Deep learning methods and graph-based approaches for traffic speed prediction in the Lyon area

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In the present work, the problem of traffic speed prediction is explored in all its phases, from data processing to forecast analysis. A detailed pipeline is described covering the necessary steps to obtain a meaningful subset of roads with which to tackle the prediction problem. A series of baselines has been implemented, from traditional techniques to machine learning approaches, to offer comparisons with current and future state-of-the-art methods. Finally, graph neural networks are introduced in the context of traffic speed prediction, with a focus on the recently proposed Diffusion Convolution Recurrent Neural Network (DCRNN), a reference in this field. This deep learning architecture has been carefully analysed, adopted and partially reimplemented for further developing purposes.

To summarise, our work offers a detailed view of the traffic speed prediction problem, involving road network analysis, time series forecasting and implementation of recently proposed approaches, dealing with real-world data coming from GPS trajectories of Lyon traffic. The contribution is threefold:

1. The data processing part, from the initial floating car data to the construction of a relevant subgraph (from the prospective of traffic forecasting), provides a general approach to select interesting road segments with respect to their associated speed time series. This issue was tackled by taking into account data availability, non-stationarity and noisiness, with simple criteria that ensure reproducibility and extensibility to other case scenarios.
2. The applications of different forecasting methods, from traditional approaches to machine learning based techniques, gave an in-depth characterization of the traffic prediction problem on a relevant part of the Lyon road network. Such results could serve as baselines for the evaluation of future state-of-the-art methods, when applied to the same speed dataset
3. The analysis of a recently proposed neural network architecture, designed to tackle spatiotemporal forecasting tasks, such as DCRNN, highlighted a way of combining recurrent neural networks and graph-based approaches. This study led to the reimplementation of the DCRNN fundamental constituent, i.e. its recurrent cell DCGRU, in the latest version of a common deep learning framework, drastically lowering the learning curve for model upgrading and reimplementation.