Building a model checker for Jackson Queueing Networks

Queueing networks have been used for about half a century now, for modeling and analyzing a wide variety of phenomena in computer, communication and logistics systems. Jackson queueing networks (JQNs) are a very general class of queueing networks that find their application in a variety of settings. The state space of the continuous-time Markov chain (CTMC) that underlies such a JQN, is highly structured, however, of infinite size in as many dimensions as there are queues. Recently, we developed CSL model checking algorithms for labeled JQNs [6].

As we know from [1], for CSL model checking of CTMCs, we need to be able to compute both steady-state and transient probabilities. For the steady-state probabilities we can rely on the seminal work of Jackson that provides well-known and easy-to-use product-form solutions [3, 4]. Inspired by our recent work on CSL model checking for quasi-birth-death processes (QBDs) [5], which form a different class of infinite-state CTMCs, we use an uniformization-based [2] approach to compute just those transient state probabilities in JQNs that are needed to verify the validity of CSL properties.

The highly structured state space allows us to conclude the validity of CSL properties for groups of states on the basis of the validity for a so-called representative state in such a group. This reduces the infinite number of state probabilities to be computed to a finite number.

The goal of this assignment is to automate the model checking algorithms as presented in [6]. The usability of the newly build model checking tool should be shown with a small case study. The following steps should be taken:

- literature research on existing model checkers for CSL model checking
- literature research on CSL model checking algorithms for infinite-state structured Markov chains
- defining a tool architecture
- implementing the model checking tool
- calculating measures for a small case study

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References

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