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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 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. The main activity of the society thus far has been the organization of a series of biennial conferences, held in Marseilles, France (1987), London, UK (1989), Maastricht, Netherlands (1991), Munich, Germany (1993), Pavia, Italy (1995), Grenoble, France (1997), Aalborg, Denmark (1999), Cascais, Portugal (2001), Protaras, Cyprus (2003), Aberdeen, UK (2005), Amsterdam, Netherlands (2007), Verona, Italy (2009), Bled, Slovenia (2011), Murcia, Spain (2013), Pavia, Italy (2015), Vienna, Austria (2017), Poznan, Poland (2019), and Minneapolis, USA (2020) - the latter hosted virtually due to the COVID-19 pandemic.

AIME 2021 was to be hosted in Portugal but, due to the ongoing pandemic, it was held virtually. This volume contains the proceedings of AIME 2021, the International Conference on Artificial Intelligence in Medicine, hosted virtually by the University of Coimbra, Portugal, during June 15–18, 2021.

The AIME 2021 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. The conference included two invited keynotes, 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. All authors were asked to highlight the value their work, created for the patient, provider, or institution, through its clinical relevance.

AIME 2021 received 138 submissions across all categories. Submissions came from 34 countries, including submissions from Europe, North and South America, Asia, Australia, and Africa. All papers were carefully peer-reviewed by experts from the Program Committee, with the support of additional reviewers, and by members of the

Senior Program Committee (a new layer to the review process introduced in AIME 2020). Each submission was reviewed by at least three reviewers. The reviewers judged the overall quality of the submitted papers together with their relevance to the AIME conference, originality, impact, technical correctness, methodology, 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 Senior Program Committee member was assigned to each paper and they wrote a meta-review and provided a recommendation to the Organizing Committee.

A small committee consisting of the conference co-chairs, Allan Tucker, Pedro Henrique Abreu, and Jaime Cardoso, made the final decisions regarding the AIME 2021 scientific program.

This process began with virtual meetings starting in March 2021. As a result, 28 long papers (an acceptance rate of 23%) and 30 short papers were accepted. Each long paper was presented in a 20-minute oral presentation during the conference. Each regular 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) Deep Learning; (2) Natural Language Processing; (3) Predictive Modeling; (4) Image Analysis; (5) Unsupervised Learning; (6) Temporal Data Analysis; (7) Planning; and (8) Knowledge Representation.

AIME 2021 had the privilege of hosting two invited keynote speakers: Virginia Dignum, Wallenberg chair on Responsible Artificial Intelligence and Scientific Director of WASP-HS (Humanities and Society) based at Umeå University, Sweden, who gave the keynote exploring "The myth of complete AI-fairness" and Pearse Keane, Associate Professor at the UCL Institute of Ophthalmology and Consultant at Moorfields Eye Hospital, UK, who talked about "Transforming healthcare with artificial intelligence - lessons from ophthalmology".

AIME 2021 provided an opportunity for PhD students to present their research goals, proposed methods, and preliminary results at an associated doctorial consortium. A scientific panel consisting of experienced researchers in the field provided constructive feedback to the students in an informal atmosphere. The doctoral consortium was chaired by Dr. David Riaño.

Two workshops: (1) The 12th International Workshop on Knowledge Representation for Health Care - KR4HC 2021 (David Riaño, Mar Marcos, and Annette ten Teije); (2) Explainable Artificial Intelligence in Healthcare (Jose M. Juarez, Gregor Stiglic, Huang Zhengxing, and Katrien Verbert); and an interactive half-day tutorial: Evaluating Prediction Models (Ameen Abu Hanna), took place prior to the AIME 2021 main conference.

Prizes were awarded for best student paper, best bioinformatics paper, and a new rising star award for young researchers within the AIME community who are running labs with recent breakthrough papers in the area.

We would like to thank everyone who contributed to AIME 2021. 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. Thank you to the Senior Program Committee for writing meta-reviews and to members of the Senior Advisory Committee for providing guidance during conference organization. Thanks are also due to the invited speakers, as well as to the organizers of the tutorials and doctoral

consortium panel. Many thanks go to the Local Organizing Committee, who helped plan this conference and transition it to a virtual one. The free EasyChair conference system (http://www.easychair.org/) was an important tool supporting us in the management of submissions, reviews, and selection of accepted papers. We would like to thank Springer and the Artificial Intelligence Journal (AIJ) for sponsoring the conference. Finally, we thank the Springer team for helping us in the final preparation of this LNAI book.

June 2021

Allan Tucker
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Transforming Healthcare with Artificial Intelligence – Lessons from Ophthalmology (Abstract of Invited Talk)

Pearse A. Keane

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Abstract. Ophthalmology is among the most technology-driven of the all the medical specialties, with treatments utilizing high-spec medical lasers and advanced microsurgical techniques, and diagnostics involving ultra-high resolution imaging. Ophthalmology is also at the forefront of many trailblazing research areas in healthcare, such as stem cell therapy, gene therapy, and - most recently - artificial intelligence. In July 2016, Moorfields announced a formal collaboration with the artificial intelligence company, DeepMind. This collaboration involves the sharing of >1,000,000 anonymised retinal scans with DeepMind to allow for the automated diagnosis of diseases such as age-related macular degeneration (AMD) and diabetic retinopathy (DR). In my presentation, I will describe the motivation - and urgent need - to apply deep learning to ophthalmology, the processes required to establish a research collaboration between the National Health Service (NHS) and a company like DeepMind, the initial results of our research, and finally, why I believe that ophthalmology could be first branch of medicine to be fundamentally reinvented through the application of artificial intelligence.

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