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Rough Sets


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Preface

The proceedings of the 2018 International Joint Conference on Rough Sets (IJCRS 2018) contain the results of the meeting of the International Rough Set Society held at the International Centre for Interdisciplinary Science and Education (ICISE) and the University of Quy Nhon in Quy Nhon, Vietnam, during August 2018.

Conferences in the IJCRS series are held annually and comprise four main tracks relating the topic rough sets to other topical paradigms: rough sets and data analysis covered by the RSCTC conference series from 1998, rough sets and granular computing covered by the RSFDGrC conference series since 1999, rough sets and knowledge technology covered by the RSKT conference series since 2006, and rough sets and intelligent systems covered by the RSEISP conference series since 2007. Owing to the gradual emergence of hybrid paradigms involving rough sets, it was deemed necessary to organize Joint Rough Set Symposiums, first in Toronto, Canada, in 2007, followed by symposiums in Chengdu, China in 2012, Halifax, Canada, 2013, Granada and Madrid, Spain, 2014, Tianjin, China, 2015, where the acronym IJCRS was proposed, continuing with the IJCRS 2016 conference in Santiago de Chile and IJCRS 2017 in Olsztyn, Poland.

The IJCRS conferences aim at bringing together experts from universities and research centers as well as from industry representing fields of research in which theoretical and applicational aspects of rough set theory already find or may potentially find usage. They also become a place for researchers who want to present their ideas to the rough set community, or for those who would like to learn about rough sets and find out if they can be useful for their problems.

This year's conference, IJCRS 2018, celebrated the 20th anniversary of the first international conference on rough sets called RSCTC, which was organized by Lech Polkowski and Andrzej Skowron during June 22–26, 1998, in Warsaw, Poland. On this occasion, we listened to a retrospective talk delivered by Andrzej Skowron, who summarized the successes of this field and showed directions for further research and development.

IJCRS 2018 attracted 61 submissions (not including invited contributions), which underwent a rigorous reviewing process. Each accepted full-length paper was evaluated by three to five experts on average. The present volume contains 45 full-length regular and workshop submissions, which were accepted by the Program Committee, as well as six invited articles.

The conference program included five keynotes and plenary talks, a fellow talk, eight parallel sessions, a tutorial, the 6th International Workshop on Three-way Decisions, Uncertainty, and Granular Computing, and a panel discussion on rough sets and data science.

The chairs of the Organizing Committee also prepared the best paper award and the best student paper award. From all research papers submitted, the Program Committee

nominated five papers as finalists for the award and, based on the final presentations during the conference, selected the winners.

We would like to express our gratitude to all the authors for submitting papers to IJCRS 2018, as well as to the members of the Program Committee for organizing this year's attractive program.

We also gratefully thank our sponsors: Vietnam National University in Ho Chi Minh City, for providing the technical support and human resources for the conference; the University of Quy Nhon, for sponsoring the reception and the conference facilities during the first day and the last day; Ton Duc Thang University, for sponsoring the pre-conference workshops on rough sets and data mining.

The conference would not have been successful without support received from distinguished individuals and organizations. We express our gratitude to the IJCRS 2018 honorary chairs, Andrzej Skowron, Huynh Thanh Dat, and Do Ngoc My, for their great leadership. We appreciate the help of Dinh Thuc Nguyen, Nguyen Tien Trung, Quang Vinh Lam, Quang Thai Thuan, Thanh Tran Thien, Luong Thi Hong Cam, Giang Thuy Minh, Phung Thai Thien Trang, Dao Thi Hong Le, Hung Nguyen-Manh, and all other representatives of Vietnam National University in Ho Chi Minh City and Quy Nhon University, who were involved in the conference organization. We would also like to thank Marcin Szeląg, Sinh Hoa Nguyen, and Dang Phuoc Huy, who supported the conference as tutorial, workshop, and special session chairs. We acknowledge the significant help from Khuong Nguyen-An, Tran Thanh Hai, Ly Tran Thai Hoc, and Marcin Szczuka provided at various stages of the conference publicity, website, and material preparation.

We are grateful to Tu Bao Ho, Hamido Fujita, Hong Yu, Andrzej Skowron, Piero Pagliani, and Mohua Banerjee for delivering excellent keynote and plenary talks and fellow talks. We thank Dominik Ślęzak and Arkadiusz Wojna for the tutorial. We are thankful to Hong Ye, Mohua Banerjee, Mihir Chakraborty, Bay Vo, and Le Thi Thuy Loan for the organization of workshops and special sessions.

Special thanks go to Alfred Hofmann of Springer, for accepting to publish the proceedings of IJCRS 2018 in the LNCS/LNAI series, and to Anna Kramer for her help with the proceedings. We are grateful to Springer for the grant of 1,000 Euro for the best paper award winners. We would also like to acknowledge the use of EasyChair, a great conference management system.

We hope that the reader will find all the papers in the proceedings interesting and stimulating.

August 2018

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Introducing Histogram Functions into a Granular Approximate Database Engine (Industry Talk)

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Abstract. We discuss an approximate database engine that we started designing at Infobright, and now we continue its development for Security On-Demand (SOD). At SOD, it is used in everyday data analytics, allowing for fast approximate execution of ad-hoc queries over tens of billions of data rows [1]. In our engine, queries are run against collections of histograms that represent domains of single columns over groupings of consecutively loaded data rows (so-called packrows). Query execution process corresponds to transformation of such granulated summaries of the input data into summaries reflecting query results [2].

We compare our algorithms that generate histogram descriptions of the original data with data quantization methods that are widely used in data mining. We also introduce a new idea of extending SQL with function *hist(a)* that produces quantized representation of column *a* by means of merging *a*'s histograms corresponding to particular packrows into a unified *a*'s histogram over the whole data. We refer to our recent works on summary-based data visualization [3] and machine learning [4] in order to illustrate several scenarios of utilizing *hist* in practice.

Keywords: Big data analytics · Data granulation · Data quantization

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Contents

Subjective Analysis of Price Herd Using Dominance Rough Set Induction: Case Study of Solar Companies	1
<i>Hamido Fujita and Yu-Chien Ko</i>	
Three-Way Decisions and Three-Way Clustering.	13
<i>Hong Yu</i>	
Some Foundational Aspects of Rough Sets Rendering Its Wide Applicability	29
<i>Andrzej Skowron and Soma Dutta</i>	
What's in a Relation? Logical Structures of Modes of Granulation	46
<i>Piero Pagliani</i>	
Multi-granularity Attribute Reduction	61
<i>Shaochen Liang, Keyu Liu, Xiangjian Chen, Pingxin Wang, and Xibei Yang</i>	
Tolerance Methods in Graph Clustering: Application to Community Detection in Social Networks	73
<i>Vahid Kardan and Sheela Ramanna</i>	
Similarity Based Rough Sets with Annotation.	88
<i>Dávid Nagy, Tamás Mihálydeák, and László Aszalós</i>	
Multidimensional Data Analysis for Evaluating the Natural and Anthropogenic Safety (in the Case of Krasnoyarsk Territory)	101
<i>Tatiana Penkova</i>	
A Metaphor for Rough Set Theory: Modular Arithmetic	110
<i>Marcin Wolski and Anna Gomolińska</i>	
A Method for Boundary Processing in Three-Way Decisions Based on Hierarchical Feature Representation.	123
<i>Jie Chen, Yang Xu, Shu Zhao, Yuanting Yan, Yanping Zhang, Weiwei Li, Qianqian Wang, and Xiangyang Wang</i>	
Covering-Based Optimistic-Pessimistic Multigranulation Decision-Theoretic Rough Sets	137
<i>Caihui Liu, Jin Qian, Nan Zhang, and Meizhi Wang</i>	

Studies on CART's Performance in Rule Induction and Comparisons by STRIM: In a Simulation Model for Data Generation and Verification of Induced Rules.	148
<i>Yuichi Kato, Shoya Kawaguchi, and Tetsuro Saeki</i>	
Rseslib 3: Open Source Library of Rough Set and Machine Learning Methods.	162
<i>Arkadiusz Wojna and Rafał Latkowski</i>	
Composite Sequential Three-Way Decisions.	177
<i>Xin Yang, Ning Wang, Tianrui Li, Dun Liu, and Chuan Luo</i>	
NDER Attribute Reduction via an Ensemble Approach	187
<i>Huixiang Wen, Appiahmantey Eric, Xiangjian Chen, Keyu Liu, and Pingxin Wang</i>	
Considerations on Rule Induction Methods by the Conventional Rough Set Theory from a View of STRIM.	202
<i>Tetsuro Saeki, Jiwei Fei, and Yuichi Kato</i>	
Multi-label Online Streaming Feature Selection Based on Spectral Granulation and Mutual Information	215
<i>Huaming Wang, Dongming Yu, Yuan Li, Zhixing Li, and Guoyin Wang</i>	
Bipolar Queries with Dialogue: Rough Set Semantics	229
<i>Soma Dutta and Andrzej Skowron</i>	
Approximation by Filter Functions	243
<i>Ivo Düntsch, Günther Gediga, and Hui Wang</i>	
A Test Cost Sensitive Heuristic Attribute Reduction Algorithm for Partially Labeled Data	257
<i>Shengdan Hu, Duoqian Miao, Zhifei Zhang, Sheng Luo, Yuanjian Zhang, and Guirong Hu</i>	
Logic on Similarity Based Rough Sets.	270
<i>Tamás Mihálydeák</i>	
Attribute Reduction Algorithms for Relation Systems on Two Universal Sets.	284
<i>Zheng Hua, Qianchen Li, and Guilong Liu</i>	
Toward Optimization of Reasoning Using Generalized Fuzzy Petri Nets	294
<i>Zbigniew Suraj</i>	
Sequent Calculi for Varieties of Topological Quasi-Boolean Algebras	309
<i>Minghui Ma, Mihir Kumar Chakraborty, and Zhe Lin</i>	

Rule Induction Based on Indiscernible Classes from Rough Sets in Information Tables with Continuous Values	323
<i>Michinori Nakata, Hiroshi Sakai, and Keitarou Hara</i>	
Contextual Probability Estimation from Data Samples – A Generalisation . . .	337
<i>Hui Wang and Bowen Wang</i>	
Application of Greedy Heuristics for Feature Characterisation and Selection: A Case Study in Stylometric Domain	350
<i>Urszula Stańczyk, Beata Zielosko, and Krzysztof Żabiński</i>	
An Optimization View on Intuitionistic Fuzzy Three-Way Decisions	363
<i>Jiubing Liu, Xianzhong Zhou, Huaxiong Li, Bing Huang, Libo Zhang, and Xiuyi Jia</i>	
External Indices for Rough Clustering	378
<i>Matteo Re Depaolini, Davide Ciucci, Silvia Calejari, and Matteo Dominoni</i>	
Application of the Pairwise Comparison Matrices into a Dispersed Decision-Making System With Pawlak's Conflict Model	392
<i>Małgorzata Przybyła-Kasperek</i>	
Exploring GTRS Based Recommender Systems with Users of Different Rating Patterns	405
<i>Bingyu Li and JingTao Yao</i>	
Boundary Region Reduction for Relation Systems.	418
<i>Guilong Liu and Jie Liu</i>	
A Method to Determine the Number of Clusters Based on Multi-validity Index.	427
<i>Ning Sun and Hong Yu</i>	
Algebras from Semiconcepts in Rough Set Theory	440
<i>Prosenjit Howlader and Mohua Banerjee</i>	
Introducing Dynamic Structures of Rough Sets. The Case of Text Processing: Anaphoric Co-reference in Texts in Natural Language	455
<i>Wojciech Budzisz and Lech T. Polkowski</i>	
Reduct Calculation and Discretization of Numeric Attributes in Entity Attribute Value Model	464
<i>Wojciech Świeboda and Nguyen Sinh Hoa</i>	
Medical Diagnosis from Images with Intuitionistic Fuzzy Distance Measures	479
<i>Roan Thi Ngan, Bui Cong Cuong, Tran Manh Tuan, and Le Hoang Son</i>	

Rough Set Approach to Sufficient Statistics	491
<i>Huynh Bao Tuyen, Ta Thi Thu Phuong, and Dang Phuoc Huy</i>	
A Formal Study of a Generalized Rough Set Model Based on Relative Approximations	502
<i>Md. Aquil Khan and Vineeta Singh Patel</i>	
Decidability in Pre-rough Algebras: Extended Abstract	511
<i>Zhe Lin, Mihir Kumar Chakraborty, and Minghui Ma</i>	
A Conflict Analysis Model Based on Three-Way Decisions	522
<i>Yan Fan, Jianjun Qi, and Ling Wei</i>	
Tolerance Relations and Rough Approximations in Incomplete Contexts	533
<i>Tong-Jun Li, Wei-Zhi Wu, and Xiao-Ping Yang</i>	
On Granular Rough Computing: Epsilon Homogenous Granulation	546
<i>Krzysztof Ropiak and Piotr Artiemjew</i>	
Fuzzy Bisimulations in Fuzzy Description Logics Under the Gödel Semantics	559
<i>Quang-Thuy Ha, Linh Anh Nguyen, Thi Hong Khanh Nguyen, and Thanh-Luong Tran</i>	
An Efficient Method for Mining Clickstream Patterns	572
<i>Bang V. Bui, Bay Vo, Huy M. Huynh, Tu-Anh Nguyen-Hoang, and Bao Huynh</i>	
Transformation Semigroups for Rough Sets	584
<i>Anuj Kumar More and Mohua Banerjee</i>	
A Sequential Three-Way Approach to Constructing a Co-association Matrix in Consensus Clustering	599
<i>Mengjun Hu, Xiaofei Deng, and Yiyu Yao</i>	
Fuzzy Partition Distance Based Attribute Reduction in Decision Tables	614
<i>Van Thien Nguyen, Long Giang Nguyen, and Nhu Son Nguyen</i>	
Dynamic and Discernibility Characteristics of Different Attribute Reduction Criteria	628
<i>Dominik Ślęzak and Soma Dutta</i>	
A New Trace Clustering Algorithm Based on Context in Process Mining. . . .	644
<i>Hong-Nhung Bui, Tri-Thanh Nguyen, Thi-Cham Nguyen, and Quang-Thuy Ha</i>	
Author Index	659