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Synthesizing Asynchronous Automata from Fair Specifications

Asynchronous automata are a model of distributed finite state processes synchronizing on shared actions. A celebrated result by Zielonka shows how a deterministic asynchronous automaton (AA) can be synthesized, starting from a global specification given as a deterministic finite-state automaton (DFA) and a distribution of the alphabet into local alphabets for each process. The procedure is quite complex and has been revisited several times.

In this work, we revisit this construction on a restricted class of "fair" specifications: a DFA describes a fair specification if in every loop, all processes participate in at least one action — so, no process is starved. For fair specifications, we present a new construction to synthesize an AA. Our construction is conceptually simpler and results in an AA where every process has a number of local states that is linear in the number of states of the DFA, and where the only exponential explosion is related to a parameter of fairness (the length of the longest word that can be read in the DFA where not every process participates). Finally, we show how this construction can be combined with an existing construction for hierarchical process architectures.

Joint work with Béatrice Berard, Benjamin Monmege and Arnab Sur.