

Algebraic invariants of Data Petri Nets.

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May 31, 2016

In order to win the market, companies need to grow and provide more and more complex products and services. Thus, management becomes a natural limiting factor for economic growth. Complex workflows are necessary and inefficiency at any stage of the workflow is a real problem. I believe almost everyone experienced how slow the public administration can work, and what difficulties it may create. Still, the common situation is when one arrives at the office with documents and it appears that something is missing then the office manager refuses to take the not complete documentation and start to process it. One can think that the reason is to avoid the mess but actually it is only the partial answer. The true reason is that the workflow in the office is not flexible and robust enough to deal with such cases without resulting in a dramatic increment of workload to the office manager.

Another serious issue is unreliability of workflows, for instance, people often collect a copy of every document as they are afraid that the originals will be lost somewhere.

One may ask a question why all that annoying inefficiency and unreliability occurs? Actually, there are attempts to deal with these difficult issues, but they require a tremendous amount of conceptual work. Moreover, in almost every kind of business the environment is dynamic, there are changes in the law, new ideas for products and constant competition. Business systems are permanently under reconstruction. That is why there is a pressure to develop methodologies that allow to organize management and keep improving in such changing conditions.

One of the successful approaches is captured by a discipline called “Business Process Management” (*BPM*) that combines the unambiguous modeling formalisms from computer science with the knowledge about management. Petri Nets are one of such formalisms and one has to admit that the most fundamental one. Intuitively they model processes by moving tokens between states that represent elements of the system. However, this is often not enough. Imagine that one of those states is a desk in the office and tokens represent documents on the desk, there are many of them and we want to distinguish documents submitted by Ms. Smith from those submitted by Mr. Been, so we need some names, data, colors that distinguish tokens. Petri nets with such tokens are called colored Petri nets or data Petri nets.

The general problem with Petri nets is that their analysis is very complex and in practice we have to use heuristics or algorithms designed for very specific sub-cases. However, it is not as bad as it may look, and nowadays many industrial workflows can be analyzed automatically. The situation with data Petri nets is worse, there are a lot of solutions, but they are fragmentary and without solid mathematical background. The aim of this project is a development of such general methodology to adapt methods and heuristics used for Petri nets to Petri nets with data.