PhD Lecture

In partial fulfillment of the terms for obtaining the PhD degree, Razvan-Gabriel Cirstea will give a lecture on the following subject:

Model Parameter Generation for Correlated Time Series Forecasting

on Tuesday 19th of July 2022, 9.00 100% online

Abstract:
In recent years, continuous digitalization and rapid technological developments have led to effective monitoring systems which resulted in different sectors of the industry such as transportation and healthcare using them to monitor and collect data from their day to day operations. Analysis on such data may provide valuable information and could allow for better planning and management of complex systems. Meanwhile, advancements in artificial neural networks combined with powerful hardware in the form of graphical processing units have enabled us to use neural networks based methods for data analysis tasks.

While recent studies are achieving impressive results for correlated time series forecasting they still suffer from the following limitations: (i) they are often spatio-temporal agnostic, (ii) they assume entity correlation is static across time, (iii) they are inefficient when modeling long term dependencies. In this thesis we focus on model parameter generation such that we enable models to be spatio-temporal aware, capture dynamic entity correlations and better model long term dependencies resulting in accurate forecasts.

First, we propose a framework that enables existing models to capture distinct temporal patterns at different locations, thus making them spatial-aware. We enrich each location with a learnable memory which is then used as input to a hypernetwork which is responsible to generate model parameters that are tailored for a specific location. The framework is model-agnostic meaning that it is not restricted to a specific type of networks and it generalizes well.

Second, when modeling spatial correlations, related studies employ a static weighted graph, where the weights are pre-computed based on different metrics. To address this limitation we propose using a Dynamic Adjacency Matrix Generation Network to generate dynamic graph, which in conjunctions with graph convolution can model dynamic interactions between entities.

Third, recent studies show that attention based methods are good at capturing long-term dependencies. However, such methods are suffering from quadratic space and time complexity which does not scale well to big datasets. To alleviate this problem we propose a window attention scheme in which we first segment the input into multiple windows and within each window introduce multiple proxies. The proxies are randomly initialized but learnable such that the network can capture the most prominent temporal patterns within a specific time window.

We evaluate our proposed methods and framework on different real world time series forecasting datasets from different domains such as transportation, energy and meteorology. The experiments justify our design choices and demonstrate that the proposals outperform state-of-the-art methods.

Members of the assessment committee are Associate Professor Johannes Bjerva, Aalborg University, Associate Professor Huaiyu Wan, Beijing Jiaotong University, and Associate Professor Lina Yao, University of New South Wales. Professor Bin Yang is Razvan’s supervisor. The moderator Associate Professor Johannes Bjerva.

All interested parties are welcome.