

Contribution to the study of weighted Petri nets

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Many real systems and applications, including embedded and flexible manufacturing systems, may be modeled by weighted Petri nets. The behavior of these systems can be checked on their model early on at the design phase, thus avoiding costly simulations on the designed systems.

Usually, the models should exhibit three behavioral properties: liveness, boundedness and reversibility. Informally, liveness states the possibility of keeping all the functionalities active over time, while boundedness ensures that the system can perform all operations with a bounded amount of resources. Reversibility preserves the possibility of returning to any reachable state using only internal operations, avoids a costly initialization phase and favors a steady, regular, behavior from the start. These properties are fundamental for many real-world applications. However, they are very difficult to analyze in weighted Petri nets.

In this talk, I give an overview of my Ph.D. thesis (2011 - 2014), which investigates the liveness, boundedness and reversibility properties in several expressive subclasses of weighted Petri nets. In most cases, we focus on well-formed nets, whose structure ensures boundedness for every initial marking and the existence of at least one live initialization. Moreover, efficient methods already exist that check well-formedness in the classes of our study.

First, I outline several new efficient transformations that simplify the study of the behavior in the resulting system. Second, I present our study of the liveness and reversibility properties, using the previous transformations. We obtained the first polynomial sufficient conditions ensuring these properties in several weighted and well-formed subclasses. Under the liveness assumption, we also found new characterizations of reversibility, one of which does not need the boundedness hypothesis.

I conclude with several perspectives.