Trajectory Prediction with Deep Learning

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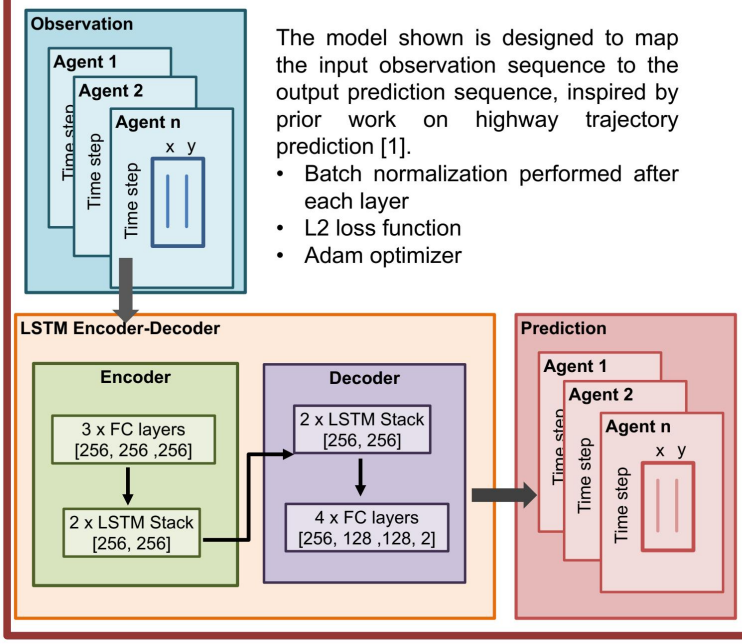
Problem Description

The project aims to predict future trajectory sequences of different traffic agents (e.g. pedestrians, bicyclists and vehicles) in an urban environment using Recurrent Neural Networks (RNN). Given an observed history of a trajectory sequence as an input, the network tries to predict the future trajectory sequence of each traffic agent.

Network Architecture



The model shown is designed to map the input observation sequence to the output prediction sequence, inspired by prior work on highway trajectory prediction [1].

- Batch normalization performed after each layer
- L2 loss function
- Adam optimizer

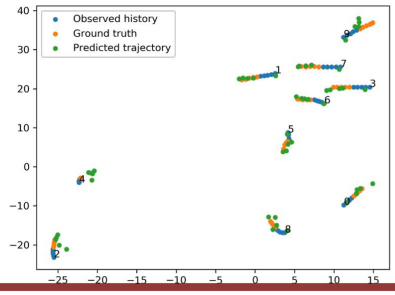
Data

The data used is from the publicly available Stanford Trajectory Forecasting Benchmark [2]. This dataset contains the ground truth x- and y- coordinates of each traffic agent in the scene at various locations, along with the unique agent ID and the timestamp.

Results and Discussion

	Training/Testing samples	Training error	Testing error	Final Displacement Error (m)	Mean Displacement Error (m)
Vanilla RNNs	6420/200	3.9e-05	4.5e-05	2.0	1.8
LSTM Encoder-Decoder	6420/200	1.8e-05	1.9e-05	0.93	1.29

- LSTM Encoder-Decoder models performs better than vanilla RNN
- The model captures the general trend of the traffic agent motion
- The uncertainty in pedestrian motion poses challenges to the model



Future Research

- Incorporate scene-specific information
- Extend to multi-modal prediction

References

[1] S. H. Park, et al., "Sequence-to-sequence prediction of vehicle trajectory via LSTM encoder-decoder architecture," in 2018 IEEE Intelligent Vehicles Symposium, IV 2018, ser. IEEE Intelligent Vehicles Symposium, Proceedings. Institute of Electrical and Electronics Engineers Inc., pp. 1672–1678

[2] Sadeghian, et al. "TrajNet: Towards a Benchmark for Human Trajectory Prediction." arXiv Preprint. 2018.