

# Brzowski Goes Concurrent – A Kleene Theorem for Pomset Languages

Alexandra Silva

University College London, London, UK  
alexandra.silva@ucl.ac.uk

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## Abstract

Concurrent Kleene Algebra (CKA) is a mathematical formalism to study programs that exhibit concurrent behaviour. As with previous extensions of Kleene Algebra, characterizing the free model is crucial in order to develop the foundations of the theory and potential applications. For CKA, this has been an open question for a few years and this talk will overview why the problem is so difficult. We will then pave the way towards a solution, by presenting a new automaton model and a Kleene-like theorem for CKA. More precisely, we connect a relaxed version of CKA to series-parallel pomset languages, which are a natural candidate for the free model. There are two substantial differences with previous work: from expressions to automata, we use Brzowski derivatives, which enable a direct construction of the automaton; from automata to expressions, we provide a syntactic characterization of the automata that denote valid CKA behaviours. We also survey how the present work can be used to extend the network specification language NetKAT with primitives for concurrency so as to model and reason about concurrency within networks. This is joint work with Tobias Kappe, Paul Brunet, Bas Luttik, and Fabio Zanasi.

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