TU Clausthal
Clausthal University of Technology

A Modern Reimplementation of CPNTools

Type	Research Project, Master Thesis
Credits	30CP
Start date	01.10.2023

Description

Coloured Petri Nets (CPNs) are a graphical language for constructing models of concurrent systems and analysing their properties. CPN models have been used for formal verification and modelling of various protocols and applications, e.g., [1], [2], [3], [4], [5]. The current state-of-the-art solution for their development, simulation and analysis is CPNTools [6]. While this tool is functionally suitable for these purposes, there are numerous reasons why using CPNTools can be incredibly difficult:

1. The Graphical User Interface (GUI) is quite dated and many simple actions like editing code is unnecessarily tedious.
2. CPNTools only works on MS Windows systems. Although CPNTools is open-source, it cannot be run natively on GNU/Linux distributions.
3. Simulation of CPNs and generation of state-space graphs is single-threaded and takes arbitrarily long amounts of time.

Thus, a comprehensive re-implementation of the features of CPNTools is necessary.

Prerequisites

1. Background in formal methods
2. CPNs
3. Python or Rust
4. Experience with GitHub projects and FOSS software development

Tasks

1. Review and select features of CPN Tools that are sufficient for a Minimum Viable Product (MVP) re-implementation.
2. Review existing “petri net compatible” simulation backends to reduce redundant development.
3. Plan and document various aspects of the proposed implementation (such as system architecture) using UML.
4. Successfully implement and test the selected features.
5. Maintain the implementation on a GitHub repository with detailed documentation of the project (Licensed under a FOSS license like GPLv3).
6. Write a report.

Resources

1. R. R. Igorevich, Daekyo Shin, and D. Min. CPN Based Analysis of In–Vehicle Secure Communication Protocol. In *International Conference on Heterogeneous Networking for Quality, Reliability, Security and Robustness*, 2016. URL https://doi.org/10.1007/978-3-319-60717-7_2
2. R. Amoah, S. Çamtepe, and E. Foo. Formal Modelling and Analysis of DNP3 Secure Authentication. J*ournal of Network and Computer Applications*, 59:345–360, 2016. URL https://doi.org/10.1016/j.jnca.2015.05.015.
3. Yi Ning Sun, Y. Liu, and Shi Shi Liang. Modeling and Analyzing of RRC Protocol Process Based on CPN. *Applied Mechanics and Materials*, 599–601:1562–1565, 2014. URL https://doi.org/10.4028/www.scientific.net/AMM.599-601.1562.
4. Benjamin Leiding and A. Norta. Mapping Requirements Specifications into a Formalized Blockchain–Enabled Authentication Protocol for Secured Personal Identity Assurance. In *International Conference on Future Data and Security Engineering*, 2017. URL https://doi.org/10.1007/978-3-319-70004-5_13.
5. A. Sujatanagarjuna, A. Bochem and B. Leiding. Formalizing the Blockchain-Based BlockVoke Protocol for Fast Certificate Revocation Using Colored Petri Nets. *Information*. 2021; 12(7):277. https://doi.org/10.3390/info12070277.
6. CPNTools: A tool for editing, simulating, and analyzing Colored Petri nets https://cpntools.org

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