- Extended abstract - Discovering Cross Organisational Processes from Message Logs

Pieter Kwantes

LIACS, Leiden University, P.O.Box 9512
NL-2300 RA Leiden, The Netherlands
p.m.kwantes@liacs.leidenuniv.nl

In [5, 6] we describe how existing algorithms, see e.g., [1], for the discovery of Petri net models of business processes from local event logs (sequences of action occurrences), can be leveraged to the discovery of Petri net models of global, industry level, cross organisational processes (COPs), such that behaviour of the local models is preserved.

However, in practice, mining COPs from local event logs can be a problem [4]. First of all, enterprises may be reluctant to disclose the information in their local event logs to the public domain. Moreover, even given a set of local event logs, it can be difficult to determine how sequences of action occurrences from these logs combine into a global event log, consisting of sequences of action occurrences of the COP. To address these problems we focus on the communication between local processes. Whereas the information in a local event log is confined to a single enterprise, communication involves multiple enterprises. Therefore, we propose message logs, recordings of communication in a COP, as an alternative to local event logs for the discovery of COPs. [1]

We take the abstract view that a COP consists of independently operating local processes that interact through the asynchronous exchange of typed messages over bilateral unidirectional channels. Here, types represent message formats prescribed by the prevailing industry standard. [2]

To model local processes (enterprises) we use Petri nets with typed input and output transitions, referred to as E-nets. At the industry level, COPs are modelled by I-nets, compositions of E-nets where input and output transitions with the same type are combined into channels. A comprehensive overview and discussion of this and other models can be found in [2].

[1] Such recordings arise, e.g., as a byproduct of day to day operations of message service providers. Case studies exploring the use of recorded messages for process mining include [3].

[2] Concrete instances of this view include SWIFT for financial services, RosettaNet for the electronics industry, and EDSN for the Dutch energy market, to name just a few.

We formalise the notion of a message log through the concept of a message event corresponding to the sending or receipt of a message. Each message event has attributes, in particular, the identities of sender and receiver, the subject or case of the message, and its local time of sending or receiving. A message log is then a set of message events. Note that, although each message event in the log is the result of the occurrence of a local action, it does not include a reference to the action itself, in contrast to events (i.e., occurrences of actions) in an event log.

We then show how message logs can be translated into event logs thus making the approach from [5, 6] available for the discovery of COPs. Clearly, a necessary condition is that this transformation preserves the essential properties of the COP and its behaviour, as recorded in the message log. To this aim, we require that the local time stamps and the order of sending and receiving of messages impose a partial order on the log. A method is then provided to interpret message events as occurrences of actions of local processes. This results in a labelled partial order on message events. The linearisation of this labelled partial order yields a global event log. Using the results from [5, 6], we show how this can then be used to discover a model of a COP, in the form of an I-net, such that its communicating behaviour matches the observed communication in the message log.

Our results contribute to a formal theory to support approaches to mining and verification of COPs, that combine information from different local and global perspectives, such that privacy concerns are respected. Future work includes extending our framework to formal choreography models, and their transformation into I-nets.

References

1. Aalst, W.: Process Mining - Data Science in Action. Springer, 2nd edn. (2016)
2. Benzin, J.V., Rinderle-Ma, S.: Petri net classes for collaboration mining: Assessment and design guidelines. In: Process Mining Workshops. pp. 449–461. Springer Nature Switzerland (2024)
3. Engel, R., et al.: Analyzing inter-organizational business processes. Inf. Syst. E Bus. Manag. 14(3), 577–612 (2016)
4. IEEE Task Force on Process Mining: Process Mining Manifesto. LNBIP, vol. 99, pp. 169–194. Springer-Verlag, Berlin (2012)
5. Kwantes, P., Kleijn, J.: On discovering distributed process models the case of asynchronous communication. CEUR Workshop Proceedings, vol. 2625, pp. 49–65. CEUR-WS.org (2020)
6. Kwantes, P., Kleijn, J.: Distributed synthesis of asynchronously communicating distributed process models. In: Trans. Petri Nets Other Model. Concurr. Lecture Notes in Computer Science, vol. 13220, pp. 49–72. Springer (2022)