

# From Low-Level Events to Activities - A Pattern-based Approach (Extended Abstract)

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**Abstract:** This extended abstract summarizes our work published in [Ma16b]. We present a supervised abstraction method that is based on behavioral activity patterns, which capture domain knowledge on the relation between activities and events. We abstract low-level events based on an alignment between activity patterns and traces of the low-level event log.

**Keywords:** Process Mining; Supervised Abstraction; Event Log; Alignment

Organizations use information systems to support their work. Often, information about the usage of those systems by workers is recorded in event logs. Process mining techniques use such event data to analyze processes of organizations. It is assumed that recorded events correspond to meaningful activities executed for instances of a process (i.e., cases) [Aa16]. The ability to identify executions of activities based on events is crucial for any process mining technique. Events that do not directly correspond to activities recognizable for process workers are unsuitable for process analytics, since their semantics are not clear to domain experts. However, events recorded by information systems often do not directly correspond to recognizable executions of activities [BMW14; GRA10]. This extended abstract summarizes our contribution of a supervised event abstraction method that was published in [Ma16b].

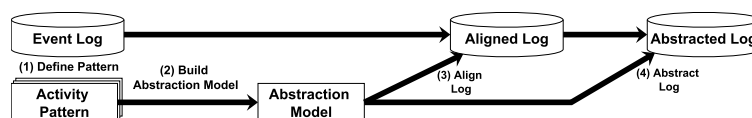


Fig. 1: Overview of the proposed event abstraction method

An overview of the four main steps of the proposed abstraction method is given in Fig. 1.

1. We model multi-perspective behavioral **activity patterns** in form of Data Petri

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nets [Ma16a] to capture domain knowledge about the conjectured relation between high-level activities and low-level events.

2. We build an **abstraction model** that specifies the dependencies among the modeled activity patterns (e.g. two patterns are mutually exclusive) through a visual language.
3. We **align** the behavior defined by these activity patterns with the observed behavior in the event log. Alignment techniques [Ma16a] are able to find an optimal mapping between low-level events and activity patterns even for event logs that contain noise.
4. Based on the alignments, we construct a reliable **abstraction mapping** from low-level events to activity patterns and create an abstracted event log.

The resulting abstracted event log contains only high-level events at the desired level of abstraction, which directly relate to executions of high-level activities. We implemented the proposed method as the *LogEnhancement* package of the process mining framework ProM. We applied the method on an event log extracted from the digital whiteboard system of a Norwegian hospital. The activity patterns were designed together with the hospital's domain experts. The case study shows that our abstraction method can be successfully applied in complex real-life environments. We obtained an abstracted event log from a system, in which (1) multiple high-level activities *share low-level events with the same label*, (2) high-level activities occur *concurrently*, and (3) *erroneous events* (i.e., noise) are recorded. We applied state-of-the-art process mining tools on both the original and the abstracted event log. The results obtained from the abstracted event log reveal insights that cannot be obtained when using the original event log. Moreover, the results are more useful in the communication with stakeholders, since the users can better relate the models to their actual work.

## References

- [Aa16] van der Aalst, W. M. P.: Process Mining - Data Science in Action, Second Edition. Springer, 2016.
- [BMW14] Baier, T.; Mendling, J.; Weske, M.: Bridging abstraction layers in process mining. *Inf. Syst.* 46/-, pp. 123–139, 2014.
- [GRA10] Günther, C. W.; Rozinat, A.; van der Aalst, W. M. P.: Activity Mining by Global Trace Segmentation. In: BPM Workshops. Vol. 43, LNBP, Springer, pp. 128–139, 2010.
- [Ma16a] Mannhardt, F.; de Leoni, M.; Reijers, H. A.; van der Aalst, W. M. P.: Balanced multi-perspective checking of process conformance. *Computing* 98/4, pp. 407–437, 2016.
- [Ma16b] Mannhardt, F.; de Leoni, M.; Reijers, H. A.; van der Aalst, W. M. P.; Tossaint, P. J.: From Low-Level Events to Activities - A Pattern-Based Approach. In: BPM. Vol. 9850. LNCS, Springer, pp. 125–141, 2016.