

# Lecture Notes in Artificial Intelligence 7885

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# Artificial Intelligence in Medicine

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# Preface

The European Society for Artificial Intelligence in Medicine (AIME) was established in 1986 following a very successful workshop held in Pavia, Italy, the year before. The principal aims are to foster fundamental and applied research in the application of artificial intelligence (AI) techniques to medical care and medical research, and to provide a forum at biennial conferences for discussing any progress made. For this reason the main activity of the society was the organization of a series of biennial conferences, held in Marseilles, France (1987), London, UK (1989), Maastricht, The Netherlands (1991), Munich, Germany (1993), Pavia, Italy (1995), Grenoble, France (1997), Aalborg, Denmark (1999), Cascais, Portugal (2001), Protaras, Cyprus (2003), Aberdeen, UK (2005), Amsterdam, The Netherlands (2007), Verona, Italy (2009), and Bled, Slovenia (2011). This volume contains the proceedings of AIME 2013, the 14th Conference on Artificial Intelligence in Medicine, held in Murcia, Spain, May 29–June 1, 2013.

The AIME 2013 goals were to present and consolidate the international state of the art of AI in biomedical research from the perspectives of theory, methodology, systems, and applications. A specific focus for the AIME 2013 conference was the role of AI in telemedicine and eHealth systems. The conference included two invited lectures, full and short papers, tutorials, workshops, and a doctoral consortium.

In the conference announcement, authors were solicited to submit original contributions regarding the development of theory, methods, systems, and applications for solving problems in the biomedical field, including AI approaches in biomedical informatics, molecular medicine, and healthcare organizational aspects. Authors of papers addressing theory were requested to describe the properties of novel AI models potentially useful for solving biomedical problems. Authors of papers addressing theory and methods were asked to describe the development or the extension of AI methods, to address the assumptions and limitations of the proposed techniques and to discuss their novelty with respect to the state of the art. Authors of papers addressing systems and applications were asked to describe the development, implementation, or evaluation of new AI-inspired tools and systems in the biomedical field. They were asked to link their work to underlying theory, and either analyze the potential benefits to solve biomedical problems or present empirical evidence of benefits in clinical practice.

AIME 2013 received 96 abstract submissions, 82 thereof were eventually submitted as complete papers. Submissions came from 25 different countries, including eight outside Europe. All papers were carefully peer-reviewed by experts from the Program Committee with the support of additional reviewers. Each submission was reviewed by at least two and in most cases three reviewers. The reviewers judged the overall quality of the submitted papers, together with

their relevance to the AIME conference, technical correctness, novelty with respect to state of the art, scholarship and quality of presentation. In addition, the reviewers provided detailed written comments on each paper, and stated their confidence in the subject area.

A small committee consisting of the AIME 2013 Scientific Chair, Niels Peek, the Scientific Co-chair and Organizing Committee Chair, Roque Marin, and the AIME 2011 Scientific Chair, Mor Peleg, made the final decisions regarding the AIME 2013 scientific program. This process started with a virtual meeting held on February 14, 2013, using three-part video conferencing. In subsequent days short discussions followed. The process ended with a short visit of the Scientific Chair to Murcia.

As a result, 18 long papers (with an acceptance rate of about 27%) and 26 short papers were accepted. Each long paper was presented in a 25-minute oral presentation during the conference. Each short paper was presented in a 5-minute presentation and by a poster. The papers were organized according to their topics in the following main themes: (1) Decision Support, Guidelines and Protocols; (2) Semantic Technology I; (3) Bioinformatics; (4) Machine Learning; (5) Probabilistic Modelling and Reasoning; (6) Image and Signal Processing; (7) Semantic Technology II; (8) Temporal Data Visualization and Analysis; and (9) Natural Language Processing.

AIME 2013 had the privilege of hosting two invited speakers: Dominik Aronsky, from the Vanderbilt University Medical Center, USA, and Hermie Hermens, from the University of Twente, The Netherlands. Dominik Aronsky showed how an integrated information infrastructure with computer-based decision support can help care providers to deliver high-quality patient care, optimize operational activities, and facilitate clinical and informatics research studies in an emergency care setting. Hermie Hermens discussed historical and current trends in the field of telemedicine, and the challenges of adding intelligence to telemedicine systems.

The fifth Doctoral Consortium for the AIME series of conferences was organized this time by Nada Lavrač from the Jožef Stefan Institute in Ljubljana, Slovenia. The Doctoral Consortium provided an opportunity for seven PhD students to present their preliminary work and to discuss their plans and preliminary results. A scientific panel consisting of Ameen Abu-Hanna, Steen Andreassen, Riccardo Bellazzi, Carlo Combi, Michel Dojat, Nada Lavrac, Peter Lucas, Roque Marin, Niels Peek, Silvana Quaglini, and Yuval Shahar discussed the contents of the students doctoral theses.

A significant number of full-day workshops were organized after the AIME 2013 main conference: the workshop entitled Knowledge Representation for Health Care and Process-Oriented Information Systems in Healthcare (KR4HC 2013 / ProHealth 2013), chaired by David Riaño (Universitat Rovira i Virgili, Spain) and Annette ten Teije (Vrije Universiteit Amsterdam, The Netherlands); the workshop Agents Applied in Health Care, chaired by Antonio Moreno (Universitat Rovira i Virgili, Spain); and the workshop Artificial Intelligence for Medical Data Streams, chaired by Pedro Pereira (University of Porto, Portugal). Moreover, three interactive tutorials were organized prior to the AIME 2013

main conference: *An Introduction to Agent-Based Modeling*, by John H. Holmes (University of Pennsylvania, USA); *Bayesian Networks in Computational Neuroscience*, by Pedro Larrañaga and Concha Bielza (Universidad Politécnica de Madrid, Spain); and *Evaluating Prognostic Models in Medicine*, by Ameen Abu-Hanna and Niels Peek (University of Amsterdam, The Netherlands).

We would like to thank everyone who contributed to AIME 2013. First of all we would like to thank the authors of the papers submitted and the members of the Program Committee together with the additional reviewers. Thanks are also due to the invited speakers as well as to the organizers of the workshops and the tutorial and doctoral consortium. Final thanks go to the Organizing Committee, who managed all the work making this conference possible. The free EasyChair conference Web system (<http://www.easychair.org/>) was an important tool supporting us in the management of submissions, reviews, selection of accepted papers, and preparation of the overall material for the final proceedings. We would like to thank the University of Murcia and the Campus Mare Nostrum, which hosted and sponsored the conference; the Fundación Séneca (Agence for Science and Technology of the Region of Murcia), who sponsored the conference through the Program for Mobility, Cooperation and Internationalization Jiménez de la Espada (Ref.18676/OC/12); and the Spanish Society of Artificial Intelligence (AEPIA), who provided a grant for young researchers. Finally, we thank the Springer team for helping us in the final preparation of this LNCS book.

March 2013

Niels Peek  
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## Workshops

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### Artificial Intelligence for Medical Data Streams

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Mohamed Medhat Gaber	University of Portsmouth, UK
Carolyn McGregor	University of Ontario Institute of Technology, Canada

## Tutorials

### Introduction to Agent-Based Modeling

John H. Holmes	University of Pennsylvania, USA
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### Bayesian Networks in Computational Neuroscience

Pedro Larrañaga and Concha Bielza	Universidad Politécnica de Madrid, Spain
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**Evaluating Prognostic Models in Medicine**

Ameen Abu-Hanna and

Niels Peek

University of Amsterdam, The Netherlands

# Computer-Based Decision Support in the Emergency Department

Dominik Aronsky<sup>1</sup>

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**Abstract.** The Emergency Department is a fast-paced, information intensive environment that can benefit from improved information management. The presentation will discuss how an integrated information system infrastructure can support providers to deliver high-quality patient care, optimize operational activities, and facilitate clinical and informatics research studies in an emergency care setting. Illustrative examples will include improvement of pneumonia-care processes, implementation of asthma guidelines, and forecasting Emergency Department overcrowding.

# Towards Intelligent Telemedicine Services

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**Abstract.** Telemedicine is an area of innovation in the delivery of health care services, which is expected to have a great impact by making health care more efficient and cost effective, and by supporting independent living and self-management. Especially these last two are crucial as the number of people with chronic conditions who need long term care increases while our limited health service resources become more and more stretched.

Telemedicine has gone through a number of cycles of evolution. In the 80's it was demonstrated that remote consultation was possible and clinically valid; later the feasibility of remote detection of critical events such as seizures was established. More recently larger scale studies (e.g. Clear, Myotel, HelloDoc) showed that clinical outcomes are comparable to conventional care and that by replacing parts of the current care process by telemedicine solutions, cost effective results can be obtained.

Telemedicine is now challenged to enter the phase of mature solutions and large scale deployment. One of the main obstacles to reaching this goal is the lack of intelligence in current systems. Clinicians need to be supported by intelligent decision support systems and patients need to be coached to support their ambitions to be independent and to change their adverse behavior, hence intelligent, safe supporting environments need to be created.

Examples of ongoing research in these directions will be presented which illustrate the integration of clinical practice guidelines into decision support systems (Mobiguide); smart activity coaching (IS-Active); and monitoring of patient behavior at home (Carebox).

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