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Artificial Neural Networks and Machine Learning – ICANN 2018

27th International Conference on Artificial Neural Networks
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Proceedings, Part I

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Preface

Technological advances in artificial intelligence (AI) are leading the rapidly changing world of the twenty-first century. We have already passed from machine learning to deep learning with numerous applications. The contribution of AI so far to the improvement of our quality of life is profound. Major challenges but also risks and threats are here. Brain-inspired computing explores, simulates, and imitates the structure and the function of the human brain, achieving high-performance modeling plus visualization capabilities.

The International Conference on Artificial Neural Networks (ICANN) is the annual flagship conference of the European Neural Network Society (ENNS). It features the main tracks “Brain-Inspired Computing” and “Machine Learning Research,” with strong cross-disciplinary interactions and applications. All research fields dealing with neural networks are present.

The 27th ICANN was held during October 4–7, 2018, at the Aldemar Amilia Mare five-star resort and conference center in Rhodes, Greece. The previous ICANN events were held in Helsinki, Finland (1991), Brighton, UK (1992), Amsterdam, The Netherlands (1993), Sorrento, Italy (1994), Paris, France (1995), Bochum, Germany (1996), Lausanne, Switzerland (1997), Skovde, Sweden (1998), Edinburgh, UK (1999), Como, Italy (2000), Vienna, Austria (2001), Madrid, Spain (2002), Istanbul, Turkey (2003), Budapest, Hungary (2004), Warsaw, Poland (2005), Athens, Greece (2006), Porto, Portugal (2007), Prague, Czech Republic (2008), Limassol, Cyprus (2009), Thessaloniki, Greece (2010), Espoo-Helsinki, Finland (2011), Lausanne, Switzerland (2012), Sofia, Bulgaria (2013), Hamburg, Germany (2014), Barcelona, Spain (2016), and Alghero, Italy (2017).

Following a long-standing tradition, these Springer volumes belong to the *Lecture Notes in Computer Science Springer* series. They contain the papers that were accepted to be presented orally or as posters during the 27th ICANN conference. The 27th ICANN Program Committee was delighted by the overwhelming response to the call for papers. All papers went through a peer-review process by at least two and many times by three or four independent academic referees to resolve any conflicts. In total, 360 papers were submitted to the 27th ICANN. Of these, 139 (38.3%) were accepted as full papers for oral presentation of 20 minutes with a maximum length of 10 pages, whereas 28 of them were accepted as short contributions to be presented orally in 15 minutes and for inclusion in the proceedings with 8 pages. Also, 41 papers (11.4%) were accepted as full papers for poster presentation (up to 10 pages long), whereas 11 were accepted as short papers for poster presentation (maximum length of 8 pages).

The accepted papers of the 27th ICANN conference are related to the following thematic topics:

- AI and Bioinformatics
- Bayesian and Echo State Networks
- Brain-Inspired Computing

Chaotic Complex Models
Clustering, Mining, Exploratory Analysis
Coding Architectures
Complex Firing Patterns
Convolutional Neural Networks
Deep Learning (DL)

- DL in Real Time Systems
- DL and Big Data Analytics
- DL and Big Data
- DL and Forensics
- DL and Cybersecurity
- DL and Social Networks

Evolving Systems – Optimization
Extreme Learning Machines
From Neurons to Neuromorphism
From Sensation to Perception
From Single Neurons to Networks
Fuzzy Modeling
Hierarchical ANN
Inference and Recognition
Information and Optimization
Interacting with the Brain
Machine Learning (ML)

- ML for Bio-Medical Systems
- ML and Video-Image Processing
- ML and Forensics
- ML and Cybersecurity
- ML and Social Media
- ML in Engineering

Movement and Motion Detection
Multilayer Perceptrons and Kernel Networks
Natural Language
Object and Face Recognition
Recurrent Neural Networks and Reservoir Computing
Reinforcement Learning
Reservoir Computing
Self-Organizing Maps
Spiking Dynamics/Spiking ANN
Support Vector Machines
Swarm Intelligence and Decision-Making
Text Mining
Theoretical Neural Computation
Time Series and Forecasting
Training and Learning

The authors of submitted papers came from 34 different countries from all over the globe, namely: Belgium, Brazil, Bulgaria, Canada, China, Czech Republic, Cyprus, Egypt, Finland, France, Germany, Greece, India, Iran, Ireland, Israel, Italy, Japan, Luxembourg, The Netherlands, Norway, Oman, Pakistan, Poland, Portugal, Romania, Russia, Slovakia, Spain, Switzerland, Tunisia, Turkey, UK, USA.

Four keynote speakers were invited, and they gave lectures on timely aspects of AI.

We hope that these proceedings will help researchers worldwide to understand and to be aware of timely evolutions in AI and more specifically in artificial neural networks. We believe that they will be of major interest for scientists over the globe and that they will stimulate further research.

October 2018

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Keynote Talks

Cognitive Phase Transitions in the Cerebral Cortex – *John Taylor Memorial Lecture*

Robert Kozma

University of Massachusetts Amherst

Abstract. Everyday subjective experience of the stream of consciousness suggests continuous cognitive processing in time and smooth underlying brain dynamics. Brain monitoring techniques with markedly improved spatio-temporal resolution, however, show that relatively smooth periods in brain dynamics are frequently interrupted by sudden changes and intermittent discontinuities, evidencing singularities. There are frequent transitions between periods of large-scale synchronization and intermittent desynchronization at alpha-theta rates. These observations support the hypothesis about the cinematic model of cognitive processing, according to which higher cognition can be viewed as multiple movies superimposed in time and space. The metastable spatial patterns of field potentials manifest the frames, and the rapid transitions provide the shutter from each pattern to the next. Recent experimental evidence indicates that the observed discontinuities are not merely important aspects of cognition; they are key attributes of intelligent behavior representing the cognitive “Aha” moment of sudden insight and deep understanding in humans and animals. The discontinuities can be characterized as phase transitions in graphs and networks. We introduce computational models to implement these insights in a new generation of devices with robust artificial intelligence, including oscillatory neuromorphic memories, and self-developing autonomous robots.

On the Deep Learning Revolution in Computer Vision

Nathan Netanyahu

Bar-Ilan University, Israel

Abstract. Computer Vision (CV) is an interdisciplinary field of Artificial Intelligence (AI), which is concerned with the embedding of human visual capabilities in a computerized system. The main thrust, essentially, of CV is to generate an “intelligent” high-level description of the world for a given scene, such that when interfaced with other thought processes can elicit, ultimately, appropriate action. In this talk we will review several central CV tasks and traditional approaches taken for handling these tasks for over 50 years. Noting the limited performance of standard methods applied, we briefly survey the evolution of artificial neural networks (ANN) during this extended period, and focus, specifically, on the ongoing revolutionary performance of deep learning (DL) techniques for the above CV tasks during the past few years. In particular, we provide also an overview of our DL activities, in the context of CV, at Bar-Ilan University. Finally, we discuss future research and development challenges in CV in light of further employment of prospective DL innovations.

From Machine Learning to Machine Diagnostics

Marios Polycarpou

University of Cyprus

Abstract. During the last few years, there have been remarkable progress in utilizing machine learning methods in several applications that benefit from deriving useful patterns among large volumes of data. These advances have attracted significant attention from industry due to the prospective of reducing the cost of predicting future events and making intelligent decisions based on data from past experiences. In this context, a key area that can benefit greatly from the use of machine learning is the task of detecting and diagnosing abnormal behaviour in dynamical systems, especially in safety-critical, large-scale applications. The goal of this presentation is to provide insight into the problem of detecting, isolating and self-correcting abnormal or faulty behaviour in large-scale dynamical systems, to present some design methodologies based on machine learning and to show some illustrative examples. The ultimate goal is to develop the foundation of the concept of machine diagnostics, which would empower smart software algorithms to continuously monitor the health of dynamical systems during the lifetime of their operation.

Multimodal Deep Learning in Biomedical Image Analysis

Sotirios Tsafaris

University of Edinburgh, UK

Abstract. Nowadays images are typically accompanied by additional information. At the same time, for example, magnetic resonance imaging exams typically contain more than one image modality: they show the same anatomy under different acquisition strategies revealing various pathophysiological information. The detection of disease, segmentation of anatomy and other classical analysis tasks, can benefit from a multimodal view to analysis that leverages shared information across the sources yet preserves unique information. It is without surprise that radiologists analyze data in this fashion, reviewing the exam as a whole. Yet, when aiming to automate analysis tasks, we still treat different image modalities in isolation and tend to ignore additional information. In this talk, I will present recent work in learning with deep neural networks, latent embeddings suitable for multimodal processing, and highlight opportunities and challenges in this area.

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