Improving the Simplicity of Workflow Nets

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Abstract. Understanding a process model is as important as its conformance with the data it was created for. Stake-holders and process analysts need to understand a model to work efficiently with it, and certain algorithms work much faster when the model is simple. But especially large processes create big and complex models. In our research, we explore ways to improve the simplicity of workflow nets by finding regions that guarantee simpler structures. While doing so, we allow the language of the net to undergo minor changes, affecting the fitness and precision of the net. We control which changes are acceptable by using weights for the quality dimensions.

Keywords: Simplicity · Complexity · Workflow nets · Process Mining.

Evaluating the quality of discovered process models is a key part of process mining. The most commonly used measures concern the quality dimensions *fitness* and *precision*. Apart from these dimensions, there are *generalization* and *simplicity* [1]. The latter quality dimensions are not as well understood as the former: The generalization and simplicity of a model depend on factors for which we have no data. For example, simplicity depends on personal preferences of people that will work with the model. Since it is difficult to define formally, the simplicity dimension is often overlooked or handled implicitly during process discovery. This results in difficult to understand process models. For an example, take the workflow net N_α of Figure 1. This net is the result of the alpha miner [2], when called for the input language $\{aegi, agei, begi, bgei, cfhi, chfi, dfhi, dhfi\}$. It is difficult to immediately recognize the language of N_α, but why is that? One reason is that N_α contains implicit places whose deletion would not change the language of the net. Another reason is that the net is not planar and has many crossing arcs. One could also argue that the concurrency in N_α introduces complexity. In general, there are many possible reasons to why a process model is complex [3]. But finding that a model is difficult to understand is not the end of the story. As soon as we know the reason, we might want to take action and simplify an existing

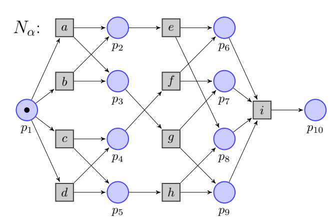

Fig. 1. A workflow net, N_α, discoverd by the alpha miner.

process model, so it is easier to work with. As an example, take again the net N_α of Figure 1. If we want to increase the simplicity of N_α by reducing its size, we can delete the implicit places p_7 and p_8, resulting in the net N_1 of Figure 2. With this operation, we do not change the language of the net, so its fitness and

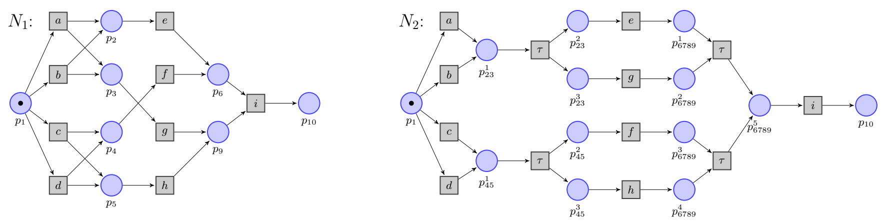

Fig. 2. Two simplified versions of N_α according to different complexity measures.

precision scores remain unchanged. If we instead consider the density of the net, we can improve the simplicity of N_α by finding less dense representations of xor- and parallel joins, resulting in the net N_2 of Figure 2. Again, the language of the net does not change. We are interested in a general set of rules we can perform to simplify the net without changing its behavior.

We found that there are several algorithms that reduce the size of a workflow net based on a set of reduction rules [4–6]. However, these algorithms aim to simplify the model to execute model checking techniques more efficiently, so they allow changing the language of the model and retain only special properties. Other approaches introduce super-nodes with special semantics to lower the cognitive load while understanding a process model [7].

The goal of our research is to define an algorithm that increases the simplicity of workflow nets while allowing only for minimal changes in its fitness and precision score. To do so, we take an event log, measures to compute fitness, precision, and simplicity, and weights for these dimensions as input. With the weights, we can express which quality dimensions are most important to us, so too drastic changes on their scores are avoided. Currently, we do not take the generalization dimension into account, since existing generalization measures have serious weaknesses [8]. In a first step towards our goal, we formulate generic rules for each complexity measure that simplify a workflow net without changing its language, like in the example of Figure 2. For the second step, we alleviate the constraint of language-equivalence. Finally, we aim to define *nifty regions*. In contrast to minimal regions, which guarantee language-inclusion of the input language, *nifty regions* focus on keeping the workflow net as simple as possible according to a simplicity measure. For example, *nifty regions* avoid edge crossings or implicit places. With our approach based on regions, we can then formulate process discovery techniques that actively take the simplicity of a net into account. This enables new ways for comparing simplicity measures and deepening the understanding of the simplicity dimension.

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