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Editorial of special issue on emerging topics in applied intelligence

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In the last decade, major breakthroughs have occurred in the field of artificial intelligence. Novel techniques and models have been developed to build intelligent software programs equipped with improved sensing, learning, reasoning, and conversational capabilities. These developments have not only been theoretical but major efforts have also been put forward to develop and deploy large scale intelligent systems in the industry, schools, organizations, as well as in our daily lives through various forms of computing devices. Many modern artificial intelligence solutions are multi-disciplinary, complex can now address hard industrial problems.

This special issue presents recent research advances on emerging research topics for the development of applied intelligent systems. This includes novel solutions to important theoretical issues but also applied contributions for the design of real-world intelligent systems. The special issue covers several application such as diagnosis, customer transaction analysis, trajectory analysis, video streaming, image analysis and chemistry.

Authors of selected papers from the 33rd International Conference on Industrial, Engineering & Other Applications of Applied Intelligent Systems (IEA/AIE 2020, Kitakyushu, Japan) have been invited to submit extended papers for this special issue. All papers have been peer-reviewed according to the journal standards.

The following papers are published in this special issue.

The paper entitled "**Model-based Reasoning using Answer Set Programming**" by Wotawa et al. presents the application of non-monotonic reasoning and, in particular, answer set programming to diagnosis. In this paper, a system model, written in a logic answer set programming formation, is used directly for detecting and locating faults in the system, given a set of observations. In addition to the foundations and algorithms given in the paper, it comprises a discussion on modeling for digital systems and analog circuits. This paper also includes an experimental evaluation, which shows the practicability of the approach and its limitations. Practitioners can use the presented findings when coming up with diagnosis applications based on system models.

The paper, titled "**Dynamic Maintenance Model for High Average-Utility Pattern Mining with Deletion Operation**" by Wu et al. presents a PRE-HAUI-DEL algorithm that uses the pre-large concept of HAUIM to handle transaction deletions in dynamic databases. Based on the pre-large concept, it serves as a buffer that reduces the problem of iterative database scans. Moreover, two upper bounds are set here to reduce the unpromising candidates early, which can accelerate the computational cost. The results show that the designed PRE-HAUI-DEL algorithm compares favorably with the traditional Apriori-like model in terms of runtime, memory and scalability in dynamic databases.

The paper titled "**Heuristically mining the top-k high-utility itemsets with cross-entropy optimization**" by Song et al. presents heuristic methods for mining top-k high-utility itemsets (HUIs). In this paper, two algorithms TKU-CE and TKU-CE+ are proposed. The TKU-CE algorithm is based on cross-entropy, and implements top-k HUI mining using combinatorial optimization. TKU-CE+ optimizes TKU-CE using three strategies: critical utility value, sample refinement, and smoothing mutation. With these strategies,

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the search space is narrowed, and more actual top-k HUIs can be discovered with fewer iterations. The experimental results show that both algorithms are efficient, memory-saving, scalable, and can discover the most actual top-k HUIs.

The paper "**Parallel grid-based density peak clustering of big trajectory data**" by Niu et al. proposes an efficient parallel trajectory clustering algorithm, named Tra-PDPC (Trajectory-Parallel DPC). It is designed to group similar trajectories using a density-peak clustering approach. The algorithm applies three steps, namely (1) trajectory division and partition, (2) trajectory similarity calculation, and (3) clustering. Those steps are all designed to run in a distributed environment using the Spark programming model. The paper reports that DPC can dramatically improves clustering speed. Moroever, it is found on multiple large realistic trajectory datasets that Tra-PDPC can considerably decrease runtime while providing a high accuracy.

The paper titled "**A New Approach to the Design of Acyclic Chemical Compounds Using Skeleton Trees and Integer Linear Programming**" by Zhang et al. presents a new concept on acyclic chemical graphs called a skeleton tree. Based on it, the paper introduces a new Mixed Integer Linear Programming (MILP) formulation. Such an MILP formulation is used to infer acyclic chemical graphs in a framework for the inverse QSAR/QSPR (quantitative structure-activity and structure-property relationship) jointly with artificial neural networks. Computational experiments indicate that the newly proposed method significantly outperforms the existing method for chemical graphs with a diameter up to 8. For a particular case where acyclic chemical compounds with 38 non-hydrogen atoms limited to carbon, oxygen, and sulfur, were inferred, the new method was faster by four orders of magnitude.

The paper titled "**One-class ensemble classifier for data imbalance problems**" by Hayashi et al. presents the One-class Classification (OCC) and One-class ensemble (OCCE) for data imbalance classification. In this paper, the OCC models are trained class by class, and an ensemble of these models creates the final classification. Such a strategy does not suffer data imbalance as the models learn from only one class. In addition, OCCE is reliable as it does not use fake minority samples. The proposed method is experimented with the imbalanced-learn dataset and compared with sampling methods. In which the OCCE shows the best AUC scores in 20 datasets.

The paper titled "**Towards addressing unauthorized sharing of subscriptions**" by Zhang et al. presents an efficient solution to address the account sharing problem. The widely spread practice of unauthorized sharing causes huge revenue loss for subscription-based business. The paper proposes to address the problem based on account usage log data. The solution builds user profiles by accumulating and representing geolocation and device usage information. Then, it estimates the risk of unauthorized sharing by analyzing the usage pattern of each account. The paper reports that the proposed solution can identify a large number of shared accounts and help service providers to recoup a significant amount of lost revenue.

Another paper titled "**Designing Convolutional Neural Networks with Constrained Evolutionary Piecemeal Training**" by Sapra et al. is about automatic machine learning (Auto-ML). A neural architecture search algorithm is presented for automatically searching for convolutional neural network architectures so as to improve classification performance. The algorithm traverses the search space of neural network architectures with the help of an evolutionary algorithm, which is augmented with a novel approach of piecemeal-training. The study demonstrates that a neural network architecture and its weights can be jointly learnt by combining concepts of the traditional training process and evolutionary architecture search in a single algorithm. Moreover, constraints are taken into account to limit the size and number of parameters of neural networks. The paper presents experimental results for image classification and human activity recognition where the algorithm discovered models providing a high accuracy.

The paper "**Active Learning using a Self-Correcting Neural Network (ALSCN)**" by Ilic et al. aims at addressing the problem that manual data labeling is labor intensive for the development of machine learning models. The paper presents a novel active learning algorithm (ALSCN) consisting of two networks, a convolutional neural network and a self-correcting neural network (SCN). The convolutional network is trained using only manually labeled data to predict the labels of unlabeled items. The SCN network is trained with all items (manually or predicted) to predict all items. The labelling errors are then fixed manually and the process is repeated. Experiments for image classification have shown that the accuracy of models trained with selected items matched or exceeded the accuracy of models trained with an entire dataset, which shows that the proposed model can reduce manual labeling effort.

Editors hope that this issue will provide inspiration as well as valuable knowledge and ideas that will benefit the research on applied intelligent systems both in terms of theory and practical applications. There are numerous opportunities for researchers and practitioners to use and extend this research. The editors appreciate the hard work and dedication of all contributors for this special issue.