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MSc Basic Module
Datenbanktechnologie

Topic: Implementation of Attentional Recurrent Neural Network for Human Mobility Prediction

Human mobility prediction is vital in several applications in fields including urban traffic management, contextual advertising and pervasive computing. Predicting human mobility, however, is challenging due to the high complexity of the time dependent sequential transition of human movements and the sparse nature of human trajectories.

Feng et al. [1] proposed an approach based on Attentional Recurrent Neural Networks (ARNN), which outperform traditional baseline algorithms like Hidden Markov Models (HMM). To capture sequential transitions of users, the authors construct a multi-modal embedding RNN by jointly embedding the multiple factors that govern mobility. To capture the multi-level periodic nature of human mobility, a layer that captures historical attention is added to improve the RNN mobility prediction performance. In addition, Smith et al. [2] describe a way for computing a performance upper bound of human mobility prediction.

The main objective of this Master Basic Module is to implement and describe the ARNN and predictability upper limit estimation on two datasets used by Feng et al. [1] and Smith et al. [2].

Tasks:

1. **Literature Study:** Study Feng et al. [1] and Smith et al. [2] to understand their approaches and the datasets they used.
2. **Python Implementation** The original implementation of these approaches can be found

in public repositories [3] [4]. The approach of Feng et al. [3] is implemented in pytorch while the approach of Smith et al. [4] is implemented in python and matlab. Implement these algorithms in python from scratch. The implementation should include the ARNN variants and baseline models [3] and the predictability evaluation approach [4].

3. **Describe the datasets and data preparation process:** Explain the two datasets in terms of their formats and representations plus the preprocessing steps needed before feeding them to the main algorithms.
4. **Result Assessment:** Experimentally evaluate your implementation on the two datasets and compare the results to the ones published in the original papers [1, 2]. Explain differences and similarities.
5. **Write a technical Report**: Describe the overall work pipeline and visualize the results in a concise way. The report should include a running example of the whole process for the mobility data of a given user. Code snippets that are essential to the overall approaches should be included and described.

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References

[1] Feng, Jie and Li, Yong and Zhang, Chao and Sun, Funing and Meng, Fanchao and Guo, Ang and Jin, Depeng, DeepMove: Predicting Human Mobility with Attentional Recurrent Networks. Proceedings of the 2018 World Wide Web Conference, pp. 1459–1468,Lyon, France, April 2018.

[2] G. Smith, R. Wieser, J. Goulding and D. Barrack, "A refined limit on the predictability of human mobility," 2014 IEEE International Conference on Pervasive Computing and Communications (PerCom), Budapest, Hungary, 2014, pp. 88-94, doi: 10.1109/PerCom.2014.6813948.

[3] https://github.com/vonfeng/DeepMove

[4] https://github.com/gavin-s-smith/MobilityPredictabilityUpperBounds

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