Editorial: Special Issue on Recent Progress in Autonomous Machine Learning

[1)]Mahardhika Pratama, School of STEM, University of South Australia, email: dhika.pratama@unisa.edu.au

[2)]Edwin Lughofer, Institute of Mathematical Methods in Medicine and Databased Modelling, Johannes Keppler University, email: Edwin.lughofer@jku.at

[3)]Plamen P. Angelov, School of Computing and Communications, Lancaster University, email: p.angelov@lancaster.ac.uk

Autonomous Machine Learning (AML) [1]-[3] offers a flexible approach where both parameter learning and structural learning of a model are carried out simultaneously in the memory-wise fashion. The advantage of such systems is obvious in the context of evolving data streams because its dynamic network structure makes possible for new knowledge to be incorporated by adding new rules or nodes and outdated knowledge to be discarded by pruning or merging inconsequential rules or nodes. Such approaches enable quick recovery in the case of drifts [4]. Compared to conventional architecture search approaches [5], AML benefits from a data-driven architecture learning approach featuring computationally efficient approach. That is, it is based on the network growing and pruning approaches, executable in the one-pass learning fashion. Combination between a single-pass learning approach and a self-evolving network structure makes AML highly scalable solutions to deal with high-pace data streams. Our special issue reports recent progress in autonomous learning machine where only selected papers are published in this special issue.

The first paper titled "An Explainable Semi-Supervised Self-Organizing Fuzzy Inference System for Streaming Data Classification" exemplifies the success of AML to handle scarcely labelled data streams. This paper proposes S^3OFIS+ developed from a zero-order fuzzy rule-based system. It presents a pseudo-labelling approach putting forward the C nearest prototypes (CNP) method. Experimental results demonstrate the advantage of this approach showing improved performances compared to prominent semi-supervised data stream approaches.

The second paper titled "Explaining Smartphone-based Acoustic Data in Bipolar Disorder: Semi-Supervised Fuzzy Clustering and Relative Linguistic Summaries" proposes linguistic summaries with fuzzy clustering (LSFC) algorithm deriving linguistic summaries of clusters extracted by dynamic incremental semi-supervised fuzzy c-means (DISSFCM). These approaches are applied to bipolar disorder monitoring. DISSFCM copes with semi-supervised data streams and features an extension of semi-supervised fuzzy c-means (SSFCM). The proposed approaches show satisfactory performance in the bipolar disorder monitoring problem as well as the benchmark data stream problems. In addition, the linguistic summaries offer explainable approach for semi-supervised data stream classification problems.

The third paper titled "FTAP: Feature Transferring Autonomous Machine Learning Pipeline" proposes an AML approach for feature transferring from source domain having plentiful labels to target domain having few or no labels. It extends the tree-based pipeline optimization tool (TPOT) for autonomous model selection and hyper-parameter search and tuning. The proposed approach has been validated in the three data modalities: text, audio and image and has shown improved performances compared to traditional AML tools.

The fourth paper titled "MLTF: Model Less Time-series Forecasting" presents a non-parametric time-series forecasting approach making use of statistical information such as trend,

linearity, entropy, etc. to cluster series from predefined repository. The series from the same clusters are tagged as similar series. Prediction is done using cross-similar series using adaptive resampling approach. Experiments have demonstrated the advantage of the MLTF in the context of execution time while achieving comparable accuracy due to its non-parametric nature.

The fifth paper titled “Adapting H-Infinity Controller for the Desired Reference Tracking of the Sphere Position in the Maglev Process” proposes the H-infinity approach for tracking problem of the Maglev process. It applies an adaptive strategy for unknown dynamic estimations while utilizing the H-infinity strategy for reference tracking. The advantage of the proposed approach has been verified theoretically using the Lyapunov stability criterion and numerically using several simulations. Comparisons have been carried out where it delivers performance improvement compared to the two stage approach and the robust tracking approach.

References

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