Soft Computing (Springer)

Call for papers on the Special Issue

"Hybrid and Ensemble Techniques in Soft Computing: Recent Advances and Emerging Trends"

Special Issue webpage: http://kms.ii.pwr.wroc.pl/events/HETSC2014

Guest Editors (in alphabetical order)
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Scope of the issue

General Statement

The application of *hybrid and ensemble methodologies* in the field of soft computing (SC) and machine learning (ML) has become more visible and attractive. The relevance of these methodologies is motivated by their power of being able to express knowledge contained in data sets in multiple ways, benefiting each of the other, i.e. exploiting their diversity, thus increasing the performance of sole base models in terms of model accuracy and generalization capability by intelligent combination strategies, especially while dealing with high dimensional, complex regression and classification problems. Another main reason for their popularity is the high complementary of its components. The integration of the basic technologies into hybrid machine learning solutions facilitates more intelligent search and reasoning methods that match various domain knowledge with empirical data to solve advanced and complex problems.

Both ensemble models and hybrid methods make use of the information fusion concept but in a slightly different way. In case of ensemble classifiers, multiple but homogeneous, weak models are combined, typically at the level of their individual output, using various merging methods, which can be grouped into fixed (e.g., majority voting), and trained combiners (e.g., decision templates), exploiting model diversity on the one hand, and exploring data variation, as e.g. caused by noise, on the other hand. Hybrid methods, in turn, combine completely different, heterogeneous soft computing and/or machine learning approaches, seeking for homogenous solutions. Usually, they are applied for complex optimization problems within the field of data driven model-based design which cannot be solved with classical analytical or standard machine learning techniques (e.g., neural networks combined with evolutionary strategies for multi-objective approximation or difference equations problems, or genetic fuzzy systems for providing interpretability/accuracy tradeoff within optimization cycles). Both, ensemble learning and hybrid approaches, may considerably improve quality of reasoning and boost adaptivity of the entire solutions. For that reason, ensemble and hybrid methods have found application in numerous real word problems ranging from person recognition, through medical diagnosis, bioinformatics, recommender systems and text/music classification to financial forecasting.

Recent Advances within the Scope of Batch Modeling

In this special issue, we intend to draw a broad picture of **recent advances of hybrid and ensemble methods in soft computing and machine learning** and also a combination of both, emphasizing the usage of fuzzy systems, neural networks, and all types of evolutionary algorithms (genetic algorithms, memetic algorithms, differential evolution, particle swarm optimization etc., to name a few), to employ them as base learners and within hybridization schemes (e.g. neuro-fuzzy systems). Multi-objectivity will play a central role in all hybrid scheme, where any form of evolutionary algorithms is employed.

A specific focus is placed on intelligent fusion strategies which are going far beyond pure (weighted) majority voting, thus also include some trainability and cascadability in terms of base learners combination and confidence level outputs strategies. In this context, model selection may play a crucial role to remove any superfluous information from the ensembles. Stability plays an important role, especially when base learners may be weak or the noise level is high. Interpretability is an important issue, e.g. in case of human-machine interaction systems, where humans may interact with the system in an enriched context, significantly going beyond monitoring purposes and providing plain feedback in form of rewards. Thus, an interesting challenge within this special issue will be that the outcomes of optimized hybrid soft computing model architectures are readable and understandable systems for users.

New Emerging Trends in Incremental and Evolving Ensemble/Hybrid Methods

A specific emphasis of this special issue is given by a recently emerging trend in the research field of hybrid and ensemble techniques, and that is, methods and algorithms which are able to perform **on-line processing on data streams**, supporting **step-wise adaptation of model ensembles in incremental manner** as well as **evolving components**. Both, temporal as well as spatial adaptation capabilities, would be of interest, that is, being able to mining model ensembles and hybrid systems in a data stream mining context (temporal case) as well as in a spatial data site mining context (spatial case). The former case leads to the possibility to use the novel methods in fast on-line real-world applications such as sequential video analysis, on-line system identification in multiple sensor networks, time-series analysis and prediction, the latter to the possibility to use them in VLDBs (very large data bases), huge web mining or cloud computing environments.

Incrementality plays a key role to prevent cost-intensive re-training cycles and thus to keep modeling efforts smart. **Strong dynamic aspects and drifting situations**, as e.g. caused by new operating modes, changing system characteristics or non-stationary environmental influences, should be captured on-demand and integrated on-the-fly into the ensembles and hybrid models. In this sense, either the whole ensembles or the architectures used within the base learners of the whole hybrid/ensemble system may **dynamically evolve (expand and shrink) in size and coverage**, in order to enhance on-line performance, robustness and furthermore process safety. **Active or semi-supervised learning techniques** within the context of incremental (single-pass) learning are important to reduce efforts and costs for operators and machines, as reducing the number of requested target values for model updates.

In summary, this special issue intends to draw a round picture of the recent advances in hybrid and ensemble methods within different learning environments, supporting static, dynamic or on-line processing.

Topics

Topics of interest include but are not limited to new aspects in:

- ➢ **Batch Hybrid and Ensemble Techniques in Soft Computing and Machine Learning:**
  - o New methods in clustering, classification and regression
  - o Model weighting and selection strategies
  - o Fusion techniques of model ensembles
  - o Homogeneous and heterogeneous ensembles
  - o Hybrid neural and (neuro-)fuzzy evolutionary systems
  - o Multi-objective hybrid optimization methods
  - o Dealing with large volumes of data and lack of adequate data
  - o Subsampling and feature selection in multiple model machine learning
  - o Diversity, accuracy, interpretability, and stability issues
  - o New methods in relational machine learning

- ➢ **On-line Hybrid and Ensemble Methods combined with**

  - o Data stream mining
  - o Adaptive and evolving learning methodologies for
    - ▪ Pattern recognition
    - ▪ Classification
    - ▪ Approximation
    - ▪ Statistical learning
  - o Incremental structural changes:
    - ▪ Model expansion, evolution and shrinkage
    - ▪ Dynamic dimensionality reduction and subspace selection
    - ▪ Dynamic evolving model ensembles (selection, integration,...)
  - o Active and semi-supervised learning strategies
  - o Techniques to address "Concept Drift"
  - o Transfer learning
  - o Online tuning via human-machine interaction
  - o Online complexity reduction => smart dynamic hybrid/ensemble systems
  - o Interactive data mining

- ➢ **Real-World Applications**

- o Huge data basis
- o Web mining
- o Data stream mining and adaptive knowledge discovery
- o Multiple sensor networks
- o Cloud computing
- o On-line system identification and modeling
- o On-line time-series prediction
- o Pattern and person recognition
- o Medical diagnosis
- o Bioinformatics
- o Recommender systems
- o Text/music classification
- o Financial forecasting
- o On-line quality control and condition monitoring
- o Social networks and user context modeling
- o Human-machine interaction
- o Human activity recognition
- o Information retrieval and many more

Important dates

Submission deadline: **December 31, 2013**
First author notification: **April 30, 2014**
Revised version: **July, 2014**
Final notification: **October, 2014**
Publication: **Fall, 2014**

Submission Instructions

Papers will be evaluated based on their originality, presentation as well as relevance and contribution to the field of hybrid and ensemble methods, suitability to the special issue, and overall quality. All papers will be rigorously refereed by 3 peer reviewers. Submission of a manuscript to this special issue implies that no similar paper is already accepted or will be submitted to any other conference or journal. Authors should consult the "Guide for Authors", which is available online at http://www.springer.com/engineering/computational+intelligence+and+complexity/journal/500 for information about preparation of their manuscripts. Manuscripts should be submitted via the Springer Editorial System https://www.editorialmanager.com/soco/. Please choose "**Spec.Iss.: Hybrid and Ensemble Techniques**" when specifying the Article Type.

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