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Theoretical Computer Science

Foreword

This special issue is mainly constituted from lectures given at *Machines et Calcul Universels/Universal Machines and Computations* International Workshop held at Paris, 28–30 March 1995. This three day conference, attended by sixty people, was funded by eight research and public French institutions and received IFIP SGFCS sponsorship. It was the first important international conference held on these topics since Pisa Conference in 1983. Among the nineteen lectures given at that occasion, ten gave rise to papers presented in this issue. After the call for papers on MCU/UMC'95 topics, several papers were submitted for publication in this special issue. From them two papers were accepted for this TCS issue.

The topics of the present issue deal mainly with decidability/undecidability problems in computer science considered within the frame of *machine* modeling. Among these problems, one has a great importance: where is the boundary between decidability and undecidability for a family of problems depending on a syntactic parameter? Let us make it more clear with example of Post Correspondence Problem: given an alphabet A and n couples of words (u_i, v_i), $1 \leqslant i \leqslant n$, is it possible to decide whether there is a finite sequence of indices i_k from $[1..n]$ such that the concatenation of u_{i_k} gives the same word as the concatenation of v_{i_k}, taken in the same order? It is known from [3] that PCP(9) is undecidable by reduction to Thue problem with 3 relations proved to be undecidable by Matijassevich, see [2]. On the the other hand, if PCP(1) is trivially decidable, the proof that PCP(2) also is decidable is not at all an easy one, see [1]. Up to now, it is not known what is the case for PCP(n) with $n \in 3$–8. In particular, it is not known starting from which value of n instances of PCP(n) cease to be decidable in order to become undecidable.

As the state of the art remains mostly the same for PCP as it was ten years ago, none of the presented papers here deal with this problem. However, important steps have been taken in this line for other contexts since the time of Pisa conference: for Turing machines and register machines, for instance.

In the first section, papers deal mainly in this line, for Turing machines. The first two papers do this from what could be called the *classical point of view*. The first one stands on the point of universality, and the second one on the point of decidability for the halting problem. The third paper opens a new direction towards universality in the frame of Turing machines. Papers of the second section also study problems in this line but for other machine modeling: the first two papers deal with register machines from different points of view, and the third paper studies splicing computations.

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During the same period, intensive works were performed in the frame of cellular automata and neural networks, also in a classical point of view. And so, the first paper of the third section deals with self-reproduction, the second one considers synchronisation problems also in the line of decidability/undecidability problems. The third paper establishes a new situation involving universality among neural nets.

For a long time, 1936 convergence of formal computation models was considered in computer science as the last word about the intuitive notion of computation. BSS model was a first tentative to shed a new light on this question within the frame of a *machine model.* This gave rise to new trends roughly presented as *real machines.* The fourth section of this issue presents representative works of these new directions. The first paper is devoted to discrete and continuous dynamical systems in a *machine* setting. The second paper considers neural nets with real weights in a new and robust setting. The third paper discusses the possibility of taking internal transition functions used in neural nets in a larger class of functions.

The organization of MCU/UMC'95 was a step towards taking stock of the present new situation. I take the occasion of this issue to thank again IFIP SGFCS through Jozef Gruska as well as the members of my program committee for this conference: Michel Cosnard, Joaquim Gabarro, Eric Goles and Maurice Nivat.

I am particularly thankful to Maurice Nivat for giving me the task of editing this TCS issue on MCU/UMC'95 topics. I am most indebt to referees who carried the task of selecting papers efficiently while maintaining very high standards. I hope the reader will be pleased by the results presented in this paper. I hope that this issue will bring him/her inspiring thoughts for his/her own reflections.

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Ile du Saulcy, Metz, March, 8, 1996,

References

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