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IFIP was founded in 1960 under the auspices of UNESCO, following the first World Computer Congress held in Paris the previous year. A federation for societies working in information processing, IFIP's aim is two-fold: to support information processing in the countries of its members and to encourage technology transfer to developing nations. As its mission statement clearly states:

IFIP is the global non-profit federation of societies of ICT professionals that aims at achieving a worldwide professional and socially responsible development and application of information and communication technologies.

IFIP is a non-profit-making organization, run almost solely by 2500 volunteers. It operates through a number of technical committees and working groups, which organize events and publications. IFIP's events range from large international open conferences to working conferences and local seminars.

The flagship event is the IFIP World Computer Congress, at which both invited and contributed papers are presented. Contributed papers are rigorously refereed and the rejection rate is high.

As with the Congress, participation in the open conferences is open to all and papers may be invited or submitted. Again, submitted papers are stringently refereed.

The working conferences are structured differently. They are usually run by a working group and attendance is generally smaller and occasionally by invitation only. Their purpose is to create an atmosphere conducive to innovation and development. Refereeing is also rigorous and papers are subjected to extensive group discussion.

Publications arising from IFIP events vary. The papers presented at the IFIP World Computer Congress and at open conferences are published as conference proceedings, while the results of the working conferences are often published as collections of selected and edited papers.

IFIP distinguishes three types of institutional membership: Country Representative Members, Members at Large, and Associate Members. The type of organization that can apply for membership is a wide variety and includes national or international societies of individual computer scientists/ICT professionals, associations or federations of such societies, government institutions/government related organizations, national or international research institutes or consortia, universities, academies of sciences, companies, national or international associations or federations of companies.


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Ilias Maglogiannis · Lazaros Iliadis ·
Elias Pimenidis (Eds.)


Artificial Intelligence Applications and Innovations

16th IFIP WG 12.5 International Conference, AIAI 2020
Neos Marmaras, Greece, June 5–7, 2020
Proceedings, Part I

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ISSN 1868-4238 ISSN 1868-422X (electronic)
IFIP Advances in Information and Communication Technology
ISBN 978-3-030-49160-4 ISBN 978-3-030-49161-1 (eBook)
<https://doi.org/10.1007/978-3-030-49161-1>

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This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

AIAI 2020

Artificial Intelligence (AI) is already affordable through a large number of applications that offer good services to our post-modern societies. Image-face recognition and translation of speech are already a reality. File sharing via Dropbox, Uber transportations, social interaction through Twitter, and shopping from eBay are employing Google's TensorFlow platform. AI has already developed high levels of reasoning. Respective applications like AlphaGo (released by Google DeepMind) have managed to defeat human experts in highly sophisticated demanding games, like *Go*. This is a great step forward, if we realize that in the *Go* game the number of potential moves is higher than the number of atoms in the entire Universe. *AlphaGo Zero* is a recent and impressive advance which is using Reinforcement Learning to teach itself. It started with no knowledge at all and in three days it bypassed the capabilities of *AlphaGo Lee*, which is the version that defeated one of the best *Go* human players in four out of five games in 2016. In 21 days, it evolved even further, and it reached Master level. More specifically, it defeated 60 top professional *Go* players online and the world champion himself.

Deep Learning has significantly contributed to the progress made during the last decades. Meta-Learning and intuitive intelligence are on the way, and soon they will enable machines to understand what learning is all about. The concept of Generative Adversarial Neural Networks will try to fuse "imagination" to AI. However historic challenges for the future of mankind will be faced. Potential unethical use of AI may violate democratic human rights and may alter the character of western societies.

The 16th conference on Artificial Intelligence Applications and Innovations (AIAI 2020) offers an insight to all timely challenges related to technical, legal, and ethical aspects of AI systems and their applications. New algorithms and potential prototypes employed in diverse domains are introduced. AIAI is a mature international scientific conference held in Europe and well established in the scientific area of AI. Its history is long and very successful, following and spreading the evolution of Intelligent Systems.

The first event was organized in Toulouse, France, in 2004. Since then, it has a continuous and dynamic presence as a major global, but mainly European, scientific event. More specifically, it has been organized in China, Greece, Cyprus, Australia, and France. It has always been technically supported by the International Federation for Information Processing (IFIP) and more specifically by the Working Group 12.5 which is interested in AI applications.

Following a long-standing tradition, this Springer volume belongs to the IFIP AICT Springer Series and contains the papers that were accepted to be presented orally at the AIAI 2020 conference. An additional volume comprises the papers that were accepted and presented at the workshops – held as parallel events.

The diverse nature of papers presented, demonstrates the vitality of AI algorithms and approaches. It certainly proves the very wide range of AI applications as well.

The event was held during June 5–7, 2020, as a remote LIVE event with live presentations, a lot of interaction, and live Q&A sessions. There was no potential for physical attendance due to the COVID-19 global pandemic.

Regardless of the extremely difficult pandemic conditions, the response of the international scientific community to the AIAI 2020 call for papers was overwhelming, with 149 papers initially submitted. All papers were peer reviewed by at least two independent academic referees. Where needed a third referee was consulted to resolve any potential conflicts. A total of 47% of the submitted manuscripts (70 papers) were accepted to be published as full papers (12-pages long) in these Springer proceedings. Due to the high quality of the submissions, the Program Committee decided additionally to accept five more papers to be published as short papers (10-pages long).

The following scientific workshops on timely AI subjects were organized under the framework of AIAI 2020:

9th Mining Humanistic Data Workshop (MHDW 2020)

We would like to thank the Steering Committee of MHDW 2020 Professors Ioannis Karydis and Katia Lida Kermanidis from Ionian University, Greece, and Professor Spyros Sioutas from the University of Patras, Greece, for their important contribution towards the organization of this high-quality and mature event. Also, we would like to thank Professor Christos Makris and Dr. Andreas Kanavos from the University of Patras, Greece, and Professor Phivos Mylonas for doing an excellent job as Senior Members of the Program Committee. MHDW is an annual event that attracts an increasing amount of high-quality research papers, under the framework of the AIAI conference.

5th Workshop on 5G-Putting Intelligence to the Network Edge (5G-PINE 2020)

We would like to thank Dr. Ioannis P. Chochliouros, Research Programs Section, Research and Development Department, Fixed & Mobile, Hellenic Telecommunications Organization (OTE). We really appreciate his great efforts in organizing this high-quality 5th 5G-PINE workshop, which is a well-established annual event. It presents timely and significant results from state-of-the-art research in the 4th industrial revolution area. This workshop connects the conference with the latest AI applications in the telecommunication industry.

The workshops organized under the framework of AIAI 2020, also followed the same review and acceptance ratio rules. More specifically the 5th 5G-PINE workshop accepted 11 full papers (50%) and one short paper out of 23 submissions, whereas the MHDW 2020 accepted 6 full (37.5%) and 3 short papers out of 16 submitted papers.

Four keynote speakers gave state-of-the-art lectures (after invitation) in timely aspects-applications of AI.

Professor Leontios Hadjileontiadis, Department of Electrical and Computer Engineering at Aristotle University of Thessaloniki, Greece, and Coordinator of i-PROGNOSIS, gave a speech on the subject of “Smartphone, Parkinson’s and Depression: A new AI-based prognostic perspective”.

Professor Hadjileontiadis has been awarded, among other awards, as innovative researcher and champion faculty from Microsoft, USA (2012), the Silver Award in Teaching Delivery at the Reimagine Education Awards (2017–2018), and the Healthcare Research Award by the Dubai Healthcare City Authority Excellence Awards (2019). He is a Senior Member of IEEE.

Professor Nikola Kasabov, FIEEE, FRSNZ, Fellow INNS College of Fellows, DVF RAE UK, Director, Knowledge Engineering and Discovery Research Institute, Auckland University of Technology, Auckland, New Zealand, Advisory/Visiting Professor SJTU and CASIA China, RGU UK, gave a speech on the subject of “Deep Learning, Knowledge Representation and Transfer with Brain-Inspired Spiking Neural Network Architectures”.

Professor Kasabov has received a number of awards, among them: Doctor Honoris Causa from Obuda University, Budapest; INNS Ada Lovelace Meritorious Service Award; NN Best Paper Award for 2016; APNNA ‘Outstanding Achievements Award’; INNS Gabor Award for ‘Outstanding contributions to engineering applications of neural networks’; EU Marie Curie Fellowship; Bayer Science Innovation Award; APNNA Excellent Service Award; RSNZ Science and Technology Medal; and 2015 AUT Medal; and Honorable Member of the Bulgarian and Greek Societies for Computer Science.

Dr. Pierre Philippe Mathieu, European Space Agency (ESA) Head of the Philab (Φ Lab) Explore Office at the European Space Agency in ESRIN (Frascati, Italy).

Professor Xiao-Jun Wu Department of Computer Science and Technology Jiangnan University, China, gave a speech on the subject of “Image Fusion Based on Deep Learning”.

Professor Xiao-Jun Wu has won the most outstanding postgraduate award by Nanjing University of Science and Technology. He has won different national and international awards for his research achievements. He was a visiting postdoctoral researcher at the Centre for Vision, Speech, and Signal Processing (CVSSP), University of Surrey, UK, from 2003–2004.

The following two tutorial sessions by experts in the AI field completed the program:

Professor John Macintyre Dean of the Faculty of Applied Sciences, Pro Vice Chancellor at the University of Sunderland, UK. During the 1990s he established the Center for Adaptive Systems – at the university, which became recognized by the UK government as a Center of Excellence for applied research in adaptive computing and AI. The Center undertook many projects working with and for external organizations in industry, science, and academia, and for three years ran the Smart Software for Decision Makers program on behalf of the Department of Trade and Industry.

Professor Macintyre presented a plenary talk on the following subject: “AI Applications during the COVID-19 Pandemic - A Double Edged Sword?”.

Dr. Kostas Karpouzis Associate Researcher, Institute of Communication and Computer Systems (ICCS) of the National Technical University of Athens, Greece.
Tutorial Subject: “AI/ML for games for AI/ML”.

Digital games have recently emerged as a very powerful research instrument for a number of reasons: they involve a wide variety of computing disciplines, from databases and networking to hardware and devices, and they are very attractive to users regardless of age or cultural background, making them popular and easy to evaluate with actual players. In the fields of AI and Machine Learning (ML), games are used in a two-fold manner: to collect information about the players’ individual characteristics (player modeling), expressivity (affective computing), and playing style (adaptivity) and also to develop AI-based player bots to assist and face the human players as a test-bed for contemporary AI algorithms.

This tutorial discusses both approaches that relate AI/ML to games: starting from a theoretical review of user/player modeling concepts, it discusses how we can collect data from the users during gameplay and use them to adapt the player experience or model the players themselves. Following that, it presents AI/ML algorithms used to train computer-based players and how these can be used in contexts outside gaming. Finally, it introduces player modeling in contexts related to serious gaming, such as health and education.

Intended audience: researchers in the fields of ML and Human Computer Interaction, game developers and designers, as well as health and education practitioners.

The accepted papers of the AIAI 2020 conference are related to the following thematic topics:

- AI Constraints
- Classification
- Clustering – Unsupervised Learning
- Deep Learning Long Short Term Memory
- Fuzzy Algebra-Fuzzy Systems
- Image Processing
- Learning Algorithms
- ML
- Medical – Health Systems
- Natural Language
- Neural Network Modeling
- Object Tracking-Object Detection
- Ontologies/AI
- Sentiment Analysis/ Recommendation Systems
- AI/Ethics/Law

The authors of submitted papers came from 28 different countries from all over the globe, namely:

Algeria, Austria, Belgium, Bulgaria, Canada, Cyprus, Czech Republic, Finland, France, Germany, Greece, The Netherlands, India, Italy, Japan, Mongolia, Morocco, Oman, Pakistan, China, Poland, Portugal, Spain, Sweden, Taiwan, Turkey, the UK, and the USA.

June 2020

Ilias Maglogiannis
Plamen Angelov
John Macintyre
Lazaros Iliadis
Stefanos Koliass
Elias Pimenidis

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Abstracts of Invited Talks

Smartphone, Parkinson's and Depression: A New AI-Based Prognostic Perspective

Leontios Hadjileontiadis

Khalifa University of Science and Technology, UAE, and Aristotle
University of Thessaloniki, Greece
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Abstract. Machine Learning (ML) is a branch of Artificial Intelligence (AI) based on the idea that systems can learn from data, identify patterns, and make decisions with minimal human intervention. While many ML algorithms have been around for a long time, the ability to automatically apply complex mathematical calculations to big data – over and over, faster and faster, deeper and deeper – is a recent development, leading to the realization of the so called Deep Learning (DL). The latter has an intuitive capability that is similar to biological brains. It is able to handle the inherent unpredictability and fuzziness of the natural world. In this keynote, the main aspects of ML and DL will be presented, and the focus will be placed in the way they are used to shed light upon the Human Behavioral Modeling. In this vein, AI-based approaches will be presented for identifying fine-motor skills deterioration due to early Parkinson's and depression symptoms reflected in the keystroke dynamics, while interacting with a smartphone. These approaches provide a new and unobtrusive way for gathering and analyzing dense sampled big data, contributing to further understanding disease symptoms at a very early stage, guiding personalized and targeted interventions that sustain the patient's quality of life.

Deep Learning, Knowledge Representation and Transfer with Brain-Inspired Spiking Neural Network Architectures

Nikola Kasabov

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Abstract. This talk argues and demonstrates that the third generation of artificial neural networks, the spiking neural networks (SNN), can be used to design brain-inspired architectures that are not only capable of deep learning of temporal or spatio-temporal data, but also enabling the extraction of deep knowledge representation from the learned data. Similarly to how the brain learns time-space data, these SNN models do not need to be restricted in number of layers, neurons in each layer, etc. When a SNN model is designed to follow a brain template, knowledge transfer between humans and machines in both directions becomes possible through the creation of brain-inspired Brain-Computer Interfaces (BCI). The presented approach is illustrated on an exemplar SNN architecture NeuCube (free software and open source available from www.kedri.aut.ac.nz/neucube) and case studies of brain and environmental data modeling and knowledge representation using incremental and transfer learning algorithms. These include predictive modeling of EEG and fMRI data measuring cognitive processes and response to treatment, AD prediction, BCI for neuro-rehabilitation, human-human and human-VR communication, hyper-scanning, and others.

The Rise of Artificial Intelligence for Earth Observation (AI4EO)

Pierre Philippe Mathieu

European Space Agency (ESA), Head of the Philab (Φ Lab), Explore Office
at the European Space Agency in ESRIN, Frascati, Italy

Abstract. The world of Earth Observation (EO) is rapidly changing as a result of exponential advances in sensor and digital technologies.

The speed of change has no historical precedent. Recent decades have witnessed extraordinary developments in ICT, including the Internet, cloud computing and storage, which have all led to radically new ways to collect, distribute and analyse data about our planet. This digital revolution is also accompanied by a sensing revolution that provides an unprecedented amount of data on the state of our planet and its changes.

Europe leads this sensing revolution in space through the Copernicus initiative and the corresponding development of a family of Sentinel missions. This has enabled the global monitoring of our planet across the whole electromagnetic spectrum on an operational and sustained basis. In addition, a new trend, referred to as “New Space”, is now rapidly emerging through the increasing commoditization and commercialization of space.

These new global data sets from space lead to a far more comprehensive picture of our planet. This picture is now even more refined via data from billions of smart and inter-connected sensors referred to as the Internet of Things. Such streams of dynamic data on our planet offer new possibilities for scientists to advance our understanding of how the ocean, atmosphere, land and cryosphere operate and interact as part of an integrated Earth System. It also represents new opportunities for entrepreneurs to turn big data into new types of information services.

However, the emergence of big data creates new opportunities but also new challenges for scientists, business, data and software providers to make sense of the vast and diverse amount of data by capitalizing on powerful techniques such as Artificial Intelligence (AI). Until recently AI was mainly a restricted field occupied by experts and scientists, but today it is routinely used in everyday life without us even noticing it, in applications ranging from recommendation engines, language services, face recognition and autonomous vehicles.

The application of AI to EO data is just at its infancy, remaining mainly concentrated on computer vision applications with Very High-Resolution satellite imagery, while there are certainly many areas of Earth Science and big data mining/fusion, which could increasingly benefit from AI, leading to entire new types of value chain, scientific knowledge and innovative EO services.

This talk will present some of the ESA research/application activities and partnerships in the AI4EO field, inviting you to stimulate new ideas and collaboration to make the most of the big data and AI revolutions.

Image Fusion Based on Deep Learning

Xiao-Jun Wu

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Abstract. Deep Learning (DL) has found very successful applications in numerous different domains with impressive results. Image Fusion (IMF) algorithms based on DL and their applications will be presented thoroughly in this keynote lecture. Initially, a brief introductory overview of both concepts will be given. Then, IMF employing DL will be presented in terms of pixel, feature, and decision level respectively. Furthermore, a DL inspired approach called MDLatLRR which is a general approach to image decomposition will be introduced for IMF. A comprehensive analysis of DL models will be offered and their typical applications will be discussed, including Image Quality Enhancement, Facial Landmark Detection, Object Tracking, Multi-Modal Image Fusion, Video Style Transformation, and Deep Fake of Facial Images, respectively.

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