

Intelligent Algorithms in Ambient and Biomedical Computing

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Intelligent Algorithms in Ambient and Biomedical Computing

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Preface

The rapid growth in electronic systems in the past decade has boosted research in the area of computational intelligence. As it has become increasingly easy to generate, collect, transport, process, and store huge amounts of data, the role of intelligent algorithms has become prominent in order to visualize, manipulate, retrieve, and interpret the data. For instance, intelligent search techniques have been developed to search for relevant items in huge collections of web pages, and data mining and interpretation techniques play a very important role in making sense out of huge amounts of biomolecular measurements. As a result, the added value of many modern systems is no longer determined by hardware only, but increasingly by the intelligent software that supports and facilitates the user in realizing his or her objectives.

Over the past years, considerable progress has been made in the area of computational intelligence, which can be positioned at the intersection of computer science, discrete mathematics, and cognitive science. This has led to a growing community of practitioners within Philips Research that develop, analyze, and apply intelligent algorithms. The Symposium on Intelligent Algorithms (SOIA) intends to provide this community of practitioners with a platform to exchange information. The first edition of SOIA, held in 2002, addressed the topic of intelligent algorithms in ambient intelligence. To share the output of the symposium with a larger audience, a selection of papers was edited and published by Kluwer in the Philips Research Book Series under the title “Algorithms in Ambient Intelligence.” For the second edition, held in 2004, the scope of the symposium was broadened so as to comply with the three main topics of the Philips company strategy, i.e., Healthcare, Lifestyle and Technology. Again a selection of papers was edited, resulting in the present book. It consists of 17 chapters, divided over three parts corresponding to the strategic topics mentioned above. The main topic in Healthcare is the understanding of biological processes, for Lifestyle the main topic is content retrieval and manipulation, and finally for Technology most contributions relate to media processing. Below we present more detailed information about the individual chapters.

Part I consists of four chapters. In Chapter 1, Chris Clack discusses the topic of modeling biological systems, thus allowing to perform in-silico experiments by means of computer simulation, to formulate hypotheses. In Chapter 2, Nevenka Dimitrova gives an overview of the reverse approach, where one does not use computers to simulate biological processes, but where one uses biology to perform computations, in DNA computing and synthetic biology. In Chapter 3, Martin Kersten and Arno Siebes discuss data management inspired by biology, resulting in an organic database system. In Chapter 4, Kees van Zon discusses how to achieve machine consciousness, and how it can be applied.

Part II consists of eight chapters, addressing problems from the area of content management and retrieval. In Chapter 5, Wim Verhaegh discusses the problem of making a schedule of preferred TV programs, while at the same time selecting TV programs for recording, under the assumption of a limited number of tuners. In Chapter 6, Mauro Barbieri, Nevenka Dimitrova, and Lalitha Agnihotri present a technique to automatically summarize video into a condensed preview, allowing one to quickly browse and access large amounts of stored programs. Chapters 7–9 concerns audio applications. First, Janto Skowronek and Martin McKinney discuss in Chapter 7 the topic of automatic classification of audio and music, for which they developed the automatic extraction of the higher-level feature of percussiveness. In Chapter 8, Steffen Pauws presents a technique to automatically extract the key from a piece of music, providing an emotional connotation to it, and making it possible to build well-sounding music mixes. In Chapter 9, Zharko Aleksovski, Warner ten Kate, and Frank van Harmelen address the problem of combining multiple databases of music data in a semantic way, by approximating matches of music classes. Next, Jan Korst, Gijs Geleijnse, Nick de Jong, and Michael Verschoor discuss in Chapter 10 the possibilities to fill a knowledge database, using an ontology to collect and structure data from web pages. In the last chapter of part II, which Wim Verhaegh, Aukje van Duijnhoven, Pim Tuyls, and Jan Korst resolve the privacy issue of population-based recommenders by encrypting the users' profiles and performing the required algorithms on encrypted data.

Part III consists of six chapters, focusing on the technology underlying intelligent algorithms and intelligent systems. The first two chapters discuss theoretical aspects of intelligent algorithms. In Chapter 12, Peter Grünwald gives an overview on the minimum description length principle to resolve the problem of model selection, based on the fundamental idea to see learning as a form of data compression. In Chapter 13, Herman ter Horst discusses the computational complexity of reasoning with semantic web ontologies, such as RDF Schema and OWL. Next, Wojciech Zajdel, Ben Kröse, and Nikos Vlassis present in Chapter 14 an introduction to dynamic Bayesian networks, and show their application in robot localization and multiple-person tracking. In

Chapter 15, Berry Schoenmaker and Pim Tuyls discuss efficient protocols for securely matching two user profiles, without leaking information on the details of the profiles. Finally, Chapters 16 and 17 address resource issues in intelligent systems. In Chapter 16, Sai Shankar N., Richard Chen, Ruediger Schmitt, Chun-Ting Chou, and Kang Shin revisit fairness in multi-rate wireless networks, and present a solution to fairly schedule airtime. Finally, in Chapter 17, Akash Kumar and Sergei Sawitzki discuss the design alternatives of Reed Solomon decoders, and address the problem of making optimal design decisions to obtain a high-throughput, low-power solution.

We are convinced that the chapters presented in this book comprise an interesting collection of examples of the use of intelligent algorithms in different settings, and that the book reconfirms that the area of computational intelligence is a truly challenging field of research.

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