EFFICIENT MACHINE LEARNING ALGORITHMS FOR AUTOMATIC RECONFIGURATION OF MOBILE HEALTH MONITORING SYSTEMS

Abstract

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Mobile health monitoring plays a central role in a variety of healthcare applications. Due to the sensitive nature of healthcare applications, these systems need to process these personal and physiological informations highly accurately. However, as mobile devices are employed in real-world scenarios, the accuracy of a machine learning model drops whenever a change in the setting of the system occurs. Therefore, machine learning algorithms that specifically address challenges associated with dynamic real-world situations are needed. At a high level, the variations can be grouped in three classes: configuration change (e.g. sensor sensitivity), context change (e.g. new user), and user need change (e.g. new sensor deployment). To cope with the effects

of the above variations, we develop efficient machine learning algorithms for designing robust and reconfigurable embedded software for these systems. We envision a high level framework for health monitoring systems and we take several inter-related directions for realizing the framework. First, we develop several algorithms to adapt the current knowledge for the setting at hand autonomously. These algorithms find relation between the setting at hand and training data, and generate context-specific labeled data. Secondly, for the case where related knowledge is insufficient to reconfigure the system, we propose a novel architecture called Co-MEAL designed for interactive reconfiguration of the system. The key idea is to keep the systems uncertainty below a pre-specified threshold while minimizing the overall cost of data annotation. This framework is designed to manage a set of heterogeneous experts and provide collaboration between the experts. Thirdly, we proposed a novel active deep architecture, 3DConvLSTM, to generate generalizable representations from raw-data. The architecture learns representations from related data, and capture the time dependency between consecutive instances in the active learning phase. Lastly, to control the way we perform reconfiguration, we propose an efficient management framework to be used in dynamically changing network of wearables. We introduce a novel graph model to capture the importance of features and their correlations along with their associated cost. We propose a greedy algorithm to solve the minimum-cost feature selection problem to classify the uncertainty (signal heterogeneity) situations.