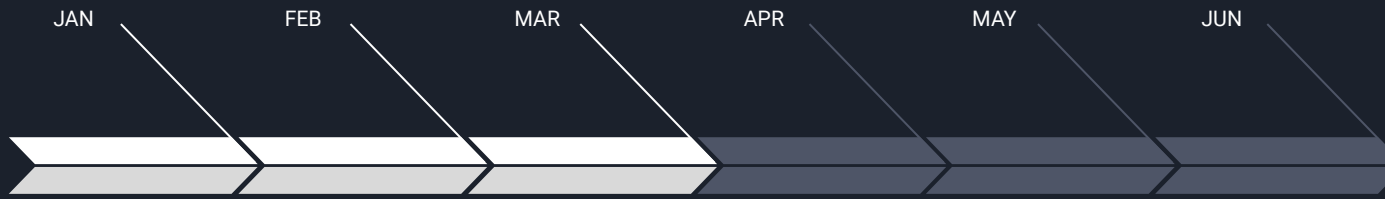
Project timeline



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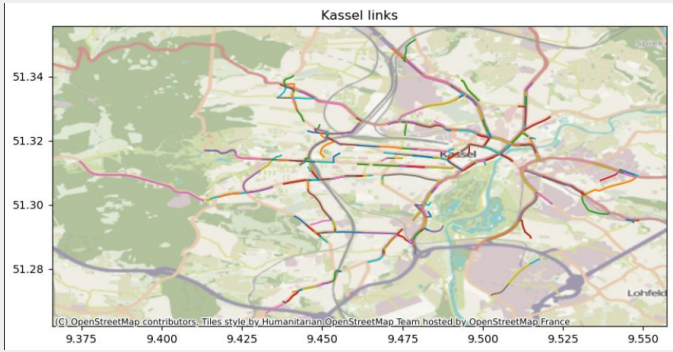
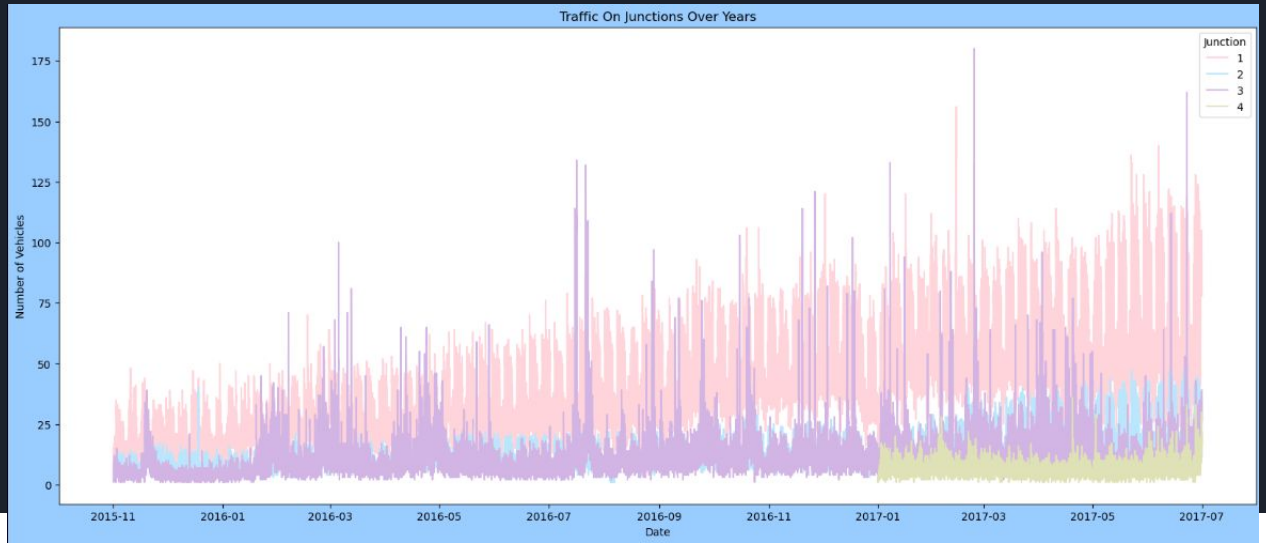
Detectors connected to road sections



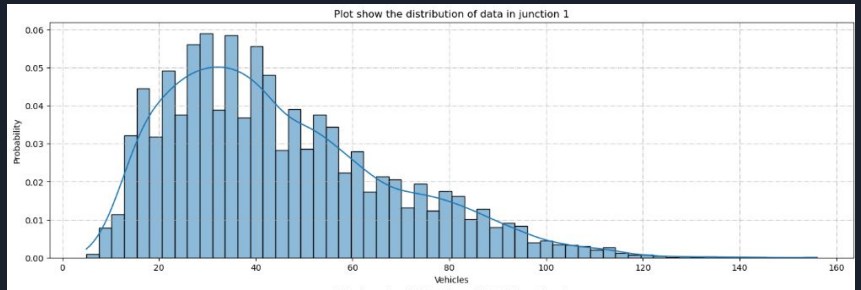
Feature Engineering with Simpler Dataset

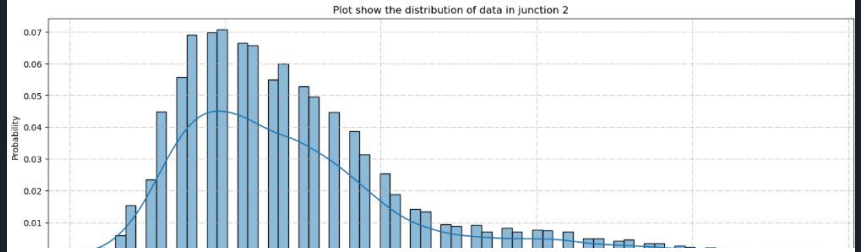
	DateTime	Junction	Vehicles	Year	Month	Date	Hour	DayOfWeek
0	2015-11-01 00:00:00	1	15	2015	11	1	0	Sunday
1	2015-11-01 01:00:00	1	13	2015	11	1	1	Sunday
2	2015-11-01 02:00:00	1	10	2015	11	1	2	Sunday
3	2015-11-01 03:00:00	1	7	2015	11	1	3	Sunday
4	2015-11-01 04:00:00	1	9	2015	11	1	4	Sunday

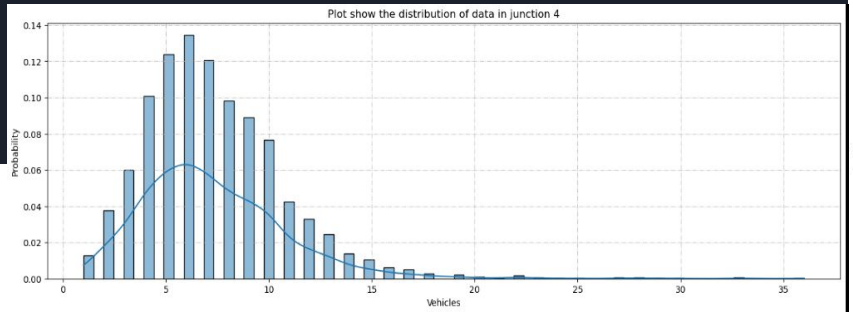
Traffic On Junctions Over Years

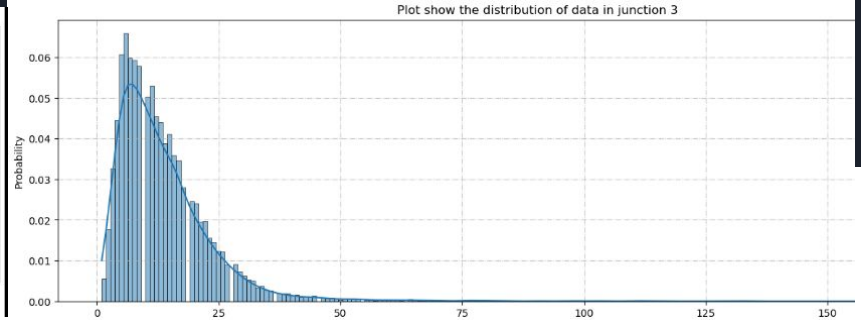


Traffic On Junctions Over Frequency of Various Flow Rates









Thank you!