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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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Zhongzhi Shi · Jean-Daniel Zucker ·
Bo An (Eds.)

Intelligent Information Processing XI

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Proceedings

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Preface

This volume comprises the proceedings of the 12th IFIP International Conference on Intelligent Information Processing (IIP 2022). As the world proceeds quickly into the Information Age, it encounters both successes and challenges, and it is well recognized that intelligent information processing provides the key to solving many challenges in the Information Age. Intelligent information processing supports the most advanced techniques that are able to change human life and the world. However, the path to success is never a straight one. Every new technology brings with it many challenging problems, and researchers are in great demand to tackle these problems. The IIP conference provides a forum for engineers and scientists in research institutes, universities, and industries to report and discuss their latest research progress in all aspects of intelligent information processing.

We received more than 56 papers for IIP 2022, of which 37 papers were included in the program as regular papers and six as short papers. All papers submitted were reviewed by three reviewers. We are grateful for the dedicated work of both authors and reviewers.

A conference such as this cannot succeed without help from many individuals who contributed their valuable time and expertise. We want to express our sincere gratitude to the Program Committee members and referees, who invested many hours for reviews and deliberations. They provided detailed and constructive review comments that significantly improved the quality of the papers included in these proceedings.

We were very grateful to have the sponsorship of the following organizations: IFIP TC12, the Shandong University of Science and Technology, and the Institute of Computing Technology of the Chinese Academy of Sciences. We specially thank Qingtian Zeng, Yongquan Liang, Shujuan Ji, and Zhongying Zhao for organizing the conference and Peiling Li and Xiaoli Guan for carefully checking the proceedings.

Finally, we hope you find this volume inspiring and informative. We wish that the research results reported in the proceedings will lead to exciting new findings in the years to come.

March 2022

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**Abstracts of Keynotes and Invited
Presentations**

Machine Learning for Decision Support in Complex Environments

Jie Lu

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Abstract. The research will present how machine learning can innovatively and effectively learn from data to support data-driven decision-making in uncertain and dynamic situations. A set of new fuzzy transfer learning theories, methodologies and algorithms will be presented that can transfer knowledge learnt in one or more source domains to target domains by building latent space, mapping functions and self-training to overcome tremendous uncertainties in data, learning processes and decision outputs (classification and regression). Another set of concept drift theories, methodologies and algorithms will be discussed about how to handle ever-changing dynamic data stream environments with unpredictable stream pattern drifts by effectively and accurately detecting, understanding, and adapting concept drift in an explanatory way, indicating when, where and how concept drift occurs and reacting accordingly. These new developments enable advanced machine learning and therefore enhance data-driven prediction and decision support systems in uncertain and dynamic real-world environments.

Making Machine Learning Fairer

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Abstract. As the rapid development of artificial intelligence (AI) and its real-world applications in recent years, AI ethics has become increasingly important. It is no longer a nice feature to consider, but a must for both AI research and applications. First, this talk first tries to recall what classical ethics is about from an historical perspective. It tries to understand how technology ethics and AI ethics grow out of the broad ethics field. Specific features of AI ethics will be discussed. Second, a brief review of current research into AI ethics will be given. Key research topics will be extracted from a large number of reports to give a more concrete picture of most important issues covered in AI ethics. Third, we will examine the fairness issue in AI ethics and demonstrate how an algorithmic approach could help machine learning to be fairer. In other words, the results from machine learning will have less biases. Finally, some open research questions will be touched upon. (This talk is partly based on the following paper: Zhang Q., Liu J., Zhang Z., Wen J., Mao B., Yao X. (2021), Fairer Machine Learning Through Multi-objective Evolutionary Learning. In: Farkaš I., Masulli P., Otte S., Wermter S. (eds) Artificial Neural Networks and Machine Learning – ICANN 2021. ICANN 2021. Lecture Notes in Computer Science, vol 12894. Springer, Cham. https://doi.org/10.1007/978-3-030-86380-7_10).

Multiagent Reinforcement Learning: Models and Modelling

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Abstract. In this talk we shall present our recent works on multi-agent reinforcement learning. In multi-agent reinforcement learning, agents interact with one another in a multi-agent system. They continuously revise their decision policies by learning from their experiences of interacting with other agents. Generally, a social norm of action will emerge at some point. I shall describe our research results in multi-agent reinforcement learning, and discuss what we can learn from these results. I shall also highlight some theoretical results on mathematical modelling of multi-agent reinforcement learning.

Affective Brain-Computer Interface and Applications

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Abstract. Affective brain-computer interface (aBCI) is a type of human-computer interface that can recognize and/or regulate emotions. In particular, according to whether to regulate emotions, aBCI can be divided into two categories. The first category is emotion recognition BCI, which can recognize emotions based on the brain signals collected by external devices. The second category is emotion recognition and regulation BCI, which can not only recognize emotions but also regulate emotions by stimulating specific brain areas. Currently, most research is focused on emotion recognition BCI. The study on emotion regulation BCI is highly limited. This talk will introduce our recent work on emotion recognition BCI and applications. Specifically, we will introduce a multimodal affective BCI framework of combining EEG signals and eye movement signals, a plug-and-play domain adaptation for cross-subject EEG-based Emotion Recognition, GAN-based methods for EEG data augmentation, and the practical application of aBCI to depression evaluation.

Accurate, Secure and Privacy-Preserving Brain-Computer Interfaces

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Abstract. Brain-computer interface (BCI) is a direct communication pathway between the brain and an external device. Because of individual differences and non-stationarity of brain signals, a BCI usually needs subject-specific calibration, which is time-consuming and user unfriendly. Sophisticated machine learning approaches can help reduce or even completely eliminate calibrations, improving the utility of BCIs. Recent studies also found that machine learning models in BCIs are vulnerable to adversarial attacks, and brain signals also contain lots of private information, so the security and privacy of BCIs are also important considerations in their commercial applications. This talk will introduce transfer learning approaches for expediting BCI calibration, and its adversarial attack and privacy protection approaches. The ultimate goal is to implement accurate, secure and privacy-preserving BCIs.

General Real-World Decision-Making by Offline Reinforcement Learning

Yang Yu

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Abstract. While reinforcement learning (RL) has shown super-human decision-making ability in playing games, the community is expecting RL will be able to solve real-world problems that are out of games. In general, real-world RL was quite difficult to come true. To achieve a good policy, an RL training process commonly explore the environment by thousands of trials and errors, which can incur unbearable cost. An apparent cause of the difficulty is the missing of a cost-free playing ground, i.e., an environment model, for RL training. However, learning an effective environment model from data is inhibited by high compounding error, stated by the *simulation lemma* firstly proved in 2002. Nearly 20 years later, we now have established a new theory with compounding error eliminated. The new theory allows us to learn effective environment models. We show that environment model learning enables truly offline RL, which makes zero trial errors to train a policy. We also show that such offline RL can be applied in a wide range of real-world tasks.

Rethinking the Learning Mechanism of GNN

Chuan Shi

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Abstract. In recent years, researchers began to study how to apply neural network to graph data, forming a research boom of graph neural network (GNN). Most GNNs are equivalent to a low-pass filter, which aggregates the feature information of neighbor nodes along the network structure, and realizes the effective fusion of network structure and attribute features. Although GNNs have achieved great success in academic research and practical applications, they still leave some open problems on learning mechanisms of GNNs. In this talk, we will rethink some key operations of GNNs and report some recent progress in this field. This talk will focus on, but not limit to, following questions: fusion mechanism of structure and features, uniform message aggregation mechanism, the role of low-pass filtering, and reliable graph structure for GNN. The answers to questions will give the insightful investigation on the learning mechanism of GNNs and guide us design better GNNs.

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