Spatiotemporal Event Prediction

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I. Introduction

This Document file created with the intention of describing the work done to predict Spatio-Temporal Events.

In real-world spatiotemporal systems are commonly found. Forecasting the future in these kind of systems is challenging and important problem. In [1], a detailed survey can be found for details of the problem and challenges.

In this work three different machine learning algorithms are used to solve on generated data samples. Firstly, one of the classical sequence algorithms Hidden Markov Models (HMMs) are used with prediction purpose. Secondly, multi-layer perceptron (MLP) is employed. Lastly, Long-Short Term Memory (LSTM) Model is used with Fully Connected (FC) layers.

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II. Method

A. Data Exploration

One of the most important part of the solution is knowing the data. Thus, starting with plotting and searching for patterns in data is most logical path.

In figure 1 the change in time can be seen on one location.

Fig. 1. Pixel change in one place.

In figure 2 the change in time can be seen with summed on day manner. In this graph we can see that there is a period in data.

Fig. 2. Summed data in day manner.

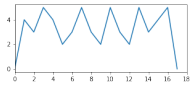

Fig. 3. A period in data

B. Prediction with HMM

One of the mostly used method for sequence learning is HMM method is employed to create baseline result for the data and to see if the data is predictable.

In figure 4 HMM prediction with 5 data points seen and future data point predicted and hamming distance and euclidean distance are used to measure the distance of the prediction to label data.

Generated average distances are 1.48 for euclidean distance and 3.2 for hamming distance.

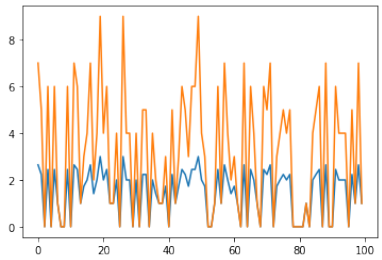

Fig. 4. Predicted Distance Graph

C. Prediction with MLP

One of the basic models for prediction is using MLP model. In this model there are 4 layers to summarize the past data and predict future data point.

To be able to generate the comparable results only 5 past data points are used in training. In training mean square error loss (MSE) is used.

Generated average euclidean distance distance is 2.38 but hamming distance's sum resulted 140.20 while average MSE loss is 0.022.

D. Prediction with LSTM

One of the commonly used sequence learning deep model is LSTM model is used with consequent layer and additional 2 layered MLP to predict future data with 5 past data points.

Generated average euclidean distance distance is 3.21 but hamming distance's sum resulted 143.89 while average MSE loss is 0.022.

III. Conclusion

In conclusion, all of the 3 models are able to predict with reasonable mistakes. These mistakes can be decreased and models can generated better results with more data points and parameter tuning.

References

[1] X. Shi and D.-Y. Yeung, "Machine Learning for Spatiotemporal Sequence Forecasting: A Survey," *arXiv:1808.06865 [cs, stat]*, Aug. 2018.