Abstract

Mobile traffic modelling is crucial for optimizing the network configuration and improving mobile user experience; by reliably modelling mobile traffic, it is feasible to obtain domain-specific knowledge and accurate mobile traffic predictions, which can help mobile operators better configure the network and adapt to the trend of mobile demand. In recent years, we have observed a dramatic growth in mobile traffic worldwide, and that raises more challenges for mobile operators to manage mobile networks efficiently. In this thesis, we explore how to model the characteristics of mobile network key performance indicators using solutions built on machine learning and deep learning.

For mobile traffic modelling, the problems can be generally subdivided into two subjects: how to obtain useful knowledge by analyzing mobile key performance indicators and how to predict them accurately. In this thesis, we first study how to recognize meaningful patterns which could be used to achieve better network management. Chapter 3 presents a novel time series clustering algorithm, this algorithm is responsible for creating clusters based on the variability of mobile traffic time series. For a cell in the mobile network, the potential activeness of its served mobile users can be reflected by the changing strength of the monitoring mobile traffic; hence the developed algorithm can be used to evaluate the importance level of each cell. Experiments have shown that the proposed clustering algorithm can identify different importance levels efficiently while having a fast running speed.

Chapter 4 and Chapter 5 focus on the problem of mobile traffic forecasting, where Chapter 4 explores the methods of predicting mobile traffic peaks and Chapter 5 focuses on general mobile traffic forecasting considering deployment constraints. In Chapter 4, we propose two deep learning-based mobile traffic peak predictors which can handle the trade-off between peak forecasting performance and general forecasting performance. Compared to widely used baseline approaches, these predictors have improved the peak forecasting performance significantly. Moreover, the proposed predictors are employed to implement a predictive detection approach, and this approach can efficiently predict if mobile traffic will be distributed among neighbouring cells in an imbalanced way, supporting the decision-making regarding the network management. Finally, Chapter 5 proposes two forecasting models respecting the deployment constraints which could be met under industrial scenarios, where memory and training time constraints are the main concerns of mobile operators. Extensive experiments are conducted on the real-world dataset, and the designed models can make accurate mobile traffic predictions having either few parameters or rather short training time.

To sum up this thesis, we study how to perform mobile traffic forecasting and knowledge extraction using machine learning and deep learning approaches. By

evaluating the proposed methods on real-world industrial datasets, we prove that our approaches can be used to address different issues encountered under real scenarios, allowing mobile operators to manage and configure mobile networks more reliably and smartly.