



GUEST EDITORS' INTRODUCTION TO THE SPECIAL ISSUE ON TIME-ORIENTED SYSTEMS IN MEDICINE

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Time is of the utmost importance in medicine. It plays a key role in medical decision making (clinical diagnosis, therapy planning) and in medical data modeling and managing (e.g. representation of the patient's medical record, including past pathologies and therapies, and follow-up data). In recent years, temporal-reasoning and temporal-maintenance systems in medicine have been the focus of an increasing interest.

Researchers with different backgrounds and interests are facing the challenge of time-oriented reasoning in clinical and in research-oriented medical domains. Examples of such researchers include computer scientists (such as those interested in temporal databases, in temporal logics, or in natural-language processing), medical informaticians, health-care providers and researchers in basic medical sciences (such as physiology and neuroanatomy). Significant solutions can be formulated through a multidisciplinary combination of these different research areas and their associated cultures. The subject of time-oriented systems in medicine covers a wide variety of specific subtopics, both theoretical and practical. In this special issue we present a brief survey paper and five research papers. It is our hope that this special issue will show how deep and multidisciplinary are the research and application issues related to time-oriented systems in medicine.

The position/survey paper "Temporal Reasoning and Temporal Data Maintenance in Medicine: Issues and Challenges", by the two guest editors, attempts to present a nonexhaustive view of the main topics investigated in the areas of temporal-reasoning and of temporal-maintenance in medicine and to highlight common issues and interconnected research areas. Several potentially interesting future research directions are also pointed out. The survey paper mentions the papers included in this special issue, and frames these papers within their appropriate contexts. We will introduce these papers here to provide the reader of the special issue with a brief overview of the topics they discuss.

The paper "Modeling Medical Trials in Pharmacoeconomics using a Temporal Object Model", by Goralwalla, Özsu and Szafron, deals with the application of a temporal object model to the management of data from pharmacoeconomic medical trials. The extensible set of types supported by the adopted data model allows one to model different time concepts, such as branching timelines, related to the evaluation of different pharmacological treatments.

The paper "Effective Data Validation of High-Frequency Data: Time-Point-, Time-Interval-, and Trend-Based Methods", by Horn, Miksch, Egghart, Popow

and Paky, proposes several time-oriented methods for validating and repairing high-frequency clinical data from the intensive-care domain; these methods, combining both numerical and knowledge-based approaches, have been applied in the field of artificial ventilation of newborn infants.

The paper "Representing and Developing Temporally Abstracted Knowledge as a Means towards Facilitating Time Modeling in Medical Decision-Support Systems", by Aliferis, Cooper, Pollack, Buchanan and Wagner, addresses the problem of providing and evaluating appropriate levels of temporal abstraction through a common formalism for medical decision-support systems. In the paper the authors employ a formalism they have previously defined, Modifiable Temporal Belief Networks (MTBNs).

The paper "Using a General Theory of Time and Change in Patient Monitoring: Experiment and Evaluation", by Chittaro and Dojat, deals with the application and extension of a well-known general theory for reasoning about time and change, Kowalsky and Sergot's Event Calculus, to a clinical setting—the management of data in the course of the process of mechanical ventilation. A prototype system using the extended model has been built and has been tested on patient mechanical-ventilation data collected in the intensive-care domain.

The final paper, "Efficient Temporal Probabilistic Reasoning Via Context-Sensitive Model Construction", by Ngo, Haddawy, Krieger and Helwig, proposes a language for representing context-sensitive temporal probabilistic knowledge. The authors illustrate the capabilities of the language by modeling the effects of medications and other interventions on the condition of a patient in cardiac arrest.

Putting together this special issue proved to be a very interesting but also a very intensive project. After the call for papers appeared (disseminated in the fall of 1995 in several international and national medical informatics conferences, through internet announcements, and through specific mailing lists for people working in the areas of artificial intelligence and databases) we received 20 papers. For each submitted manuscript, at least two or three reviewers, and often four or five, have been used. A second revision and review phase followed for potentially accepted papers. (The two guest editors also were involved in the review and revision of each of the submitted or accepted papers.) More than 300 messages of electronic mail were exchanged between the guest editors, the managing editor, and the authors of the submitted papers. Eventually, we selected five research papers from the original 20. Two additional papers have been recommended for acceptance to standard issues of this journal due to overall quality, although they did not fit within the specific topic we had defined for the special issue. We selected the papers according to several interdisciplinary criteria: In particular, reviewers evaluated papers with respect to both their methodological content and their significance to a clinical application. Thus, researchers from areas such as computer science, engineering and biomedicine were required to demonstrate that their research contains both a technically solid methodology and a demonstrable medically relevant aspect. The existence and the innovative integration of these two components were the major criteria in the evaluation process.

We are indebted to many people for bringing this project to a successful conclusion. We thank Prof. Francesco Pinciroli, European Deputy Editor of *Computers in Biology and Medicine*, for providing the first spark that initiated this special issue. We thank Blaire Mossman, the managing editor, for her assistance during the past months. We thank also Prof. Elpida Keravnou for her suggestions during both the formative phase of the project and the reviewing of the papers. We thank all of the dedicated reviewers (a complete list of these follows) for their invaluable assistance in the production of this special issue. Finally, we thank the authors of all of the 20 papers submitted for this special

issue.

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