

P automata

(An unconventional approach to automata theory)

Erzsébet Csuhaj-Varjú

Department of Algorithms and Their Applications, Faculty of Informatics
Eötvös Loránd University, 1117 Budapest, Pázmány Péter sétány 1/c, Hungary
E-mail: csuhaj@inf.elte.hu

Membrane systems or P systems are computational models inspired by the architecture and the functioning of the living cell. Briefly, a P system is a structure of hierarchically embedded membranes, each having a label and enclosing a region containing a multiset of objects and possibly other membranes. The unique out-most membrane is called the skin membrane. During the functioning of the P system, the objects in the different regions may change and move across (are communicated between) the regions and may be communicated to and from the surrounding environment.

P automata are variants of purely communicating P systems which accepts strings in an automaton-like fashion. Strings in the language of a P automaton are obtained as mappings of the multiset sequences which enter the membrane system through the skin membrane during an accepting computation.

Due to unconventional properties of P automata, new automata-theoretic-like characterizations of certain well-known language classes were obtained. For example, the context-sensitive language class is the class of languages accepted by P automata working in the so-called maximally parallel manner and using simple, non-erasing mappings for defining words of the language.

Considering distributed P automata (dP automata, for short), descriptions of well-known types of classical automata in terms of membrane systems were obtained. dP automata consist of a finite number of component P automata which have their separate inputs and which also may communicate with each other by means of special communication rules. It was shown, among others, that dP automata having only a finite number of configurations correspond to one-way multihead finite automata. In this case, the components of the dP automaton represent the heads, the multisets entering the components from the environment correspond to the strings scanned by the heads, and the states of the multihead finite automaton can be represented by configurations of the dP automaton.

In the talk we discuss the correspondence between well-known types of classical automata, as one-way and two-way multihead and multitape finite automata, multi-pushdown automata, linear bounded automata, and the unconventional P and dP automata, pointing out the differences and similarities of the classical and the unconventional types of constructs. We also deal with computational and descriptonal complexity of these variants of membrane systems.