

AI Based on Lattice Theory

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Presentation Outline

1. The Context
2. The Fact
3. The Claim
4. The Evidence

1. The Context

“AI Based on Lattice Theory”

with reference to

- Keynote B: Jürgen Schmidhuber
“General AI as a formal science”

2. The Fact

- Many types of data in AI applications are *partially-ordered*.

Such data include

- Arrays of (Real) Numbers,
- Logic Values,
- (Fuzzy) Sets,
- (Strings of) Symbols,
- Graphs, etc.

3. The Claim

- *Order-Theory*, or equivalently *Lattice Theory*, emerges as an enabling instrument for rigorous analysis and design in AI.

4. The Evidence

Selected Journal Publications

- Kaburlasos VG (2004) FINs: lattice theoretic tools for improving prediction of sugar production from populations of measurements. **IEEE Trans. Systems, Man and Cybernetics – B** 34(2): 1017-1030.
- Kaburlasos VG, Kehagias A (2006) Novel fuzzy inference system (FIS) analysis and design based on lattice theory, Part I: Working principles. **International Journal of General Systems** 35(1): 45-67.
- Kaburlasos VG, Kehagias A (2007) Novel fuzzy inference system (FIS) analysis and design based on lattice theory. **IEEE Trans. Fuzzy Systems** 15(2): 243-260.

- Kaburlasos VG, Papadakis SE (2006) Granular self-organizing map (grSOM) for structure identification. **Neural Networks** 19(5): 623-643.
- Kaburlasos VG Papadakis S (2009) A granular extension of the fuzzy-ARTMAP (FAM) neural classifier based on fuzzy lattice reasoning (FLR). **Neurocomputing** 72(10-12): 2067-2078.
- Kaburlasos VG, Petridis V (2000) Fuzzy lattice neurocomputing (FLN) models. **Neural Networks** 13(10): 1145-1170.
- Kaburlasos VG, Athanasiadis IN, Mitkas PA (2007) Fuzzy lattice reasoning (FLR) classifier and its application for ambient ozone estimation. **Intl. Journal Approximate Reasoning** 45(1): 152-188.
- Kaburlasos VG, Moussiades L, Vakali A (2009) Fuzzy lattice reasoning (FLR) type neural computation for weighted graph partitioning. **Neurocomputing** 72(10-12): 2121-2133.

Books

- Kaburlasos VG (2006) Towards a Unified Modeling and Knowledge-Representation Based on Lattice Theory. Heidelberg, Germany: **Springer**, series: Studies in Computational Intelligence, 27.
- Kaburlasos VG, Ritter GX, Eds. (2007) Computational Intelligence Based on Lattice Theory. Heidelberg, Germany: **Springer**, series: Studies in Computational Intelligence, 67.
- Kaburlasos V, Priss U, Graña M, Eds. (2008) Proceedings of the Lattice-Based Modeling Workshop (LBM 2008) in conjunction with The Sixth International Conference on Concept Lattices and Their Applications (CLA 2008). Olomouc, Czech Republic: **Palacký Univ.**

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Special Issue Call for Papers

“Information Engineering Applications Based on Lattices”

Guest Editors

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Aims and Scope

With the proliferation of both computing devices and Information Technologies (ITs), a variety of domain-specific information processing paradigms have emerged in different application domains. The latter (domains) include (digital) signal processing, prediction and decision-making by static/dynamic systems also under uncertainty and/or vagueness, clustering, data mining, graph processing, symbol manipulation, etc. The corresponding mathematical modelling tools are, frequently, different also due to the need to cope with disparate types of data including logic values, (fuzzy) numbers/sets, (strings of) symbols, graphs, etc. A unification of the aforementioned tools is expected to result in fruitful technology cross-fertilization. Nevertheless, an “enabling” mathematical framework is currently missing.

It turns out that popular types of data, including the aforementioned ones, are lattice (partially)-ordered. Hence, lattice theory (LT) emerges as an “enabling” mathematical framework for sound analysis and design in Information Engineering (IE) applications. Moreover, based on meaningful knowledge-representations, an additional, fundamentally different, capacity of LT is to compute with *semantics*. Furthermore, LT has demonstrated its potential for hybrid system design, which may accommodate, either separately or jointly in any combination, (non)numeric data.

Currently, there is a number of isolated research Communities that employ LT in various information processing domains including (Fuzzy) Logic and Reasoning for automated decision-making, Mathematical Morphology for signal/image processing, Formal Concept Analysis for knowledge-representation and information-retrieval, Computational Intelligence for clustering /classification /regression, etc.

Despite creative interactions within a Community, different research communities typically work separately. Hence, practitioners of LT typically develop their own tools/practices without being aware of valuable contributions by colleagues in other Communities. In conclusion, potentially useful work may be ignored or duplicated; sometimes a conflicting terminology is proposed. In the aforementioned context, there is room for creative syntheses by bringing forward innovative ideas and research results of multidisciplinary character towards unified future advances.

Papers are solicited from different information processing domains including (Fuzzy) Logic and Reasoning, Mathematical Morphology, Formal Concept Analysis, Computational Intelligence, Data Bases, etc., where LT is instrumental. Our focus is on IE applications of practical significance. Especially welcome are application papers involving Intelligent Agents, the Semantic Web, Human Computer Interaction (HCI), Multimedia, Sensor Networks, Machine Learning, Computing With Words, Statistics, etc. Pure mathematical papers on lattice theory will not be considered. Nevertheless, we encourage tutorial- or review- papers from existing areas with the intention to identify and accelerate vitally relevant and emerging trends. If the authors are concerned whether their paper would fall within the scope of this Special Issue, please send an abstract to the Guest Editor for a preliminary evaluation prior to the due date.

Tentative Schedule

Submission of full papers: July 15, 2009
First revision notification: October 15, 2009
Submission revised papers: December 31, 2009
Final decision notification: As soon as possible upon receiving the revised version.
Estimated publication date: Second half of 2010

Submission Instructions

All papers will be rigorously refereed by at least three reviewers of the Journal. 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.elsevier.com/wps/find/journaldescription.cws_home/505730/authorinstructions, for information about preparation of their manuscripts. Manuscripts should be submitted via the Elsevier Editorial System <http://ees.elsevier.com/ins/>. Please choose "**Spec.Iss.: Lattices**" when you reach the Article Type step. First time users need register themselves as Author.