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On some algorithmic problems in automaton (semi)groups.

In this talk we are going to survey some recent results regarding algorithmic problems in automaton (semi)groups. As an intermediate concept between automaton semigroups and automaton groups, we introduce automaton-inverse semigroups, which are generated by partial and invertible automata. We show that there is an automaton-inverse semigroup and, thus, an automaton semigroup with a PSPACE-complete word problem. We also show that there is an automaton group for which the word problem with a single rational constraint is PSPACE-complete. Finally, we survey some undecidability results regarding the freeness of an automaton (semi)group. First, we show that it is undecidable to check whether the group generated by a given invertible automaton has a positive relation, i.e., a relation $w = 1$ such that w only contains positive generators. Besides its obvious relation with the freeness of the group, the absence of positive relations is equivalent to the dynamical property that all (directed positive) orbital graphs centered at non-singular points are acyclic. Then, we show that checking whether the semigroup generated by an automaton group (the semigroup generated by considering only the positive generators) is free is also an undecidable problem. (Received February 17, 2018)