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A Deep Learning Approach to Real Time and Robust Vehicular Traffic Prediction

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Abstract : Vehicular traffic events have overly complex spatial correlations and temporal interdependencies and are also influenced by environmental events such as weather conditions. To capture these spatial and temporal interdependencies and make more realistic vehicular traffic predictions, graph neural networks (GNN) based traffic prediction models have been extensively utilized due to their capability of capturing non-Euclidean spatial correlation very effectively. However, most of the already existing GNN-based traffic prediction models have some limitations during learning complex and dynamic spatial and temporal patterns due to the following missing factors. First, most GNN-based traffic prediction models have used static distance or sometimes haversine distance mechanisms between spatially separated traffic observations to estimate spatial correlation. Secondly, most GNN-based traffic prediction models have not incorporated environmental events that have a major impact on the normal traffic states. Finally, most of the GNN-based models did not use an attention mechanism to focus on only important traffic observations. The objective of this paper is to study and make real-time vehicular traffic predictions while incorporating the effect of weather conditions. To fill the previously mentioned gaps, our prediction model uses a real-time driving distance between sensors to build a distance matrix or spatial adjacency matrix and capture spatial correlation. In addition, our prediction model considers the effect of six types of weather conditions and has an attention mechanism in both spatial and temporal data aggregation. Our prediction model efficiently captures the spatial and temporal correlation between traffic events, and it relies on the graph attention network (GAT) and Bidirectional bidirectional long short-term memory (Bi-LSTM) plus attention layers and is called GAT-BILSTMA.

Keywords : deep learning, real time prediction, GAT, Bi-LSTM, attention
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