

## Acad. Gheorghe Păun

**Member of the Romanian Academy Honorary President of the International Membrane Computing Society**



**Gheorghe Păun** (born on December 6, 1950) graduated the Faculty of Mathematics, University of Bucharest, in 1974 and received his Ph.D. in mathematics (with specialization in computer science) from the same university in 1977. He held a research position at the University of Bucharest, and from 1990 to 2015, when he retired, he was at the Institute of Mathematics of the Romanian Academy, as a senior researcher. His main research areas are formal language theory and its applications, computational linguistics, DNA computing, and membrane computing; this last research area was initiated by him, in 1998, and the respective models are now called P systems, see <http://ppage.psystems.eu>). He is the honorary president of IMCS, the International Membrane Computing Society – see, e.g., <http://membranecomputing.net/IMCSBulletin/index.php>.

He has published a large number of research papers (collaborating with many researchers worldwide), has visited and lectured at over 100 universities in Europe, Asia, and North America, and gave numerous invited talks at recognized international conferences. He has published eleven monographs in mathematics and computer science (some of them translated in Japanese, Chinese, Russian), has (co)edited over seventy collective volumes and special issues of journals, and also published many popular science books, books on recreational mathematics (games), and fiction books (he is a member of the Romanian Writers Association).

He was or still is a member of the editorial board of more than two dozen international journals and was/is involved in the program/steering/organizing committees for many international conferences and workshops.

In 1997 he was elected a member of the Romanian Academy and from 2006 he is a member of Academia Europaea. He also got many other honors, in Romania or abroad (professional and literary prizes, honorary citizenship titles, six doctor honoris causa titles, etc.). In 2009 he was included in the ISI Highly Cited Scientists category, see <http://isihighlycited.com>.



### **Some Wonders of a Bio-Computer-Scientist**

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#### **Abstract**

During the more than two decades of working in the area of bio-inspired computing, especially DNA and membrane computing, I have met many situations when I was amazed-excited-fascinated by the beautiful and useful ideas a computer scientist can get from biology, sometimes at a speculative level, suggesting new points of view or new research vistas in computer science, of interest at least at the theoretical level.

The talk will briefly discuss several ideas of this type, for instance, related to: the intrinsic computational universality of the DNA structure (Watson-Crick complementarity), the question “what means to compute in a natural way?” (natural here meaning “as nature computes”), computing by communicating (a model inspired from the so-called symport/antiport processes from the cellular biology), the time as a support of information (the suggestion comes from the way the neurons

communicate with each other by means of spikes, with the distance in time between two consecutive spikes being rather relevant; the model defined in this framework is called spiking neural P system, in short, SN P system), looking for “universal brains” (from a computability point of view) with a small number of neurons (formally, we look for a small universal SN P system), computing “by carving” (inspired from the DNA computing experiments and making possible the passage beyond “the Turing barrier”, that is, able of hypercomputation), the borderline between efficiency and non-efficiency in membrane computing (Milano theorem and its significance, polynomial solutions to computationally hard problems, based on a time-space trade-off made possible by bio-inspired operations such as membrane division, membrane creation, string replication), challenges for the classic computational complexity theory originated in natural computing, especially in DNA and membrane computing (pre-computed resources, semi-uniform solutions, confluent non-deterministic solutions, etc.), other similar ideas.

The presentation is in general informal and it does not assume detailed computer science or biology knowledge, but some familiarity with basic computability and cell biology would be helpful.

Some useful references (but much more comprehensive than needed for this talk):

1. Gh. Păun, G. Rozenberg, A. Salomaa: *DNA Computing. New Computing Paradigms*, Springer, Berlin 1998; Tokyo 1999; Tsinghua Univ. Press, Beijing, 2004; Mir, Moskow, 2005.
2. Gh. Păun, G. Rozenberg, A. Salomaa, eds.: *Handbook of Membrane Computing*, Oxford University Press, 2010.
3. Gh. Păun: *Looking for Computers in the Biological Cell. After Twenty Years* (in Romanian). Reception Discourse in Romanian Academy, The Publ. House of the Romanian Academy, Bucharest, 2014.
4. The membrane computing web page: <http://ppage.psystems.eu>.
5. The web page of the *Bulletin of the International Membrane Computing Society*: <http://membranecomputing.net/IMCSBulletin/index.php>.