

## 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 of AIME 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), Bled, Slovenia (2011), and Murcia, Spain (2013). This volume contains the proceedings of AIME 2015, the 15th Conference on Artificial Intelligence in Medicine, held in Pavia, Italy, June 17–20, 2015.

The AIME 2015 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. AIME 2015 focused on AI methods and approaches to address big biomedical data challenges. The conference included two invited lectures, full and short papers, tutorials, workshops, and a doctoral consortium.

In the conference announcement, authors were invited 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 health-care 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 2015 received 110 abstract submissions, 99 thereof were eventually submitted as complete papers. Submissions came from 25 countries, including five 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 2015 Scientific Chair John H. Holmes, the Local Organization Co-chairs Riccardo Bellazzi and Lucia Sacchi, and Niels Peek, Doctoral Consortium Chair and AIME 2013 Scientific Chair, made the final decisions regarding the AIME 2015 scientific program. This process began with virtual meetings held weekly starting in January 2015. The process ended with a face-to-face meeting of the committee in Pavia to assemble the final program.

As a result, 19 long papers (with an acceptance rate of 25%) and 24 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) Data Mining and Machine Learning; (2) Knowledge Representation and Guidelines; (3) Prediction in Clinical Practice; (4) Process Mining and Phenotyping; (5) Temporal Data Mining; (6) Text Mining; and (7) Uncertainty and Bayesian Methods.

AIME 2015 had the privilege of hosting two invited speakers: George M. Hripcsak, from Columbia University, USA, and Goran Nenadic, from the University of Manchester, UK. George Hripcsak discussed the importance of dealing with the temporal nature of the electronic medical record in using these data for studies. He called for further study of the “physics of the medical record,” health-care processes, and new methods for analyzing electronic medical record data. Goran Nenadic’s keynote focused on the use of and challenges presented by text mining of health data from a variety of sources, including the medical record as well as patient-generated data. He called for the integration of spatiotemporal and reasoning under uncertainly models to be incorporated into the text mining paradigm.

The Doctoral Consortium provided an opportunity for six PhD students to present their research goals, proposed methods, and preliminary results. A scientific panel consisting of experienced researchers in the field (Ameen Abu-Hanna, John Holmes, José Juárez, Goran Nenadic, David Riaño, Lucia Sacchi, Stephen Swift, Annette ten Teije, and Blaz Zupan) provided constructive feedback to the students in an informal atmosphere. The Doctoral Consortium was chaired by Niels Peek.

Three full-day workshops were organized after the AIME 2015 main conference. These included the 7th International Workshop on Knowledge Representation for Health Care (KRH4C) and the 8th International Workshop on Process-oriented Information Systems in Healthcare (ProHealth), joined together for the first time at AIME 2015. This workshop included a keynote address presented by Robert Greenes from Arizona State University, “Evolution and Revolution in Knowledge-Driven Health IT: A 50-Year Perspective and a Look Ahead.” This workshop was chaired by Richard Lenz, Silvia Miksch, Mor Peleg, Manfred Reichert, David Riaño, and Annette ten Teije. A second full-day workshop was the First Workshop on Matrix Computations for Biomedical Informatics, chaired by Riccardo Bellazzi, Jimeng Sun, and Ping Zhang. The third workshop was the 4th International Workshop on Artificial Intelligence and Assistive Medicine, chaired by Constantine Spyropoulos and Aldo Franco Dragoni.

In addition to the workshops, three interactive tutorials were presented prior to the AIME 2015 main conference: “Data Fusion of Everything” (Marinka Zitnik and Blaz Zupan, University of Ljubljana, Slovenia); “Big Data Analytics for Healthcare” (Jimeng Sun, Georgia Institute of Technology); and “Evaluation of Prediction Models

in Medicine” (Ameen Abu-Hanna, Academic Medical Center, Amsterdam, and Niels Peek, University of Manchester).

We would like to thank everyone who contributed to AIME 2015. 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. Many thanks go to the local Organizing Committee, who managed all the work making this conference possible. The free EasyChair conference 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 Pavia, which hosted AIME 2015, and our sponsors, who so generously supported the conference.

Finally, we thank the Springer team for helping us in the final preparation of this LNCS book.

June 2015

John H. Holmes  
Riccardo Bellazzi  
Lucia Sacchi  
Niels Peek

Artificial Intelligence in Medicine

15th Conference on Artificial Intelligence in Medicine,  
AIME 2015, Pavia, Italy, June 17-20, 2015. Proceedings

Holmes, J.H.; Bellazzi, R.; Sacchi, L.; Peek, N. (Eds.)

2015, XVI, 345 p. 76 illus., Softcover

ISBN: 978-3-319-19550-6