



Traffic Prediction with Convolutional Long Short-Term Memory

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Traffic Prediction with Convolutional Long Short-Term Memory

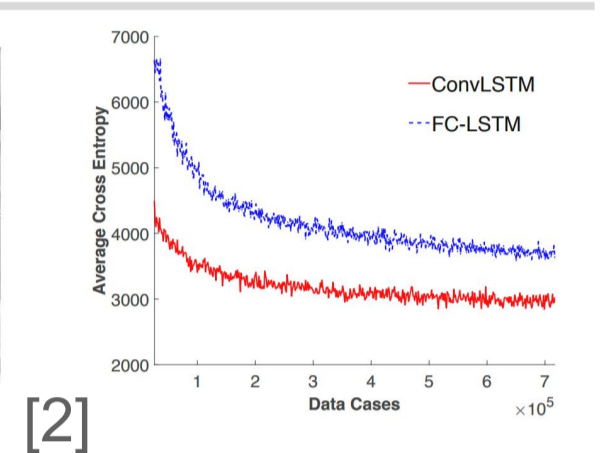
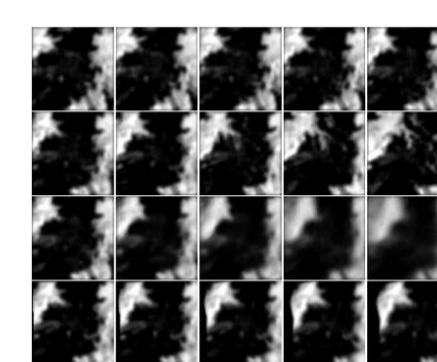
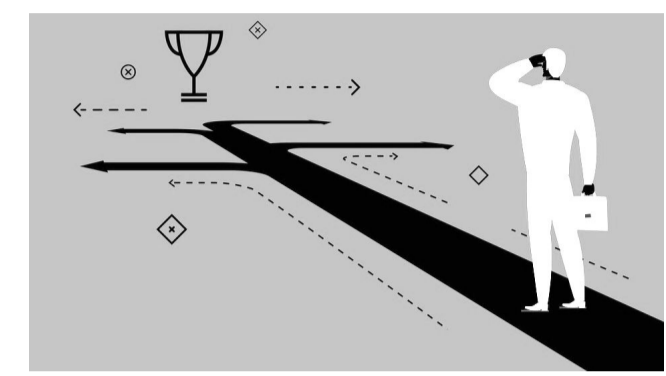
Inon Peled, Francisco C. Pereira, Ole Winther

Background and Motivation

Accurate prediction of traffic admits many benefits: reliable travel planning, early detection of congestion, effective response by road practitioners, and more.

Recurrent Neural Networks (RNNs) with Long Short-Term Memory (LSTM) have been successfully applied to **time series prediction** [1]. Recently, [2] showed that *Convolutional LSTM (Conv-LSTM)* outperforms classic LSTM in predicting time series data on a **2-dimensional spatial grid**.

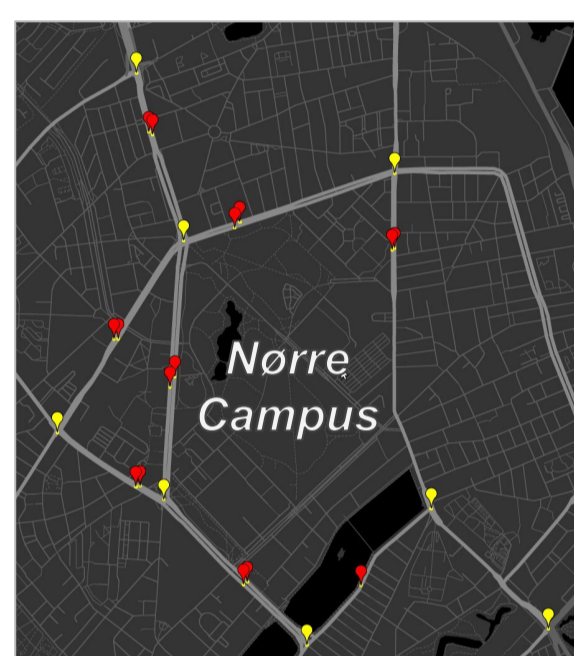
In this work, we study the applicability of **Conv-LSTM to prediction of traffic on a road network**.



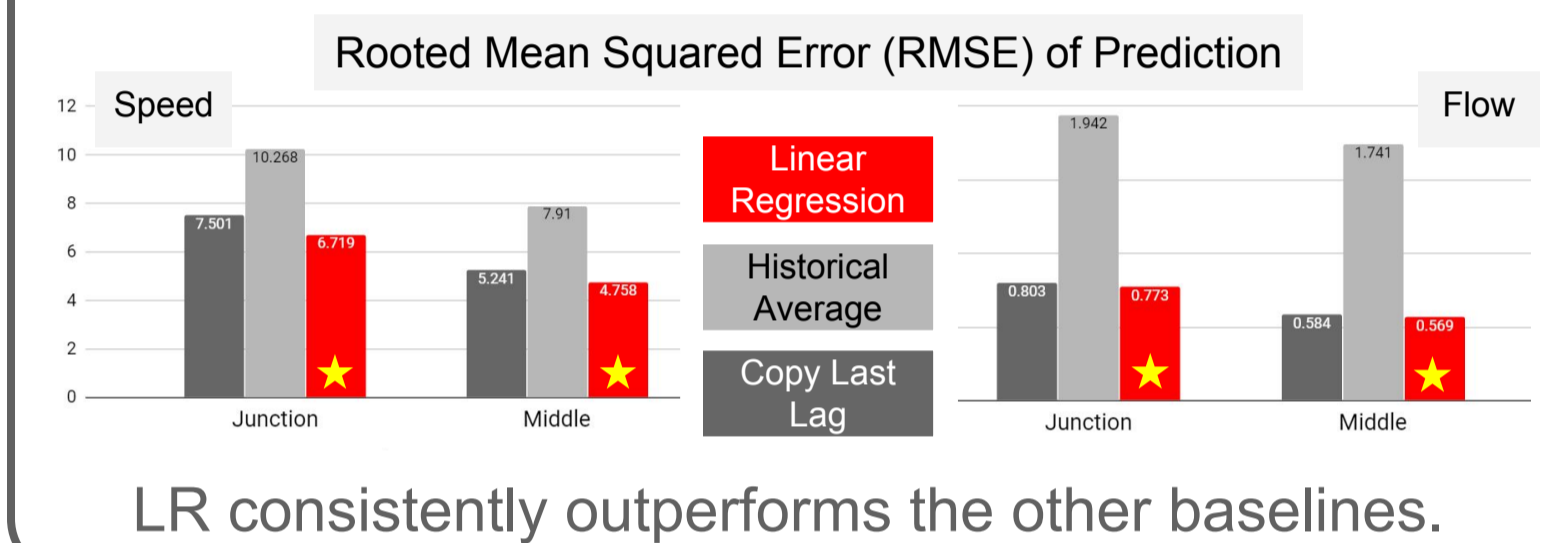
Data

Speeds and relative flows from Android devices.

- Around University of Copenhagen, January-June 2015.
- Averaged every 5 minutes in several **middle-of-roads** and **junctions**.
- **Goal:** predict speed and flow in next 5min, given last hour.
- January..May for training, June for testing.

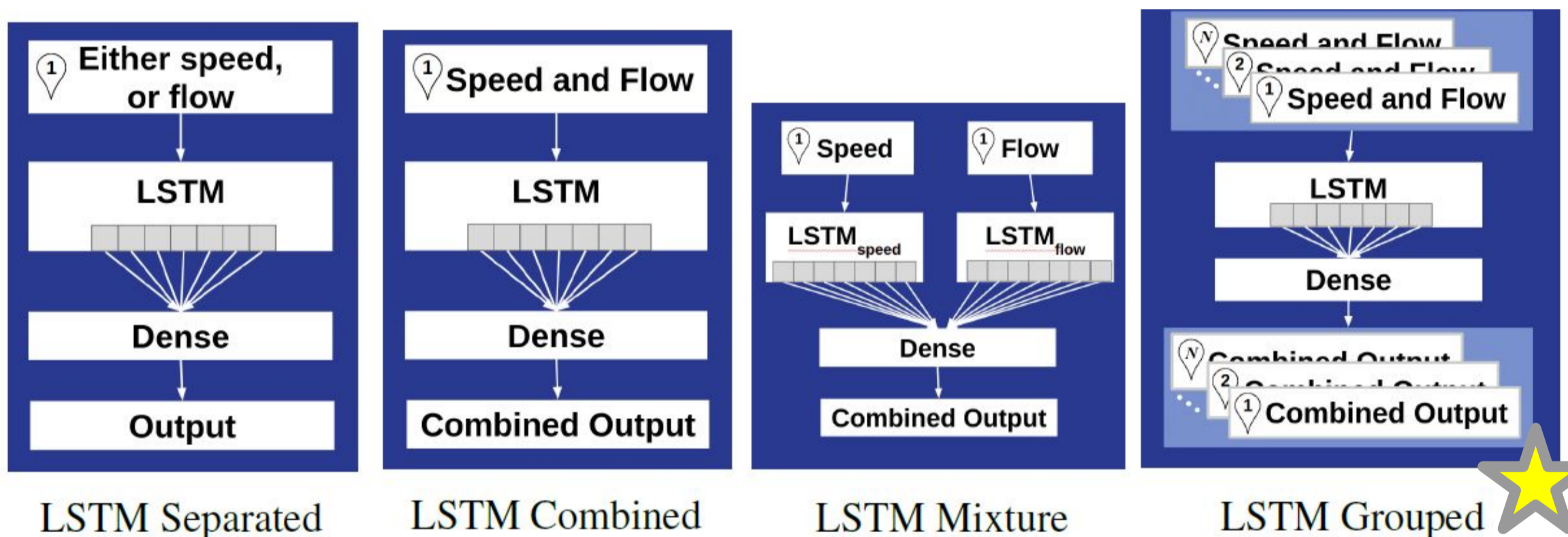


1) Baseline Models

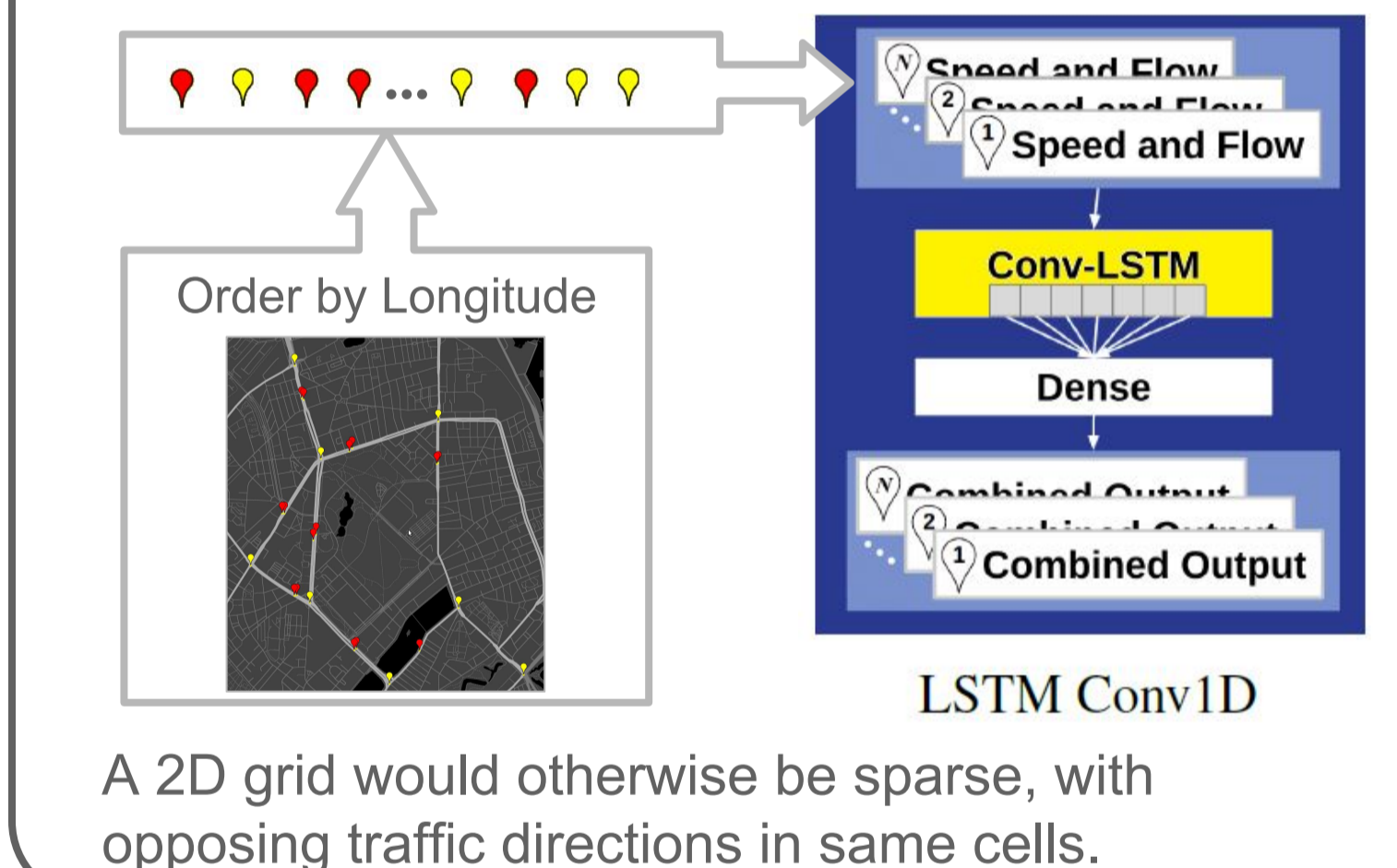


2) RNN Models with Classic LSTM

Iteratively improve architecture, with exhaustive search for best hyper-parameters.

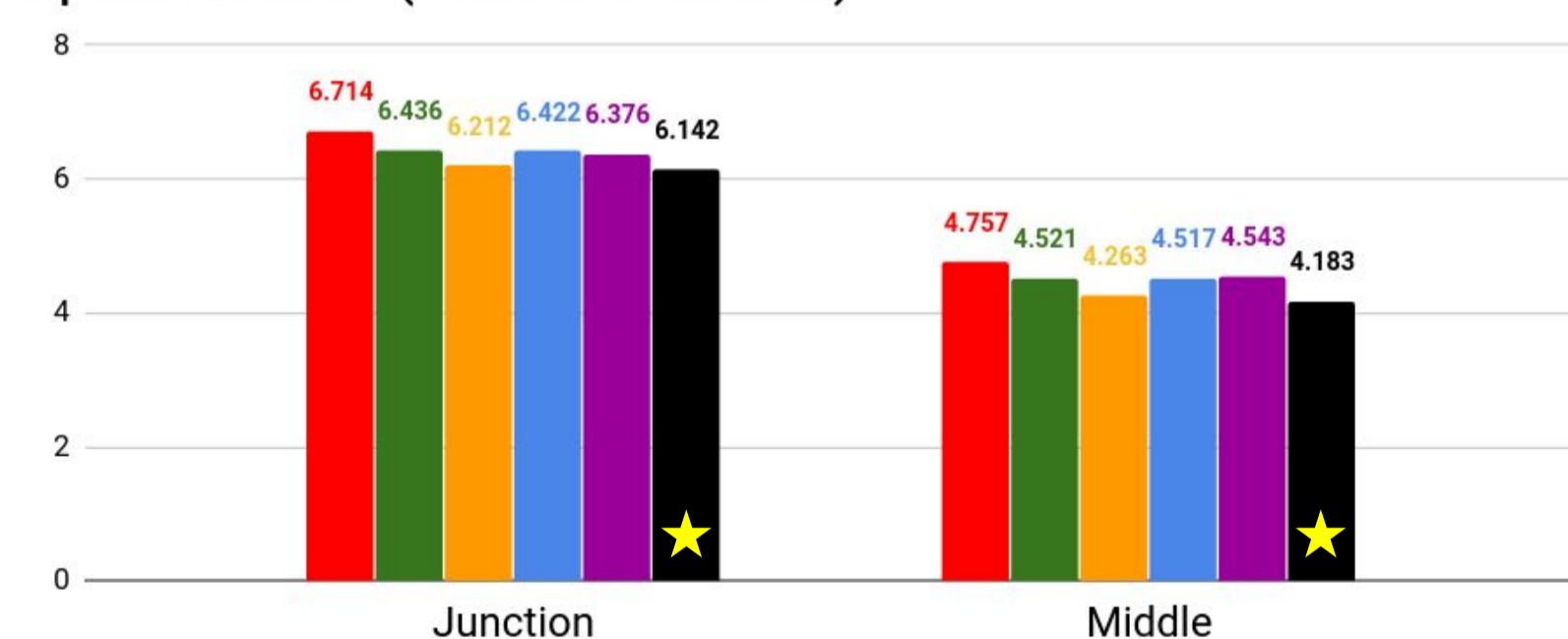


3) Conv-LSTM, 1-Dimensional Grid

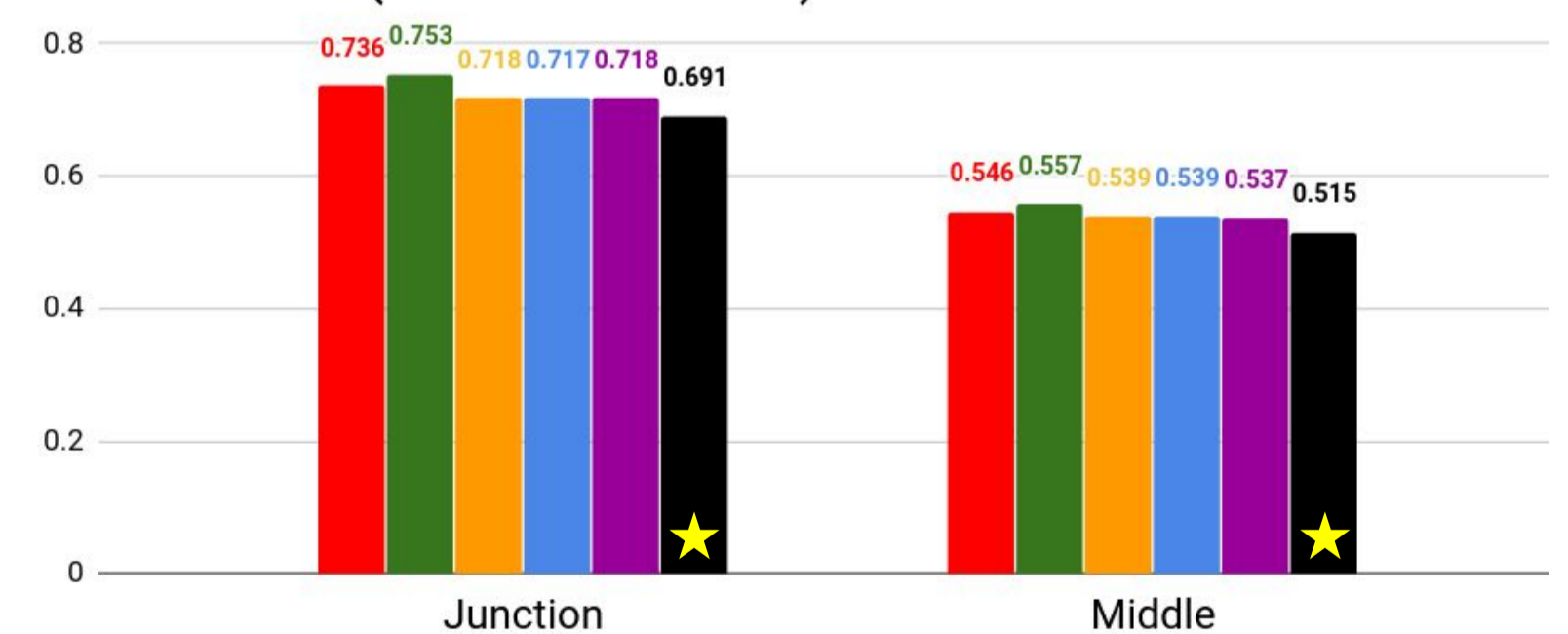


Results

Speed RMSE (Lower is Better)



Flow RMSE (Lower is Better)



Conv-LSTM 1D outperforms all other models.

Consistent results also under Mean Absolute Error (MAE), Pearson Correlation Coefficient ρ , and Coefficient of Determination R^2 .

Conclusions

1. Similarly to LR, RNNs perform better in *middle-of-roads* than in *junctions*.
2. Unlike LR, RNNs benefit from *combining* flow and speed.
3. **Conv-LSTM** takes advantage of **spatio-temporal correlations**, and outperforms classic LSTM for traffic data too.

References

- [1] "The unreasonable effectiveness of recurrent neural networks", <http://karpathy.github.io/2015/05/21/rnn-effectiveness/>.
- [2] Chen et al., "Convolutional LSTM network: A machine learning approach for precipitation nowcasting," CoRR, vol. abs/1506.04214, 2015.