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Preface

For the fifth consecutive year, the Summer University of Southern Stockholm included a programme on dynamical systems. This time the emphasis was on various types of cognitive systems in a broad sense. Being a powerful tool in modelling a variety of phenomena and in elucidating structural aspects of complex systems, cognitive systems enjoy steadily increasing attention. The natural mathematical framework is that of dynamical systems or cellular neural networks (CNN). Especially CNN have undergone a remarkable development since the concept first made its appearance in the early 1940s.

The contributions in this volume fall into three (partly overlapping!) classes; limits of computability and undecidability questions, universal CNN – structural aspects and applications, and dynamical systems and complexity. Within the first group Gregory Chaitin covered essential aspects of algorithmic information theory and the limits of computability. In this framework Chaitin extends the Hilbert way of formulating decidability and he also generates far-reaching generalisations of Gödel-type theorems. A brief historical background to this field is provided by Jan Tarski's contribution, in which he also presents the original way in which these questions and results were phrased. In the same spirit, although working within the framework of symbolic dynamics, Antonio Perrone treats general theorems for avoiding undecidability. These results have consequences for, e.g., parallel computations.

The CNN universal machine and its ramifications is the topic of the joint contribution of Leon Chua, Tamás Roska, and Tibor Kozek. Other aspects of neural networks are dealt with in the papers of Leo van Hemmen/Raphael Ritz and Stefan Wimbauer/Leo van Hemmen. The first one focuses on the processing of complex information using spiking neurones whereas the second one concentrates on algorithmic properties of unlearning and its structural consequences. The paper by Alexander Murgu is also concerned with (Hopfield) neural networks although the aim is here to map successive approximation methods for Markov decision problems onto such networks. The section ends with a paper by Sören Molander on image sequencing using finite state automata, where segmentation and delineation of the system is achieved via unsupervised learning.

Complexity and dynamical systems are dealt with in the remaining two papers. Petr Kurka's contribution regards finite automata from the dynamical systems point of view and formulates, using the concept of a regular language, simplicity criteria for dynamical systems. In the paper by M. Sintzsoff/Frédéric Geurts the focus is also on discrete dynamical systems but the analysis now proceeds by using predicate transformers defining certain set-valued functions.

The 1993 meeting was, like the other ones in this series, the result of the combined efforts of a number of organisations and individuals. Thanks are due to IBM Svenska AB for generous support via Mr. Carl Tengwall and Mr. Fredrik Holmberg. Also, of course, I thank the Board of the Summer University of Southern Stockholm and project manager Mr. Staffan Ström of the Stockholm City Council. The success of the technical and administrative arrangement – including much of the general logistics of the meeting – is due uniquely to the capacity and ability of Ms. Annika Hofling, Chalmers University of Technology.

Göteborg, November 1994 Stig I. Andersson

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