REPORT ON THE *Magic in Science* SYMPOSIUM

Kai Salomaa
Queen's University, Canada

Andrew L. Szilard
Western University, Canada

The Symposium Magic in Science took place on June 17, 2017 in Finland to celebrate the 75th birthday of our distinguished colleague Professor Grzegorz Rozenberg, U. of Leiden, U. of Colorado. The symposium was organized by Ion Petre, with help of a local team.

The symposium featured several well known authors with various topics: **David Harel**, *On odor reproduction and how to test for it;* **Hendrik Jan Hoogeboom**, *From DNA rearrangements in ciliates to elegant graph problems;* **Juraj Hromkovič**, *Why P vs. NP is so hard that even magicians failed to solve it;* **Natasha Jonoska**, *Patterns emerging from a scrambled ciliate genome;* **Juhani Karhumäki**, *k-Abelian equivalence an equivalence relation in between the equality and the abelian equivalence;* **Jetty Kleijn**, *The spellbinding simplicity of complex reaction systems;* **Maciej Koutny**, *Regions: the magic ingredient in synthesis of concurrent systems;* **Hermann Maurer**, *Some unusual applications of computer science;* **Giancarlo Mauri**, *Modelling and simulation of biochemical reaction systems;* **Gheorghe Paǔn**, *Borderlines or limits? (in Natural Computing);* **Azaria Paz**, *Linked magic squares on a cube. Theme and variations;* **Moshe Vardi**, *The automated-reasoning revolution: from theory to practice and back;* **Erik Winfree**, *Chemical reaction networks and stochastic local search.*
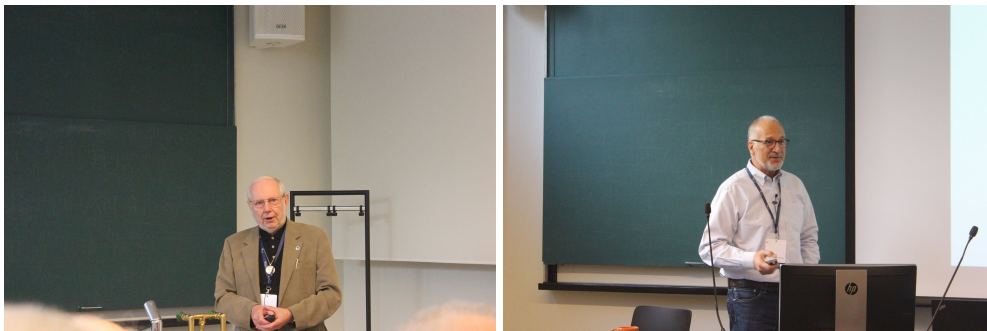
Hermann Maurer and David Harel

Moshe Vardi and Juraj Hromkovič
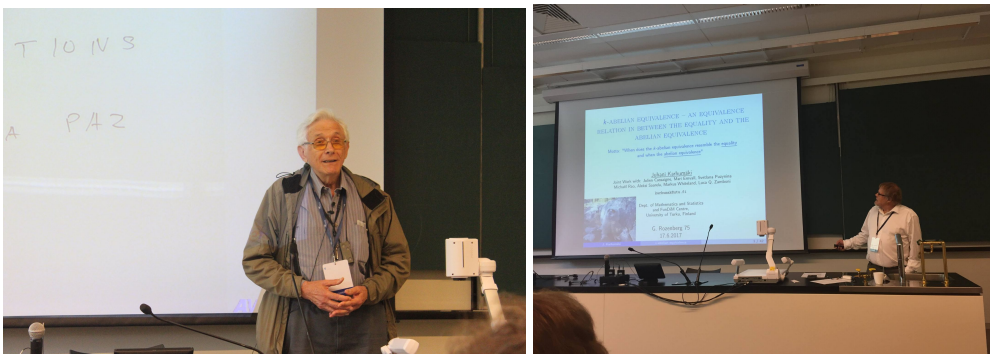
Azaria Paz and Juhani Karhumäki

Maciej Koutny and Jetty Kleijn

Here we will review only a few of these remarkable lectures. Hermann Maurer, the premier presenter, gave a most thought-provoking lecture to engage scientists in solving problems related to human lives and existence. Population explosion, in our life time 1950-2018, the human population would have grown from 3 giga-lives to 8 giga-lives. Pollution, during 2015-2017, 8 mega-lives were lost due to pollution and 3 mega-lives due to car accidents. He called for establishing systems to limit population growth and pollution, to establish safe traffic systems, to decrease our energy dependence on oil and coal, currently 31% and 28.6%

resp., to switch to green-energy solutions, currently only 1.4%, to reduce global transportation by switching to local production of goods, to use graphene filters to recover drinkable water- a method without having to use large amounts of energy -, to use recycled bottles for building building materials, etc.

David Harel gave a an interesting talk on olfaction: how to test the validity of a system claimed to reproduce arbitrary odors artificially, in a way recognizable to humans. Although odor reproduction systems are still far from being viable, the method proposed can be viewed to be inspired by Turing's test for artificial intelligence.

Moshe Vardi gave a general survey on the extensive interaction between mathematical logic and computer science. Although logic was, in some sense, a disappointment as foundations for computer science, as almost all decision problems in logic are either unsolvable or intractable, starting from the 1980s, however, there has been a quiet revolution in logic in computer science, and problems that are, in general, undecidable or intractable were shown to be quite feasible in practice.

Juraj Hromkovič gave an interesting talk on the hardness of questions in computational complexity. By outlining the notion of unprovability in algorithmically verifiable mathematics, Hromkovič gave concrete illustrations of the inherent difficulty of solving the P vs. NP problem and other open problems in complexity theory. In the talk these foundational questions were nicely connected with Prof. Rozenberg's expertise in magic and affinity to owls: the best chance for progress in the field occurs when you listen to what the owls have to say.

Giancarlo Mauri and Erik Winfree
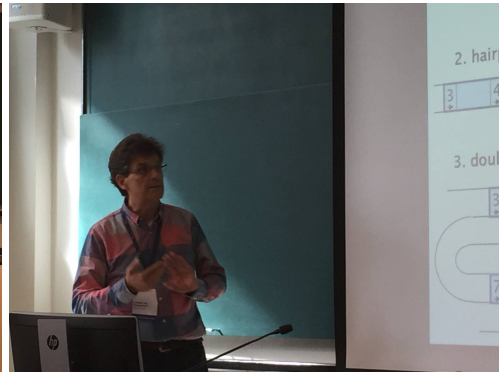
Natasha Jonoska and Hendrik Jan Hoogeboom

Gheorghe Paŭn and Ion Petre (closing the symposium)

Azaria Paz gave a brilliant lecture on Magic Squares, very much keeping to the theme of the conference. He pointed out the enormous historical literature on magic squares. Among other things, he presented three 3×3 magic squares as a birthday present to Prof. Rozenberg, whose day of birth is 14/3/42.

$$A = \begin{matrix} 25 & 2 & 15 \\ 4 & 14 & 24 \\ 13 & 26 & 3 \end{matrix} \qquad B = \begin{matrix} 25 & 5 & 12 \\ 1 & 14 & 27 \\ 16 & 23 & 3 \end{matrix} \qquad C = \begin{matrix} 25 & 6 & 11 \\ 0 & 14 & 2 \\ 17 & 22 & 3 \end{matrix}$$

$$D = \begin{matrix} c - b & c + a + b & c - a \\ c - a + b & c & c + a - b \\ c + a & c - a - b & c + b \end{matrix}$$

Paz noted that in each square, in each row and diagonal, there the non-negative distinct integers sum to 42, in particular all three main diagonals in A, B and C contain 25 14 3, which sum to 42, this magically corresponds to Prof. Rozenberg's birthday 14/3/42. Paz gave a general formula D for constructing 3×3 Magic squares. (Reviewer's note: for any $n > 0$, a simple method exists to construct a magic square with entries being the first $(2n + 1)^2$ positive integers, but for the first

$4n^2$ numbers, $n > 1$, such a method is complicated, Ref. Kaitchik, Magic Squares, Mathematical Recreations. New York: Norton, pp. 142-192, 1942) Prof. Paz contributed his magic squares to the delightful new compendium A Magician in Science, Liber Amicorum Grzegorz Rozenberg, with the famous advice of Indira Gandhi: "There are two kinds of people, those who do the work and those who take the credit. Try to be in the first group; there is less competition there." At the birthday ceremony, as a surprise gift from his adoring fans, this Liber Amicorum was presented to the totally speechless Prof. Rozenberg, a very rare occurrence.
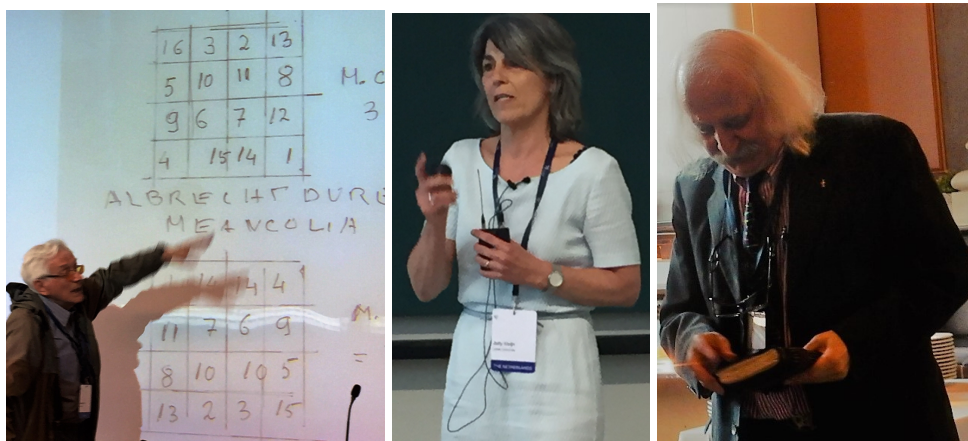
Azaria Paz, Jetty Kleijn, and Grzegorz Rozenberg

Family Rozenberg with Sorin Istrail