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論 文 題 目	A Study on Learning and Recommending Treatments Using Electronic Medical Records		
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論文の内容の要旨

Data mining has shown to be a promising technique with many applications in various domains. In healthcare, accessible electronic medical records provide valuable resources for data mining tasks to address health-related issues. The two emerging tasks are learning treatment patterns and recommending treatments, which are expected to assist healthcare organizations and physicians to manage the use of medical resources and minimize accidental faults causing adverse drug reactions.

Although many data-driven models have been proposed for learning and recommending treatments, approaching these tasks is still very challenging due to several reasons. First, electronic medical records are heterogeneous, longitudinal and varying length objects. These characteristics pose challenges of data processing and representation, the important steps of the knowledge discovery process. Second, although solving healthcare issues typically requires a lot of domain knowledge, related studies have mainly developed black box models that neglect this factor. For example, few studies have focused on explaining the recommendation mechanism from the healthcare perspective or identifying treatment period intervals hidden in prescription records of acute disease patients. As a result, the lack of domain knowledge incorporation considerably weakens the interpretability of current studies.

This dissertation aims to propose a class of treatment learning and treatment recommendation methods to tackle the above challenges. Different from most of the current studies, our proposed methods take into account various patient information to maximize the capability of data utilization. To overcome the challenge of presenting mixed-type medical objects, we adopt a powerful data representation model named mixed-variate restricted Boltzmann machine for representing various patient

information. We also address the challenge in handling longitudinal and varying length prescription records partially by a scoring algorithm that splits prescription records into periods where significant changes in prescription indication happen. In the treatment learning method, we propose an algorithm to fully reflect usage frequency of prescription drugs under a tree form. In the treatment recommendation methods, we propose a class of neighbor-based approaches to synthesize neighbor patients' treatments and suggest treatment for new patients.

The experimental evaluations show that the proposed treatment learning method can reveal many more different kinds of treatment patterns together with more interesting results connecting the curing relation of drugs and symptoms compared to traditional approaches using association analysis for treatment pattern discovery. In the case of treatment recommendation methods, we obtain competitive results with advanced recommendation systems for implicit feedback dataset in terms of precision and recall. More importantly, we point out that there are plenty of rooms for developing neighbor-based recommendation approaches that achieve similar precision and better interpretation compared to the black box models.

論文審査の結果の要旨

Treatment is one of the main factors which significantly affects patient health status. Learning treatment patterns and recommending treatments for new patients using data-driven models are promising to reduce the occurrence of adverse drug reactions and thoroughly manage medical resources. Recently, the extensive use of electronic medical records has enabled researchers to work on the two above problems actively. However, most of the research works are limited with few treatment patterns and hard-interpretable models under the healthcare perspective. The candidate has addressed the above drawbacks with novel and significant contributions, which are listed as follows.

1. Incorporate medical domain knowledge to tackle the task of treatment period identification task and to derive drug-disease relationships.
2. Develop a new representation to discover many more different kinds of treatment patterns under a tree form.
3. Employ both data-driven approach and knowledge-driven approach to capture human knowledge on how to treat a patient.

The candidate conducted this study with a considerably large volume of workload and obtained promising results. We approve awarding a doctoral degree to Mr. HOANG Khanh Hung.