Abstract (for the general public):

Data-enriched models of computation and orbit-finite structures

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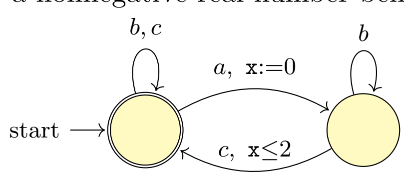
Objectives. The project is about extending classical models of computation, such as finite automata, with the concept of *data*. State space of such automaton is no more finite – but it is finite up to permutation of data (orbit-finite). The main research objective is to design decision procedures for these models, for the problems such as non-emptiness (does the automaton accept some input word?), and to study language-theoretic properties of these models such as determinization or separability. We also plan to investigate orbit-finite mathematical structures which are suitable tools in our investigations, such as orbit-finite systems of linear equations.

Illustrating example. As an example, consider finite automata enriched with *timed* data, a model in which time elapses between consecutive input letters. We describe this model as an automaton with *clocks*. A clock $\mathtt{x}$ is an entity that can be set to 0 by a transition of an automaton ($\mathtt{x} := 0$), and then its value increases along with the elapse of time until next reset occurs. In other words, at every moment the clock's value measures the amount of time that elapsed since its last reset. This value can be tested by transitions (e.g. $\mathtt{x} \leq 2$).

Here is a clock automaton over input alphabet is $\{a, b, c\}$, with two control states, where the left-most one is both initial and accepting. The automaton uses one clock $\mathtt{x}$ (thus, besides the control state, the full state description stores also a nonnegative real number being the value of $\mathtt{x}$).



On every input letter a the automaton resets the clock $\mathtt{x}$ and moves to the right-most state, from which it can return back to the accepting one after the elapse of at most 2 time units. Therefore, the automaton accepts exactly those words where some c appears at most 2 time units after every occurence of a, and no other a appears in between. The example automaton is *deterministic*: input word determines uniquely the state reached after reading that word.