

Ph.D. Thesis Proposal

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Title: Contextual and Causal Analytics of Process-centric Data

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Description:

Process mining is a recent research topic that applies artificial intelligence and data mining techniques to process modelling and analysis [1,2]. The main idea is to extract knowledge from events recorded in an *events log* to discover, monitor and improve processes. Event logs stores *activities* related to process instances, as well as additional information such as the *resources* executing the activities, data produced or used, *timestamps*, or *costs*.

Process mining approaches allow the discovery of the process model or its variants (a.k.a. *discovery*), the detection of deviations between the real process and the designed model (a.k.a. *conformance checking*), and the improvement of the process model based on the observed events (a.k.a. *enhancement*). Predictive process monitoring is a subfield of process mining that deals with predicting outcome for running instances [3,4].

Most existing process mining and process monitoring approaches consider the process to be in steady state and so do not consider the *context* in which the process takes place nor the changes that may affect it while being analyzed [5,6]. Information about the context could be derived from the process log (resource occupation rate...) or captured from other sources of information that could enrich the log. Dealing with context information is important to detect and analyze changes [7,8] and is one of the challenges for research described in the Process Mining Manifesto [9].

Objectives:

The aim of this thesis is to consider the context in all the phases of the process improvement life cycle (discovery, conformance checking, enhancement) as well as in process monitoring. Including the context could improve the precision of the discovered process model and of its analysis enabling better recommendation for process improvement and better predictions for process monitoring. It will also allow to address fairness issues (e.g., not blame an overloaded resource for delays) and conduct causality analysis (e.g., which factor, or context variable causes delays).

Towards a context-enhanced analysis of process-centric data, the following objectives should be addressed:

- Propose context-driven process discovery and conformance checking techniques
- Use context attributes to propose meaningful improvements
- Study what context attributes to monitor and how to identify when these attributes change
- Propose approaches to detect context changes online
- Propose predictive approaches with online learning to make sure that the process model is up to date

Required skills:

We seek for excellent and highly motivated student with a background in Computer Science. We need a student with good knowledge of business process management or petri nets, process mining and data mining. Having good programming skills and some notion of machine learning would be an asset.

To apply:

Please send the following material before March 30th, 2021:

- fully detailed CV,
- academic records (master's degree or equivalent),
- cover letter,
- recommendation(s) and supporting letter(s).

References

- [1] Van Der Aalst, W. (2016). Data science in action. In Process mining. Springer, Berlin, Heidelberg.
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- [3] Taymour, F., La Rosa, M., Dumas, M., & Maggi, F. M. (2019). Business Process Variant Analysis: Survey and Classification. arXiv preprint arXiv:1911.07582.
- [4] Rama-Maneiro, E., Vidal, J. C., & Lama, M. (2020). Deep Learning for Predictive Business Process Monitoring: Review and Benchmark. arXiv preprint arXiv:2009.13251.
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- [6] Van Der Aalst, W. M., and Dustdar, S. (2012). Process mining put into context. IEEE Internet Computing, 16(1), 82-86.
- [7] Acheli, Mehdi; Grigori, Daniela; Weidlich, Matthias (2021), Discovering and Analyzing Contextual Behavioral Patterns from Event Logs, under submission.
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- [9] Wil M. P. van der Aalst et al. (2011), Process Mining Manifesto. Business Process Management Workshops (1) 2011: 169-194 .

