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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.

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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.

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Lazaros Iliadis · Ilias Maglogiannis
Vassilis Plagianakos (Eds.)

Artificial Intelligence Applications and Innovations

14th IFIP WG 12.5 International Conference, AIAI 2018
Rhodes, Greece, May 25–27, 2018
Proceedings

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Preface

It is a fact that the world is changing extremely fast. Technological advances in artificial intelligence (AI) are leading this change. We have already passed from theory and algorithmic approaches, to actual delivery with several real-life practical applications. We have entered the fourth “industrial revolution” era. AI will definitely rupture the human-centric status of our civilization. Many philosophical and ethical issues will arise mainly due to the challenge and fear that the machines might take over. However, the contribution of AI so far to the improvement of our quality of life is profound. The AIAI conference offers insight into all timely challenges related to intelligent systems-algorithms and their applications.

AIAI is a mature European conference, well established in the scientific area of artificial intelligence (AI). It has a very long and successful history, following and spreading the evolution of AI. The first event was organized in Toulouse, France, in 2004. Since then, it has had a continuous and dynamic presence as a major European scientific event. More specifically, it has been organized in China, Greece, Cyprus, and France.

Through the years it has always been technically supported by the International Federation for Information Processing (IFIP) and more specifically by the WG12.5.

Following a long-standing tradition, this Springer volume belongs to the IFIP AICT Springer series and it contains the papers that were accepted for oral presentation at the 14th AIAI conference. An additional volume comprises the papers that were accepted and presented at the workshops and were held as parallel events.

The event was held May 25–27, 2018, in the Aldemar Amilia Mare five-star Hotel in Rhodes, Greece.

Four scientific workshops on timely AI subjects were organized successfully during the 2018 event:

1. The 7th Mining Humanistic Data Workshop (MHDW) supported by the Ionian University and the University of Patras, Greece. The 7th MHDW was organized by Professor Christos Makris, Department of Computer Engineering and Informatics, University of Patras, Professor Phivos Mylonas Department of Informatics, Ionian University, Dr. Andreas Kanavos, Department of Computer Engineering and Informatics, University of Patras, and Georgios Drakopoulos, Department of Informatics, Ionian University Greece. The Steering Committee of MHDW 2018 comprised Dr. Ioannis Karydis, Department of Informatics, Ionian University, Professor Katia Lida Kermanidis Department of Informatics, Ionian University, and Professor Spyros Sioutas, Department of Informatics, Ionian University. We express our sincere appreciation to the committees of MHDW 2018 for organizing this important event for the seventh consecutive time.
2. The Third Workshop on 5G-Putting Intelligence to the Network Edge (5G-PINE 2018). The Third 5G-PINE was driven by the hard work of Dr. Ioannis P. Chochliouros (Hellenic Telecommunications Organization, OTE, Greece) Dr. Alexandros

Kostopoulos (OTE, Greece), Professors Oriol Sallent and Jordi Pérez-Romero (Universitat Politècnica de Catalunya UPC, Spain), Dr. Ioannis Neokosmidis (INCITES Consulting S.A.R.L, Luxembourg), Professor Fidel Liberal (Universidad del País Vasco/Euskal Herriko Unibertsitatea EHU, Spain), Dr. Emmanouil Kafetzakis (ORION Innovations Company, Greece), and Dr. Ioannis Giannoulakis, National Center for Scientific Research Demokritos, Greece). We would like to thank all of these colleagues for their hard work.

3. The Workshop on Semantics in the Deep: Semantic Analytics for Big Data (SEDSEAL 2018) supported by the University of Patras, Greece. The workshop was organized by Professor Spiridon D. Likothanasis, Department of Computer Engineering and Informatics, University of Patras, and Dr. Dimitrios Koutsomitropoulos, University of Patras, Greece. We wish to express our gratitude to these colleagues for their invaluable contribution.
4. The Intelligent Cloud and IOT Paradigms in EHealth (HEALTHIOT). This scientific event was organized by Professor Ilias Maglogiannis, Department of Digital Systems, University of Piraeus, Greece, Dimosthenis Kyriazis, Department of Digital Systems, University of Piraeus, Greece, and Vassilios Plagianakos, Department of Computer Science and Biomedical Informatics, University of Thessaly, Greece. We are very happy for the important contribution of this workshop to the success of the AIAI 2018.

The diverse nature of the papers presented demonstrates the vitality of neural computing and related soft computing approaches and proves the very wide range of ANN applications as well.

The Organizing Committee was delighted by the overwhelming response to the call for papers. All papers went through a peer-review process by at least two independent academic referees. Where needed, a third referee was consulted to resolve any conflicts. In total, 88 papers were submitted to the main event and 42 of them (around 47.7%) were accepted as full papers to be presented orally for 20 min each and to be included in the proceedings with 12 pages maximum. Owing to the high quality of the submissions, the Program Committee decided to accept an additional 12 short papers that were given 15 min for oral presentation and 10 pages each in the proceedings. The workshops also followed the same rules. More specifically, 5G-PINE accepted six full papers out of 14 submissions (42.85%) and one short, whereas the MHDW accepted seven full (46.6%) and four short papers of 15 submitted papers. HealthIOT accepted four full (44.5%) out of nine and SEDSEAL accepted two full papers out of five (40%).

The papers accepted for the 14th AIAI conference are related to the following thematic topics:

- Deep learning
- Genetic algorithms
- Constraints modeling
- ANN training algorithms
- Social media intelligent modeling
- Text mining/machine translation
- Fuzzy modeling
- Medical ANN

- Feature selection
- Emotion recognition
- Hybrid intelligent models
- Support vector machines
- Voice separation
- Classification-pattern recognition
- Greedy heuristics
- Intelligent security modeling
- Optimization
- Complex stochastic games
- Unsupervised machine learning
- ANN in industry
- Intelligent clustering
- Convolutional ANN
- Recommender systems
- Intelligent telecommunications modeling
- Intelligent hybrid systems using Internet of Things
- Intelligent systems simulation

The authors of submitted and of accepted papers came from 30 different countries from all over the globe, namely: Europe (Austria, Bulgaria, Czech Republic, Denmark, France, Finland, Germany, Greece, The Netherlands, Ireland, Italy, Norway, Romania, Russia, Spain, Slovakia, Turkey, UK), America (e.g., Brazil, Canada, USA), Asia (China, India, Japan, Pakistan, Iran), and Africa (Egypt, Algeria, South Africa).

Three keynote speakers were invited to give lectures in timely aspects of AI and ANN.

1. Plamen Angelov: “Empirical Approach to Learning from Data (Streams): Fast and Interpretable Deep Learning”.

Professor Angelov has 25+ years of professional experience in high-level research and holds a Personal Chair in Intelligent Systems at Lancaster University, UK. He leads the Data Science Groups at the School of Computing and Communications, which includes over 20 academics, researchers, and PhD students and is one of the eight groups of the school.

2. Georgios N. Yannakakis: “AI Designing Games for Us... with (or Without) Us”.

Georgios N. Yannakakis is Professor at the University of Malta (UoM) and Director of the Institute of Digital Games.

3. Anastasios Tefas: “Deep Learning and Robotics: Perception, Control, and Innovations”.

Anastasios Tefas is Associate Professor in the Department of Informatics of the Aristotle University of Thessaloniki, Greece.

A very interesting tutorial on the “Implementation of Hardware Accelerators for Machine Learning” was delivered by Professor Yannis Papaefstathiou, Technical University of Crete, Greece. Yannis Papaefstathiou has been Associate Professor at the ECE Department of the Technical University of Crete since June 2004.

We hope that these proceedings will help researchers worldwide to understand and to be aware of new AI aspects. We believe they will be of major interest for scientists from all over the globe and will stimulate further research in the domain of artificial intelligence in general.

May 2018

Lazaros Iliadis
Ilias Maglogiannis
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Abstracts

Empirical Approach to Learning from Data (Streams): Fast and Interpretable Deep Learning

Plamen Angelov

Lancaster University, UK

Abstract. We are witnessing an explosion of data (streams) being generated and growing exponentially. Today, we carry in our pockets gigabytes of data in the form of USB flash memory sticks, smartphones, smartwatches etc. Extracting useful information and knowledge from these big data streams is of immense importance for society, the economy, and science. Deep learning has quickly become known as a powerful method for enabling items and processes with elements of AI in the sense that it makes possible human-like performance in recognizing images and speech. However, the currently used methods for deep learning that are based on neural networks (recurrent, belief, etc.) are opaque (not transparent), require a huge amount of training data and computing power (hours of training using GPUs), are offline and their online versions based on reinforcement learning have no proven convergence and do not guarantee the same result for the same input (lack repeatability).

The speaker recently introduced a new concept of empirical approach to machine learning and fuzzy sets and systems, which had proven convergence for a class of such models and used the link between neural networks and fuzzy systems; neuro-fuzzy systems are known to have a duality from the radial basis function (RBF) networks and fuzzy rule-based models and possess the key property of universal approximation proven for both. In this talk the author presents in a systematic way the basics of the newly introduced “Empirical Approach to Machine Learning, Fuzzy Sets, and Systems” and its applications to problems such as anomaly detection, clustering, classification, prediction, and control.

The major advantages of this new paradigm are the liberation from the restrictive and often unrealistic assumptions and requirements concerning the nature of the data (random, deterministic, fuzzy), the need to formulate and assume a priori the type of distribution models, membership functions, the independence of the individual data observations, their large (theoretically infinite) number, etc. From a pragmatic point of view, this direct approach from data (streams) to complex, layered model representation is automated fully and leads to very efficient model structures. In addition, the proposed new concept learns in a way similar to the way people learn – it can start from a single example. The reason why the proposed new approach makes this possible is because it is prototype based and non-parametric.

AI Designing Games for Us... with (or Without) Us

Georgios N. Yannakakis

University of Malta

Abstract. Can computational processes and machine-crafted artifacts be considered creative? When does this happen and who judges after all? What happens when we create together with a creative machine? Do we merely create together or can a machine truly foster our creativity as human creators? When does such co-creation foster the creativity of both humans and machines? In this talk these questions are addressed by positioning computer games as the ideal application domain for artificial intelligence because of the unique features they offer. Advanced methods for autonomous game design as well as procedural content generation and AI-assisted game design will be showcased via a plethora of projects running currently at the Institute of Digital Games.

Deep Learning and Robotics: Perception, Control, and Innovations

Anastasios Tefas

Aristotle University of Thessaloniki, Greece

Abstract. This keynote lecture focuses on deep learning methods and their use in robotics for increased perception, control, and other innovative tasks. Deep learning has emerged as one of the most promising research fields in artificial intelligence. The significant advancements that deep-learning methods have fostered for large-scale image classification tasks have generated a surge of excitement in applying the techniques to other problems in computer vision and more broadly to other disciplines of computer science, such as robotics. However, building deep-learning algorithms for highly non-linear real-world problems such as those encountered in computer vision and robotics is non-trivial and requires substantial expertise. Unmanned aerial vehicles (drones) are among the robotic units that have substantial needs for autonomous control and perception owing to their increasing use in several applications such as transportation, inspection, surveillance, and cinematography among others. Deep convolutional neural networks (CNNs) are among the state-of-the-art techniques for visual information analysis that can provide increased perception capabilities. CNNs can be used to perform several robotic perception tasks such as object detection and tracking, face detection and person identification, crowd detection for ensuring flight safety on drones, emergency landing point detection, etc. However, deploying such deep learning models on drones or other robotic units is not a straightforward task, since there are significant memory and model complexity constraints. To overcome these limitations several methodologies have been proposed: (a) training small lightweight CNNs, (b) using knowledge transfer techniques, such as neural-network distillation, layer hints, and similarity embeddings, to reduce the size of CNNs, and (c) using neural region proposals for fast object detection and classification (faster R-CNN, YOLO, SSD).

Furthermore, gathering training data suitable for training the deep learning models is also a challenging task. Learning by using dataset augmentation techniques, such as hard negative and positive sample mining, can help to partially overcome this limitation, while allowing us to further increase the performance of the trained models. Deep-learning techniques can be also used for end-to-end drone control, allowing the deep model to control every aspect of the flight, from the visual information analysis to the drone and camera controls. Using multiple drones (multidrone set-up) can increase the flexibility of drone cinematography. Such systems can be adaptive and evolving. Finally, there are several deep-learning frameworks that can be used for deploying the aforementioned deep-learning techniques on robotics (Tensorflow, Caffe, Theano, Darknet).

Tutorial

Yannis Papaefstathiou

Technical University of Crete, Greece

Abstract. Machine learning (ML) in general and deep-learning (DL) in particular have been widely accepted as the most prominent approaches for solving very complex problems in numerous application domains. However, their computational and power demands can be forbiddingly high when executed on general purpose CPUs. As a result, it is highly desirable to implement such schemes in reconfigurable hardware accelerators.

This tutorial provides an overview of the main ML and DL schemes that have been implemented in hardware to date. It focuses on how a software developer can utilize high-level synthesis so as to develop such an efficient accelerator in a modern reconfigurable hardware device (i.e., FPGA); this is illustrated in the design of a certain widely used DL module. Furthermore, a number of optimizations, applicable to most ML and DL schemes that allow the designer to explore in full the capabilities of the modern FPGAs, are presented.

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