On using Petri nets to model and simulate processes with uncertainty

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ABSTRACT

This work presents a study on using Petri nets [1] to model and simulate processes with uncertainties. They typically describe and simulate discrete event systems, especially queue analysis which is of great interest in processes. Their measures are useful for understanding the process and they naturally compose formulations of optimization problems for a process.

Petri nets are notable for their simplicity and elegant mathematical support. Their simulation involves a few simple matrix equations and graph operations so that their analysis has been explored in depth. The Petri net fundamental concept is quite simple: tokens that go from one place to another place as transitions connecting those places fires after having enough tokens for that. Hence, a first fundamental question arises: will a Petri net fire forever? The answer may be desirably no but also undesirably no, where one would like to identify and fix deadlocks [3]. Another natural question is whether a desired state is reachable from given starting conditions [2]. Some of these questions and further questions have at least partial answers, but many of them are still open.

This work instantiates and analyses a simple process with uncertainty in order to properly show the applicability and usability of Petri nets using a structural approach [4]. The properties of this instance are investigated to the limits of knowledge, even though some methods may not be sufficiently generic to be applied to any Petri net.

REFERENCES

[1] C. G. Cassandras, S. Lafortune, *Introduction fo Discrete Systems*, 2nd ed, Springer, 2008.
[2] P. Küngas, *Petri Net Reachability Checking Is Polynomial with Optimal Abstraction Hierarchies*, Proceedings of the 6th International Symposium on Abstraction, pp. 26–29, 2005.
[3] T. Murata, *Petri Nets: Properties, Analysis and Applications*, Proceedings of the IEEE, v. 77, n. 4 pp. 541-58, 1989.
[4] D.-J. Zee, *Building insightful simulation models using Petri nets – a structured approach*, Decision Support Systems, v. 51, pp. 53-64, 2011.