Levels of Persistency in Place/Transition Nets*

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Abstract

The classical notion of persistency, originated in 60s, has been extensively studied up to now. An action of a processing system is said to be persistent if, whenever it becomes enabled, it remains enabled until executed. And a system is said to be persistent if each of its actions is persistent. This notion, introduced by Karp/Miller, is one of the most frequently discussed issues in the Petri net theory. The notion is based on the rule “no action can disable another one”. For uniformity, we name the traditional persistency notion e/e-persistency. We propose two ways of generalization of this notion: l/l-persistency and e/l-persistency. The first is “no action can kill another one” (an action is said to be l/l-persistent if it remains live until executed), and the second “no action can kill another enabled one” (an action is e/l-persistent if, whenever it is enabled, it cannot be killed by another action). And l/l- and e/l-persistency of a system means that any action of the system meets the respective property. One can say that the traditional e/e-persistency is enabling-oriented, and the new notions, l/l- and e/l-persistency, are liveness-oriented.

We study the three kinds of persistency in place/transition nets, the fundamental class of Petri nets. We compare the three classes of persistent Petri nets (denoted $P_{e/e}$, $P_{l/l}$ and $P_{e/l}$) and prove that they form the increasing strict hierarchy $P_{e/e} \subset P_{l/l} \subset P_{e/l}$.

We study decision problems concerning persistencies (of the three types). We introduce the notion of convex subsets of $\mathbb{N}^k$ and show that such sets are rational. Moreover, we generalize the classical marking reachability problem to the Set Reachability Problem, and prove that the latter is decidable for rational convex sets of markings. Then we prove that all kinds of persistency are decidable for place/transition nets.

References:


* The research supported by Ministry of Science and Higher Education of Poland – grant N N206 258035