

Interactive Process Discovery in Healthcare: A Case Study of an Emergency Department

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Introduction

The Emergency Department (ED) is one of the most significant first-contact points with the healthcare system. ED must provide the required services to screen, examine, and provide care to patients in the most effective way. This has led to increased efforts to improve the service levels, to reduce overcrowding and to provide prompt and efficient care [6]. To increase the efficacy and effectiveness, business process analysis is recognized as an extremely important activity in this field [3]. Process Mining aims to analyse, discover, improve, and manage real processes, by extracting knowledge from event logs [5]. However, due to the characteristics of healthcare processes, traditional Process Mining techniques present some limitations, providing complex and incomprehensible process models [3]. Recent studies show that exploiting domain knowledge within (semi-)automated process discovery leads to better process models [1,2]. This is particularly valuable in healthcare, where physicians typically have an advanced understanding of the treatment process that may improve the discovered process models. The aim of this on-going research work is to demonstrate the suitability of Cortado⁴ [4] to discover healthcare processes from event data. Cortado is an innovative interactive process discovery tool that allows a user to incrementally discover a process model. In this work, we conduct a real case study within a Brazilian ED.

Case Study

The dataset subject of our study contains information about patients admitted to the ED of a Brazilian hospital between March and July 2021. To ensure the reliability of the results, we pre-processed the dataset, including: (a) outliers' removal, (b) low level activities aggregation, (c) less significant activities filtering. The final dataset includes 17,027 cases and 138,643 events. The cases in the log belong to 3,747 different variants.

We applied Cortado to discover the process model for all the patients admitted to the ED. The model was obtained by incrementally adjusting the automatic decisions from Cortado with insights and suggestions from the domain experts.

⁴ <https://cortado.fit.fraunhofer.de>

For example, some inadequate behaviours were excluded from the model, e.g., premature ED abandonment or treatments after the discharge. A procedural process model for ED patients, obtained by Cortado, is shown in the corresponding poster. The discovered models allows to obtain insights in the structure of the process and the main patient-flows. The analysis reveals that ED patients are characterized by a quite homogeneous high-level behavior in the first part of the process, while several variants exist in the second part due to different examinations and treatments depending on the pathology of the various patients.

To evaluate the accuracy of the process model obtained by Cortado, we experimented with fitness (F), precision (P), and the F1-score (F1). The evaluation was conducted against models discovered with the Inductive Miner (IM) and the Heuristic Miner (HM) to show the potential benefits that domain knowledge brings in improving the quality of the process model. We applied IM and HM with standard filtering thresholds. The results show that Cortado achieves the best results (F: 0.96, P: 0.71, F1: 0.81), outperforming IM (F: 0.95, P: 0.26, F1: 0.41) and HM (F: 0.75, P: 0.24, F1: 0.36) across all the metrics. In particular, HM and IM are less precise, allowing behaviors not recorded in the event log. This negatively affects the F1-score value. On the contrary, Cortado is able to balance fitness and precision values. This is a promising result in a complex context like the healthcare.

Outlook

In this extended abstract, we briefly presented preliminary results of applying Cortado to a real case study within a Brazilian ED. In future work, we plan to extend this preliminary results by involving various domain experts of the ED to evaluate the effectiveness of interactive process discovery compared to conventional process discovery in a large-scale.

References

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