Looking into the Future of Creativity and Decision Support Systems

Proceedings of the 8th International Conference on

Knowledge, Information and Creativity Support Systems

Kraków, Poland
November 7-9, 2013

Andrzej M.J. Skulimowski
(Editor)

PROGRESS & BUSINESS PUBLISHERS

Looking into the Future of Creativity and Decision Support Systems

Proceedings of the 8th International Conference on Knowledge, Information and Creativity Support Systems Kraków, Poland, November 7-9, 2013

Editor: Andrzej M.J. Skulimowski

Progress & Business Publishers
Kraków 2015

Editor: Andrzej M.J. Skulimowski

National Library of Poland Cataloging-in-Publication Data

CIP – Biblioteka Narodowa
Looking into the Future of Creativity and Decision Support Systems
Proceedings of the 8th International Conference on Knowledge, Information and Creativity Support Systems / ed. by Andrzej M.J. Skulimowski

ISBN: 978-83-939344-1-6 (print)
ISBN: 978-83-912831-8-9 (CD)

Book series: Advances in Decision Sciences and Futures Studies, Vol. 2

Typesetting: *Camera-ready by authors*
Technical Editor: *Witold Majdak*
Cover Design: *Alicja Madura*

Progress & Business Publishers
is the publication department
of the Progress & Business Foundation
ul. Juliusza Lea 12B
PL-30048 Kraków, Poland
e-mail: publishers@pbf.pl
http://www.pbf.pl

The Eighth International Conference on Knowledge, Information and Creativity Support Systems

Kraków-Wieliczka, Poland
November 7-9, 2013

http://www.kicss2013.ipbf.eu

Conference Organizers

Progress and Business Foundation
Kraków, Poland

International Center for Decision Science
and Forecasting

In cooperation with

Supported by

Ministry of Science and Higher Education
Republic of Poland

Contract No.: 778/P-DUN/2015

Under the auspices of

Małopolska KRAKÓW Region

Honorary Patron: Marek Sowa
The Marshal of the
Małopolska Voivodship

PARP

Polish Agency
for Enterprise Development

Municipality
of Wieliczka

A message from the Vice President of JAIST

本国際会議KICSS AGH大学とP＆B財団からアンドリューM. Skulimowski
教授と小生が立した国際会議で2006年から毎年1回、世界各地で開催している。最初は
創造性支援システムの研究開発をしている研究者が中心にスタートしたが、
今や知識情報を駆使して、人間の知的活動を支援するシステムを研究開発してい
る研究者が国際的に集まり、研究発表および研究交流する場に発展している。
開催地もアユタヤ(タイ）、能美市（日本）、ハノイ(ベトナム）、ソウル(韓国）、チェンマイ（タイ）
、北京（中国）、メルボルン（オーストラリア）と
太平洋岸を変遷した。今年は太平洋を離れ、ヨーロッパの古都クラコフ(ポーランド）
で開催されるのは、創立者として望外の喜びである。KICSS2013では
研究発表を楽しみ、大いに情報交換してこの分野の研究が盛り上がることを
期待したい。

Creativity enters into every aspect of life. Facing the ever-changing and full-of-conflicts world, creative thinking, innovative ideas and implementations are openly needed. Supporting creativity is natural and becoming one of most challenging areas in the 21st century. Research on creativity support systems and its relevant fields is emerging. The conference of KICSS aims to facilitate technology and knowledge exchange between international researchers/scholars in the field of knowledge science, information science, system science and creativity support systems. KICSS started in Ayutthaya (2006) and successfully was held in Nomi (2007), Hanoi (2008), Seoul (2009), Chang Mai (2010), Beijing (2011), and Melbourne (2012). It is my pleasure that KICSS2013 is held in Europe, because Krakow is the most beautiful ancient city in Poland.

Prof. Susumu KUNIFUJI (JAIST)

TABLE OF CONTENTS

Preface: Looking into the Future of Creativity and Decision Support Systems

Andrzej M.J. Skulimowski[1,2]

[1] Decision Sciences Laboratory, Chair of Automatic Control and Biomedical Engineering, AGH University of Science and Technology, Kraków, Poland
[2] International Centre for Decision Sciences and Forecasting, Progress and Business Foundation, Kraków, Poland
ams@agh.edu.pl

Abstract. The scope of the 8th International Conference on Knowledge, Information and Creativity Support Systems (KICSS'2013) and basic characteristics of submitted papers are presented in the context of the historical development of this conference series. General remarks and acknowledgements are included as well.

After seven highly successful interdisciplinary conferences organized in East Asia and Australia, the 8th International Conference on Knowledge, Information and Creativity Support Systems (KICSS'2013) was organized for the first time in Europe - in Kraków and Wieliczka, Poland. The previous conferences in this series were held in Ayutthaya, Thailand (2006), Ishikawa, Japan (2007), Hanoi, Vietnam (2008), Seoul, Korea (2009), Chiang Mai, Thailand (2010), Beijing, China (2011) and Melbourne, Australia (2012). The proceedings of KICSS conferences have been published a.o. by Springer in the LNCS/LNAI series, IEEE CPS and JAIST Press [1-3,5]. KICSS conferences provide an international forum for researchers as well as IT practitioners to share new ideas and original research results. New research and development areas for knowledge, decision and creativity sciences are also determined and practical development experiences in all the areas mentioned above are shared.

Following the tradition of previous conferences on Knowledge, Information and Creativity Support Systems, KICSS'2013 covers the most relevant aspects of knowledge management, knowledge engineering, decision support systems, intelligent information systems and creativity in an information technology context. The conference specifically covers the cognitive and collaborative aspects of creativity. The focus theme of KICSS'2013 was "*Looking into the Future of Creativity and Decision Support Systems*". As a result, the list of conference topics included for the first time future-oriented fields of research, such as anticipatory networks and systems, foresight support systems, relevant newly-emerging applications such as autonomous creative systems. Also included were areas of future research such as general creativity. In addition, several papers presented the results of the recent foresight project SCETIST [4] concerning the future trends and scenarios of selected artificial intelligence and information society technologies until 2025. Their topics included the development of decision and creativity support systems.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 11-13

Each paper submitted to the conference was peer reviewed by experts in knowledge sciences -- 2 or 3 experts for short and demo papers, and 3 or 4 experts for regular papers. From over 100 submitted papers, 60 papers were accepted for presentation. 40 of these were full papers, while 20 were short or poster papers. The submissions came from a total of 20 countries from 4 continents, including Belgium, Botswana, China, Czech Republic, France, Germany, Greece, India, Italy, Japan, Korea, Malaysia, Poland, Portugal, Russia, Spain, Thailand, Tunisia, UK and USA. The truly global nature of the conference was also evident in the composition of the International Program Committee, which comprised 45 high-rank experts from 18 countries.

The papers in this volume are - with one exception - listed alphabetically according to the author names. They report original, unpublished research results on theoretical foundations, IT implementations of decision support and expert systems, creativity support systems as well as case studies of successful applications of these ideas in various fields. The typesetting was performed using the electronic camera-ready version of the papers submitted by the authors. In addition to the accepted papers, this volume includes two invited lectures presented by Professor Susumu Kunifuji from the Japan Institute of Advanced Science and Technology, Ishikawa, Japan, and Professor Thomas Köhler from the Technical University of Dresden, Germany.

We are grateful to the Program Committee members and external reviewers for their great work providing expert comments and assessments during the review and paper selection process of KICSS 2013. We express our thanks to all the invited speakers, contributing authors and participants of KICSS'2013 who jointly contributed to the scientific quality of the conference.

Besides the scientific program, Kraków (Cracow), where the main conference venue was located, offers a variety of tourist attractions. Kraków had been the capital of Poland until 1596 and is still a major cultural, scientific, technological and industrial center. As a special feature of KICSS'2013, on 9th November 2013, the sessions were organized 110m underground in the Wieliczka Salt Mine. The scientific program was combined with a visit of the historical monuments in this 1000 year-old mine, which is a UNESCO world heritage treasure. While visiting the Salt Mine, participants enjoyed the hospitality of the Mayor of the Wieliczka Municipality.

The conference was organized by the International Progress and Business Foundation, Kraków, Poland. The Foundation department responsible for the organization of KICSS'2013 was the International Centre for Decision Sciences and Forecasting (CDSF), whose activities cover the KICSS topics. The Foundation is an international research, consultancy, educational and technology transfer institution founded in 1991 by two principal universities in Kraków, joined by other academic, industrial and governmental institutions. The AGH University of Science and Technology is the second oldest and second largest technical university in Poland, ranked first among the technical universities in the country in areas related to Information Technology. The Jagiellonian University, founded in 1364, is the oldest university in Poland and also the second largest. The other founders include the Danish Technological Institute, the Polish Ministry of Industry and Trade, the Polish Academy of Sciences and other institutions. For over two decades of activity, the Foundation has developed a unique combination of expertise in applied research in artificial intelligence, decision sciences, financial and economic modeling, as well as information technologies with practical aspects of know-how transfer and policy research. The

Foundation performs foresight studies in information technologies and other areas. Real-life problem solving includes roadmapping-based strategic planning for government, finance and industry concerning technological investment, environmental engineering and infrastructural projects.

Acknowledgements.
I would like to express my sincere thanks to all members of the local Organizing Committee, in particular to Dariusz Kluz - the webmaster of the conference website, Alicja Madura - the conference secretary, Dr Witold Majdak – the technical editor of this volume, and to Urszula Markowicz – the publicity assistant. I am also grateful to all those who helped with KICSS'2013 but whose names could not yet be listed at the time of closing this volume.

Finally, it should be mentioned that this conference could not have been organized without the financial support of the Polish Ministry of Science and Higher Education. We appreciate the technical support and the experience shared by the Japan Advanced Institute of Science and Technology (JAIST) and the AGH University of Science and Technology, Kraków. I would like to thank in particular Prof. Susumu Kunifuji, the Vice President of JAIST, for his encouragement and continual support during the organization process. The Polish Artificial Intelligence Society (www.pssi.org.pl) selected KICSS'2013 as its 'annual meeting conference' in 2013. Prof. Janusz Kacprzyk, the Editor of the Springer series "*Advances in Intelligent Systems and Computing*" *(AISC),* offered to publish the post-conference volume containing selected revised and extended papers presented at KICSS'2013.

The organizers greatly appreciate the assistance of additional institutions, including the Japan Creativity Society, P&B Incubator Ltd. and Amsoft Consulting Ltd. - the provider of the innovative Delphi-based collaborative forecasting system. I would like to express my thanks to those mentioned above and all those who were not mentioned, but jointly contributed to the success of KICSS'2013.

Kraków, November 2013

References

1. Kunifuji, S.: Proceedings of The Third International Conference on Knowledge, Information and Creativity Support Systems, Dec. 22-23, 2008, Hanoi, Vietnam, Hanoi National University of Education (2008).
2. Kunifuji, S., Tang, X.J., Theeramunkong, T. (Eds.): Proc. of the 6th International Conference on Knowledge, Information and Creativity Support Systems, Beijing, China, Oct. 22-24, 2011 (KICSS 2011), JAIST Press, Beijing (2011).
3. Lee, V.C.S., Ong K.L. (Eds.): KICSS 2012: seventh international conference on Knowledge, Information and Creativity Support Systems: Melbourne, Victoria, Australia, 8–10 November 2012, IEEE Computer Society. CPS Conference Publishing Services (2012).
4. Skulimowski, A.M.J. (Ed.): "Scenarios and Development Trends of Selected Information Society Technologies until 2025" (SCETIST) - Final Report, Progress & Business Publishers, Kraków, Progress & Business Foundation, http://www.ict.foresight.pl (2013).
5. Theeramunkong, T., Kunifuji, S., Nattee, C., Sornlertlamvanich, V. (Eds.): Knowledge, Information, and Creativity Support Systems: KICSS 2010 Revised Selected Papers, LNAI, Vol. 6746, Springer, Berlin; Heidelberg (2011).

On Potential Usefulness of Inconsistency in Collaborative Knowledge Engineering *

Weronika T. Adrian[1], Grzegorz J. Nalepa[1], Antoni Ligęza[1]

AGH University of Science and Technology
al. Mickiewicza 30, 30-059 Krakow, Poland
{wta,gjn,ligeza}@agh.edu.pl

Abstract. Inconsistency in knowledge bases traditionally was considered undesired. Systematic eradication of it served to ensure high quality of a system. However, in Collaborative Knowledge Engineering ($\mathcal{CKE}$), where distributed, hybrid knowledge bases are developed and maintained collectively, inconsistency appears to be an intrinsic phenomena. In this paper, we analyze inconsistency in $\mathcal{CKE}$ in terms of its origin, level, type and significance. We claim that in some cases inconsistency should be tolerated and show examples where it can be used constructively.

Keywords: Collaborative Knowledge Engineering; inconsistency

1 Introduction

Traditional approach to inconsistency in Knowledge-Based Systems considered it an anomaly [29]. One of the main reasons for that is the "principle of explosion" (ECQ, from Latin: *Ex contradictione sequitur quodlibet* which means "from a contradiction, anything follows"). If anything can be entailed from a set of inconsistent statements, then the inconsistent knowledge base becomes unusable. Therefore, numerous methods and techniques have been developed to suppress inconsistency, either by rejecting contradictions (removing, forgetting etc.) or by searching for a consensus to restore consistency.

With the advent of modern Web-based technologies, there is a growing intensity of collaboration on the Web. Wikipedia-like portals, recommendation systems or community websites are examples of modern knowledge bases. New challenges are posed by distributed knowledge authoring, increased use of mobile devices, dynamic changes of the knowledge, and use of hybrid knowledge representation with mixed levels of formality [7]. Quality of knowledge is often evaluated collectively, by voting and discussion.

It is unpractical to treat such knowledge bases same as centralized homogenous systems, where consistency was an important quality factor. We claim that in Collaborative Knowledge Engineering ($\mathcal{CKE}$), struggling for consistency can be ineffective, and can suppress such desirable phenomena as collaborative synergy and fast development of knowledge. Thus, inconsistency should be accepted and incorporated into reasoning rather than removed or ignored.

* The paper is supported by the AGH UST Grant 15.11.120.363.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 14-25

References

1. Adrian, W.T., Bobek, S., Nalepa, G.J., Kaczor, K., Kluza, K.: How to reason by HeaRT in a semantic knowledge-based wiki. In: Proceedings of the 23rd IEEE International Conference on Tools with Artificial Intelligence, ICTAI 2011. pp. 438–441. Boca Raton, Florida, USA (November 2011), http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6103361&tag=1
2. Adrian, W.T., Ciężkowski, P., Kaczor, K., Ligęza, A., Nalepa, G.J.: Web-based knowledge acquisition and management system supporting collaboration for improving safety in urban environment. In: Dziech, A., Czyżewski, A. (eds.) Multimedia Communications, Services and Security: 5th International Conference, MCSS 2012: Kraków, Poland. May 31-June 1, 2012. Proceedings. Communications in Computer and Information Science, vol. 287, pp. 1–12 (2012), http://link.springer.com/book/10.1007/978-3-642-30721-8/page/1
3. Adrian, W.T., Ligęza, A., Nalepa, G.J.: Inconsistency handling in collaborative knowledge management. In: Ganzha, M., Maciaszek, L.A., Paprzycki, M. (eds.) Proceedings of the Federated Conference on Computer Science and Information Systems – FedCSIS 2013, Krakow, Poland, 8-11 September 2013. IEEE (2013)
4. Alejandro Gomez, S., Ivan Chesnevar, C., Simari, G.R.: Reasoning with inconsistent ontologies through argumentation. Appl. Artif. Intell. 24(1-2), 102–148 (2010)
5. Analyti, A., Antoniou, G., Damásio, C.V., Wagner, G.: Extended rdf as a semantic foundation of rule markup languages. Journal of Artificial Intelligence Research 32(1), 37–94 (2008)
6. Baumeister, J., Nalepa, G.J.: Verification of distributed knowledge in semantic knowledge wikis. In: Lane, H.C., Guesgen, H.W. (eds.) FLAIRS-22: Proceedings of the twenty-second international Florida Artificial Intelligence Research Society conference: 19–21 May 2009, Sanibel Island, Florida, USA. pp. 384–389. FLAIRS, AAAI Press, Menlo Park, California (2009), to be published
7. Baumeister, J., Reutelshoefer, J., Puppe, F.: Engineering intelligent systems on the knowledge formalization continuum. International Journal of Applied Mathematics and Computer Science (AMCS) 21(1) (2011), http://ki.informatik.uni-wuerzburg.de/papers/baumeister/2011/2011-Baumeister-KFC-AMCS.pdf
8. Baumeister, J., Seipel, D.: Anomalies in ontologies with rules. Web Semantics: Science, Services and Agents on the World Wide Web 8(1), 55 – 68 (2010), http://www.sciencedirect.com/science/article/pii/S1570826809000778
9. Beck, H., Eiter, T., Krennwallner, T.: Inconsistency management for traffic regulations: Formalization and complexity results. In: Cerro, L., Herzig, A., Mengin, J. (eds.) Logics in Artificial Intelligence, Lecture Notes in Computer Science, vol. 7519, pp. 80–93. Springer Berlin Heidelberg (2012), http://dx.doi.org/10.1007/978-3-642-33353-8_7
10. Belnap Jr, N.D.: A useful four-valued logic. In: Modern uses of multiple-valued logic, pp. 5–37. Springer (1977)
11. Bertossi, L., Hunter, A., Schaub, T.: Introduction to inconsistency tolerance. In: Bertossi, L., Hunter, A., Schaub, T. (eds.) Inconsistency Tolerance, Lecture Notes in Computer Science, vol. 3300, pp. 1–14. Springer Berlin Heidelberg (2005), http://dx.doi.org/10.1007/978-3-540-30597-2_1
12. Besnard, P., Hunter, A.: Introduction to actual and potential contradictions. In: Besnard, P., Hunter, A. (eds.) Reasoning with Actual and Potential Contradictions, Handbook of Defeasible Reasoning and Uncertainty Management Systems, vol. 2, pp. 1–9. Springer Netherlands (1998), http://dx.doi.org/10.1007/978-94-017-1739-7_1

13. Bienvenu, M., Rosati, R.: New inconsistency-tolerant semantics for robust ontology-based data access. In: Description Logics. pp. 53–64 (2013)
14. Coenen, F., Bench-Capon, T., Boswell, R., Dibie-Barthélemy, J., Eaglestone, B., Gerrits, R., Grégoire, E., Ligęza, A., Laita, L., Owoc, M., Sellini, F., Spreeuwenberg, S., Vanthienen, J., Vermesan, A., Wiratunga, N.: Validation and verification of knowledge-based systems: report on eurovav99. Knowl. Eng. Rev. 15(2), 187–196 (Jun 2000), http://dx.doi.org/10.1017/S0269888900002010
15. Eiter, T., Fink, M., Weinzierl, A.: Preference-based inconsistency assessment in multi-context systems. In: Janhunen, T., Niemelä, I. (eds.) Logics in Artificial Intelligence, Lecture Notes in Computer Science, vol. 6341, pp. 143–155. Springer Berlin Heidelberg (2010), http://dx.doi.org/10.1007/978-3-642-15675-5_14
16. Fang, J., Zhisheng, H.: A new approach of reasoning with inconsistent ontologies. In: CSWS'10 (2010)
17. Gabbay, D., Hunter, A.: Making inconsistency respectable: A logical framework for inconsistency in reasoning, part i – a position paper. In: Jorrand, P., Kelemen, J. (eds.) Fundamentals of Artificial Intelligence Research, Lecture Notes in Computer Science, vol. 535, pp. 19–32. Springer Berlin Heidelberg (1991), http://dx.doi.org/10.1007/3-540-54507-7_3
18. Grant, J.: Classifications for inconsistent theories. Notre Dame Journal of Formal Logic 19(3), 435–444 (1978)
19. Grant, J., Hunter, A.: Measuring inconsistency in knowledgebases. J. Intell. Inf. Syst. 27(2), 159–184 (Sep 2006)
20. Grant, J., Hunter, A.: Measuring consistency gain and information loss in stepwise inconsistency resolution. In: Liu, W. (ed.) Symbolic and Quantitative Approaches to Reasoning with Uncertainty, Lecture Notes in Computer Science, vol. 6717, pp. 362–373. Springer Berlin Heidelberg (2011)
21. Huang, Z., Harmelen, F.: Using semantic distances for reasoning with inconsistent ontologies. In: Proceedings of the 7th International Conference on The Semantic Web. pp. 178–194. ISWC '08, Springer-Verlag, Berlin, Heidelberg (2008)
22. Hunter, A.: How to act on inconsistent news: ignore, resolve, or reject. Data Knowl. Eng. 57(3), 221–239 (2006), http://dx.doi.org/10.1016/j.datak.2005.04.005
23. Hunter, A., Konieczny, S.: Approaches to measuring inconsistent information. In: Bertossi, L., Hunter, A., Schaub, T. (eds.) Inconsistency Tolerance, Lecture Notes in Computer Science, vol. 3300, pp. 191–236. Springer Berlin Heidelberg (2005), http://dx.doi.org/10.1007/978-3-540-30597-2_7
24. Kühnberger, K.U., Geibel, P., Gust, H., Krumnack, U., Ovchinnikova, E., Schwering, A., Wandmacher, T.: Learning from inconsistencies in an integrated cognitive architecture. In: Proceedings of the 2008 conference on Artificial General Intelligence 2008. pp. 212–223. IOS Press, Amsterdam, The Netherlands, The Netherlands (2008), http://dl.acm.org/citation.cfm?id=1566174.1566194
25. Lenzerini, M., Savo, D.F.: Updating inconsistent description logic knowledge bases. In: ECAI. pp. 516–521 (2012)
26. Ligeza, A., Koscielny, J.M.: A new approach to multiple fault diagnosis: A combination of diagnostic matrices, graphs, algebraic and rule-based models. the case of two-layer models. Applied Mathematics and Computer Science 18(4), 465–476 (2008)
27. Ligęza, A., Nalepa, G.J.: Proposal of a formal verification framework for the XTT2 rule bases. In: Tadeusiewicz, R., Ligęza, A., Mitkowski, W., Szymkat, M. (eds.) CMS'09: Computer Methods and Systems: 7th conference, 26–27 November 2009, Kraków, Poland. pp. 105–110. AGH University of Science and Technology, Cracow, Oprogramowanie Naukowo-Techniczne, Kraków (2009)

28. Ligęza, A., Nalepa, G.J., Ligęza, A.: Proposal of a graph-oriented approach to verification of XTT2 rule bases. In: Ligęza, A., Nalepa, G.J. (eds.) International Workshop on Design, Evaluation and Refinement of Intelligent Systems (DERIS2009): November 28, 2009, Kraków, Poland. pp. 52–63. Kraków, Poland (2009)
29. Ligęza, A.: Intelligent data and knowledge analysis and verification; towards a taxonomy of specific problems. In: Vermesan, A., Coenen, F. (eds.) Validation and Verification of Knowledge Based Systems, pp. 313–325. Springer US (1999), http://dx.doi.org/10.1007/978-1-4757-6916-6_21
30. Ligęza, A.: A 3-valued logic for diagnostic applications. In: Yannick Pencolé, Alexander Feldman, A.G. (ed.) Diagnostic REAsoning: Model Analysis and Performance, August, 27th, Montpellier, France (2012), http://dreamap.sciencesconf.org/conference/dreamap/eda_en.pdf
31. Ligęza, A., Nalepa, G.J.: A study of methodological issues in design and development of rule-based systems: proposal of a new approach. Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery 1(2), 117–137 (2011)
32. Ma, Y., Hitzler, P.: Paraconsistent reasoning for OWL 2. In: Polleres, A., Swift, T. (eds.) Web Reasoning and Rule Systems, Lecture Notes in Computer Science, vol. 5837, pp. 197–211. Springer Berlin Heidelberg (2009)
33. Ma, Y., Qi, G., Hitzler, P.: Computing inconsistency measure based on paraconsistent semantics. Journal of Logic and Computation 21(6), 1257–1281 (2011)
34. Nalepa, G.J.: Collective knowledge engineering with semantic wikis. Journal of Universal Computer Science 16(7), 1006–1023 (2010), http://www.jucs.org/jucs_16_7/collective_knowledge_engineering_with
35. Nalepa, G.J., Kluza, K., Ciaputa, U.: Proposal of automation of the collaborative modeling and evaluation of business processes using a semantic wiki. In: Proceedings of the 17th IEEE International Conference on Emerging Technologies and Factory Automation ETFA 2012, Kraków, Poland, 28 September 2012 (2012)
36. Nalepa, G.J., Ligęza, A., Kaczor, K.: Formalization and modeling of rules using the XTT2 method. International Journal on Artificial Intelligence Tools 20(6), 1107–1125 (2011)
37. Newell, A.: The knowledge level. Artificial Intelligence 18(1), 87–127 (1982)
38. Nguyen, N.T.: Advanced Methods for Inconsistent Knowledge Management (Advanced Information and Knowledge Processing). Springer London (2008)
39. Nuseibeh, B., Easterbrook, S., Russo, A.: Making inconsistency respectable in software development. Journal of Systems and Software 58(2), 171–180 (2001)
40. Pniewska, J., Adrian, W.T., Czerwoniec, A.: Prototyping: is it a more creative way for shaping ideas. In: Proceedings of the International Conference on Multimedia, Interaction, Design and Innovation. pp. 18:1–18:8. MIDI '13, ACM, New York, NY, USA (2013), http://doi.acm.org/10.1145/2500342.2500361
41. Priest, G., Tanaka, K., Weber, Z.: Paraconsistent logic. In: Zalta, E.N. (ed.) The Stanford Encyclopedia of Philosophy. Summer 2013 edn. (2013)
42. Qi, G., Wang, Y., Haase, P., Hitzler, P.: A forgetting-based approach for reasoning with inconsistent distributed ontologies. Institute AIFB, Institute AIFB, University of Karlsruhe, Germany (2008)
43. Rodriguez, A.: Inconsistency issues in spatial databases. In: Bertossi, L., Hunter, A., Schaub, T. (eds.) Inconsistency Tolerance, Lecture Notes in Computer Science, vol. 3300, pp. 237–269. Springer Berlin Heidelberg (2005), http://dx.doi.org/10.1007/978-3-540-30597-2_8
44. Schlobach, S., Cornet, R.: Non-standard reasoning services for the debugging of description logic terminologies. In: International Joint Conference on Artificial Intelligence. vol. 18, pp. 355–362. LAWRENCE ERLBAUM ASSOCIATES LTD (2003)

Knowledge Extraction from the Behaviour of Players in a Web Browser Game

João Alves[1], José Neves[1], Sascha Lange[2], and Martin Riedmiller[3]

[1] University of Minho, Department of Informatics,
Braga, Portugal
pg20688@alunos.uminho.pt, jneves@di.uminho.pt
[2] 5DLab,
Freiburg, Germany
sascha@5dlab.com
[3] University of Freiburg, Department of Computer Science,
Freiburg, Germany
riedmiller@informatik.uni-freiburg.de

Abstract. Analysis of player behaviour is a technique with growing popularity in the traditional computer games segment and has been proven to aid the developers creating better games. There is now interest in trying to replicate this attainment in a less conventional genre of games, normally called browser games. Browser games are computer games that have as defining characteristic the fact that they are played directly on the web browser. Due to the increased ease of internet access and the growth of the smart phone market, this game genre has a promising future. One of the advantages of browser games in the area of game mining is that player behaviour is relatively easy to record. In this paper we describe a study where we aim to extract knowledge from the behaviour of players in a browser game, during a short period of time.

Key words: Knowledge Extraction, Data Mining, Machine Learning, Browser Games, MMOG.

1 Introduction

Browser games are computer games that have the unique characteristic of being played directly on the web browser, without the need of additional software fittings. Typically games in this genre offer a multiplayer environment where users can interact with each other. Attending to the way this genre works, the current game status of the players needs to be stored by the game provider. This fact makes it easy to collect information about the players, since companies already need to store it in order for their games to work.

There is an increasing awareness in the game developers community about browser games with the rise of smart phones with web access [2] and the growing popularity of social platforms [11].

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 26-37

we should note that to identify complex behaviour patterns it is necessary to use longer time spans.

References

1. Anagnostou, K.; Maragoudakis, M., "Data Mining for Player Modeling in Videogames", 2009 13th Panhellenic Conference on Informatics, vol.0, pp.30-34, 2009
2. Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 20102015 (1 February 2011) by Cisco Systems Inc.
3. Cohen, W.W., "Fast Effective Rule Induction", Proceedings of the Twelfth International Conference on Machine Learning, vol.3, pp.115-123, 1995
4. Drachen, A.; Sifa, R.; Bauckhage, C.; Thurau, C., "Guns, swords and data: Clustering of player behavior in computer games in the wild", Computational Intelligence and Games (CIG), 2012 IEEE Conference on, pp.163,170, 11-14 Sept. 2012
5. Drachen, Anders; Thurau, Christian; Togelius, Julian; Yannakakis, GeorgiosN.; Bauckhage, Christian, "Game Analytics", "Game Data Mining", Springer London, pp.205-253, 2013
6. Mellon, L., "Applying metrics driven development to MMO costs and risks", Versant Corporation, 2009
7. Fields, T.; Cotton, B., "Social game design: Monetization methods and mechanics", Waltham: Morgan Kauffman Publishers, 2011
8. Fields, T. V., "Game Analytics", "Game Industry Metrics Terminology and Analytics Case Study", Springer London, pp.53-71, 2013
9. Langley, P.; Simon, H.A., "Applications of machine learning and rule induction", Communications of the ACM, vol.38, pp.54-64, 1995.
10. Kawale, J.; Pal, A.; Srivastava, J., "Churn Prediction in MMORPGs: A Social Influence Based Approach", 2009 International Conference on Computational Science and Engineering, vol.4, pp.423-428, 2009
11. Kirman, B.; Lawson, Shaun; Linehan, C., "Gaming On and Off the Social Graph: The Social Structure of Facebook Games" Computational Science and Engineering, 2009. CSE '09. International Conference on , vol. 4, pp.627,632, 29-31 Aug. 2009
12. Klimmt, C.; Schmid, H.; Orthmann, J., "Exploring the enjoyment of playing browser games", Cyberpsychology and Behavior, vol.12, pp.231-234, 2009.
13. Mahlmann, T.; Drachen, A.; Togelius, J.; Canossa, A.; Yannakakis, G.N., "Predicting player behavior in Tomb Raider: Underworld," Computational Intelligence and Games (CIG), 2010 IEEE Symposium on, pp.178,185, 18-21 Aug. 2010
14. Ross, Q., "C4.5: Programs for Machine Learning", Morgan Kaufmann Publishers, San Mateo, California, 1993
15. Shim, K.J.S.K.J., Srivastava, J., "Sequence Alignment Based Analysis of Player Behavior in Massively Multiplayer Online Role-Playing Games (MMORPGs)", Data Mining Workshops ICDMW 2010 IEEE International Conference, 997-1004, 2010
16. Swift, S.; Kok, J.; Liu, X., "Learning short multivariate time series models through evolutionary and sparse matrix computation", Natural Computing, vol.5, pp.387-426, 2009
17. Vanhatupa, J.-M., "Business model of long-term browser-based games - Income without game packages". Next Generation Web Services Practices (NWeSP), 2011 7th International Conference on , pp.369,372, 19-21 Oct. 2011
18. Weber, B.G.; John, M.; Mateas, M., "Modeling Player Retention in Madden NFL 11", Foundations, 1701-1706, 2011

Communities of Practice for Developers: HelpMe tool

D. Assimakopoulos[*#], M. Tzagarakis[#^], J. Garofalakis[*#]
* University of Patras, Computer Engineering and Informatics Department
# CTI, Computer Technology Institute and Press "Diophantus"
^ University of Patras, Department of Economics
Research Academic Computer Technology Institute, N. Kazantzaki, University of Patras, 26500 Rion, Greece
{asimakop@ceid.upatras.gr, tzagara@upatras.gr, garofala@cti.gr}

Abstract.
The term Web 2.0 focuses on: user, software development and content, which results from many users that share experiences and interests. Due to the fact that many people gather on web sites looking for a solution to their problem, communities of practice (CoPs) were developed. CoPs have become important places for people who seek and share experience. In CoPs area, Argumentative Collaboration is developing between users, so that users can help each other. This paper refers to CoPs and especially to the field that refers to computer programmers. We introduce HelpMe tool that receives questions about a subject that is tagged by the init (or start) user. The start user of a query process is the user that brings the initial question to the community. HelpMe tool automatically selects a group of people according to rules and metrics, in order to supply feedback to the community group who deals with the specific subject (according to label tagging). We introduce two new metrics ULQI (user label query importance) and ULCI (user label communication importance) that are responsible for selecting the appropriate group of people in the community and computing the reputation scores based on the received ratings. HelpMe tool visualizes conversations through graphs, text clouds and statistics.

Keywords: Collaboration, Web2.0, Communities of Practice (CoPs), argumentative collaboration, social media, recommender systems, expertise finding, forum, help, seeking, tools in CoPs

1 Introduction

1.1 Communities of Practice (CoPs)

Social media, wikis, blogs, forums are characteristic applications of web2.0, where interaction instructions such as search, tag, ranking, links and authoring enable users to refresh and modify articles. Web2.0 focuses on user actions, on software implementation, on content that is contribution result of many users. That is why the need of communities of practice, a gathering place of people with common interests, is created. CoPs have become important places for people that seek and

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 38-49

4 References

[1] Ackerman, M.S. and McDonald, D.W. Answer Garden 2:merging organizational memory with collaborative help. In *Proceedings of CSCW '96*, Boston, MA, 1996, ACM Press, 97-105

[2] Ackerman, M.S., Wulf, V. and Pipek, V. (eds.). *Sharing Expertise: Beyond Knowledge Management*. MIT Press, 2002.

[3] Atkinson, K., Bench-Capon, T. and McBurney, P. (2006): PARMENIDES: Facilitating deliberation in democracies. In: Artificial Intelligence and Law, 14 (4), pp. 261-275.

[4] Bielenberg, K. and Zacher, M., Groups in Social Software: Utilizing Tagging to Integrate Individual Contexts for Social Navigation, Masters Thesis submitted to the Program of Digital Media, Universität Bremen (2006)

[5] Foner, L.N. Yenta: a multi-agent, referral-based matchmaking system. In *Proceedings of Agents '97*, ACM Press, Marina del Rey, CA, 1997, 301-307

[6] Francesco Ricci and Lior Rokach and Bracha Shapira, Introduction to Recommender Systems Handbook

[7] Golder, S. and Huberman, B.A. (2006). Usage Patterns of Collaborative Tagging Systems. *Journal of Information Science*, 32(2). 198-208.

[8] Jun Zhang, Mark S. Ackerman, Lada Adamic, Expertise Networks in Online Communities: Structure and Algorithms

[9] Kamel Aouiche, Daniel Lemire, Robert Godin, Collaborative OLAP with Tag Clouds: Web 2.0 OLAP Formalism and Experimental Evaluation, WEBIST 2008.

[10] Kautz, H., Selman, B. and Shah, M. Referral Web:combining social networks and collaborative filtering. *Commun. ACM*, *40* (3). 63-65

[11] Krulwich, B. and Burkey, C., ContactFinder agent:answering bulletin board questions with referrals. In *the 13th National Conference on Artificial Intelligence*, Portland, OR,1996, 10-15

[12] Simon BUCKINGHAM SHUM. Cohere: Towards Web 2.0 Argumentation. Knowledge Media Institute, The Open University, UK.

[13] Streeter, L. and Lochbaum, K., Who Knows: A System Based on Automatic Representation of Semantic Structure.In *Proceedings of RIAO*, 1988, 380-388

[14] Tudor Groza, Siegfried Handschuh, John G. Breslin. Adding Provenance and Evolution Information to Modularized Argumentation Models

[15] Tzagarakis Manolis, Karousos Nikos, Gkotsis Giorgos, Kallistros Vasilis, Christodoulou Spyros, Mettouris Christos, Kyriakou Panagiotis, Nousia Dora. From 'Collecting' to 'Deciding': Facilitating the Emergence of Decisions in ArgumentativeCollaboration. Research Academic Computer Technology Institute, N. Kazantzaki, University of Patras, 26500 Rion, Greece.

[16]Wikipedia article. Stack Overflow. http://en.wikipedia.org/wiki/Stack_Overflow

[17] Wikipedia article . Reddit. http://en.wikipedia.org/wiki/Reddit

Learners' attitudes toward knowledge sharing in the inter-cultural and high-contextual cooperative learning

Pimnapa Atsawintarangkun, Takaya Yuizono

Japan Advanced Institute of Science and Technology
1-1 Asahidai Nomi, Ishikawa 923-1211, Japan
pimnapa.a@jaist.ac.jp, yuizono@jaist.ac.jp

Abstract. In this paper, we investigated how the cultural differences affect to a cooperative learning based on Jigsaw technique. The experiment measured attitudes of learners from Thai, Japan and China who have different cultures but share the similar style of high-context communication and showed a comparison between learners' feelings in the intra-cultural learning and the inter-cultural learning. The results revealed that the cultural differences and the style of high-context communication caused learners facing more difficult to share their own knowledge in the inter-cultural group than that in the intra-cultural group. Though a quiz score in the experiment showed a fair learning outcome, learners reported a low level of achievement feeling to share knowledge in the inter-cultural group. This work also analyzed the effects of cultural background and cultural dimensions on learning outcome. The results showed that cultural background can enhance inter-cultural competences in cooperative learning. Besides the attitudes of high difficulty and low achievement, the differences in culture and the high-context style also impacted on three feelings including annoyance, interest and understanding. Learners felt more annoyed but less understandable when learning with partners from different cultures. Nevertheless, the results revealed that learners showed more interest in inter-cultural cooperative learning.

Keywords: Inter-cultural learning, Cooperative learning, Jigsaw method, High-context communication

1 Introduction

In the era of globalization, the education system faces a lot of changes. Cooperative learning is an effective educational approach that involves small groups of learners using a variety of learning activities for sharing their own knowledge to complete a task, solve a problem or accomplish a common goal [11]. However, a process to share knowledge in a cooperative learning among people from different countries and cultures may face communication problems such as negative feelings and lead to misunderstandings.

Hall [2] has classified styles of communication based on a key factor "context". It relates to the framework, background and surrounding situations in which communi-

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 50-57

cooperative learning. Moreover, this work analyzed the effect of cultural background and cultural dimensions on learning outcome. The result showed that cultural background can enhance inter-cultural competence in cooperative learning.

For the future directions, we will point out how information technology can reduce a culture gap and can enhance performance of cooperative learning among learners from different cultures. For example, the level of understanding influenced from the difference in languages can be improved by using techniques of Natural Language Processing such as machine translation and speech recognition. Moreover, the shared information space and groupware technology can reduce misinterpretations of the communicated messages in the inter-cultural situations and can make mutual understanding among participants in the knowledge sharing process.

References

1. Aronson, E., Patnoe, S.: The Jigsaw Classroom: Building Cooperation in the Classroom. 2nd Edition, Addison Wesley Longman (1997)
2. Hall, E. T.: Beyond Culture. Doubleday, New York (1976)
3. Hart, S. G., Staveland , L. E.: Development of a multi-dimensional workload rating scale: Results of empirical and theoretical research. In: P. A. Hancock & N. Meshkati (Ed.), Human mental workload, Elsevier, Amsterdam (1988)
4. Hofstede, G., Hofstede, G. J., Minkov, M.: Cultures and Organizations: Software of the Mind. 3rd Edition, McGrae-Hill, USA (2010)
5. Johnson, D., Johnson, R., Holubec, E.: Circles of learning: Cooperation in the classroom. MN: Interaction Book Company. 95-118 (2002)
6. Katz, L.: Negotiating International Business: The Negotiator's Reference Guide to 50 Countries Around the World. 2nd Edition, Booksurge (2007)
7. Kelly, J. R., Barsade, S.: Mood and Emotions in Small Groups and Work Teams. In: Organizational Behavior and Human Decision Processes, Vol.86 , pp.99-130, (2001)
8. Lu, J., Chin, K.L., Yao, J., Xu, J., Xiao, J.: Cross-cultural education: learning methodology and behaviour analysis for Asian students in IT field of Australian universities. In: 12th Australasian Computing Education Conference, pp.117-126 (2010)
9. Nguyen, T. D., Fussell, S. R.: How did you feel during our conversation? Retrospective analysis of intercultural and same-culture Instant Messaging conversations, In: Proceedings of the 2010 ACM Conference on Computer Supported Cooperative Work, pp.117-126.
10. Setlock, L. D., Fussell, S. R.: What's it worth to you? The costs and affordances of CMC tools to Asian and American users, In: Proceedings of the 2010 ACM Conference on Computer Supported Cooperative Work, pp.341-350
11. Slavin, R. E.: Cooperative Learning. Prentice-Hall, New Jersey (1990)
12. The Hofstede Centre, http://geert-hofstede.com/index.php
13. Yuizono, T., Li, W.: Promoting Cultural Learning: Effects of Cultural Knowledge on Text Chats between Japanese and Chinese participants. In: 15th International Conference on Knowledge-Based and Intelligent Information & Engineering Systems. LNAI, pp.167-176. Springer, Heidelberg (2011)

A Logical Foundation For Troubleshooting Agents

Reza Basseda[1], Paul Fodor[1], and Steven Greenspan[2]**

[1] Stony Brook University, Stony Brook, NY, 11794, USA
[2] CA Inc., Islandia, NY, 11749, USA

Abstract. Intelligent software agents interacting with users arise in different applications. One of the applications of such agents, which are called virtual experts, is troubleshooting systems. In this project, we are trying to use different available textual resources to automatically construct a troubleshooting virtual expert. In our solution, we extract the information about the structure of the system from textual document, then generate a conversation with the user in order to identify the problem and recommend appropriate remedies. To illustrate the approach, we have built a knowledge base for a simple use case. A special parser generates troubleshooting conversations that guides the user solve configuration problems.

Keywords: Description Logic, Ontology, Troubleshooting Systems

1 Introduction

Troubleshooting of complex systems is a form of problem solving, often applied to repair failed systems composed of different components and sub-systems. Troubleshooting is a logical, systematic search for the source of problems so that they can be fixed and the system can be made operational again. Troubleshooting techniques are used widely in different complex systems, such as smart phone services and applications. A *troubleshooting and diagnosis system* identifies the malfunction(s) within a *failed system* according to its knowledge about the *original complex system*, and it provides solutions for the potential problems. A *troubleshooting and diagnosis system* runs a troubleshooting process which not only identifies the malfunction(s) within a failed system, but also requires confirmation that the solution restores the failed system to a working state. An efficient and powerful knowledge representation component is usually required to have such troubleshooting and diagnostic process.

Designing such diagnostic systems dates back to 1989. In [4], Martin et al. proposes a diagnostic system based on a simple search of symptoms and causal models. Portinale [7] provides a diagnostic model which is captured within a framework based on the formalism of Petri nets; it shows how the formalization

** The authors would like to thank Prof. Michael Kifer from Stony Brook University and John Kane from CA Technologies for their helpful advises and supports.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 58-68

a picture of complex system structure which helps the diagnosis systems to extract an organized case repository out of unstructured data sources. Our formalism is a Description Logic extension including problem-solution cases. We not only extended Description Logic according to the requirements of diagnosis system, but also limited its semantics to fit in our application. We have completely developed a parser which gets the knowledge base and builds the troubleshooting procedure in an imperative programming language. Using a practical example about smart phone services, we have shown that our formalism can completely express the required knowledge about complex system structure and use it to refine and organize its case base. Our implementation also showed that this knowledge base is expressive enough to automatically build the interactive troubleshooting process.

Although constructing a behavioral model of a complex system needs to have a detail knowledge about how the complex system works, it can be really helpful to use such dynamic behavior representation beside of our structural knowledge about the complex system.

References

1. Baader, F., Sattler, U.: Description logics with aggregates and concrete domains. Inf. Syst. 28(8), 979–1004 (Dec 2003), http://dx.doi.org/10.1016/S0306-4379(03)00003-6
2. Bandini, S., Colombo, E., Frisoni, G., Sartori, F., Svensson, J.: Case-based troubleshooting in the automotive context: The smmart project. In: Proceedings of the 9th European conference on Advances in Case-Based Reasoning. pp. 600–614. ECCBR '08, Springer-Verlag, Berlin, Heidelberg (2008), http://dx.doi.org/10.1007/978-3-540-85502-6_41
3. Basseda, R., Kifer, M., Greenspan, S., Kane, J.P., Fodor, P.I., Zhao, R.: Developing troubleshooting systems using ontologies. In: Proceedings of the 2013 CEWIT conference (2013)
4. Martin, J.D., Redmond, M.: Acquiring knowledge by explaining observed problem solving. SIGART Bull. (108), 77–83 (Apr 1989), http://doi.acm.org/10.1145/63266.63276
5. Nardi, D., Brachman, R.J.: The description logic handbook. chap. An introduction to description logics, pp. 1–40. Cambridge University Press, New York, NY, USA (2003), http://dl.acm.org/citation.cfm?id=885746.885748
6. Nikolaychuk, O.A., Yurin, A.Y.: Computer-aided identification of mechanical system's technical state with the aid of case-based reasoning. Expert Syst. Appl. 34(1), 635–642 (Jan 2008), http://dx.doi.org/10.1016/j.eswa.2006.10.001
7. Portinale, L.: Behavioral petri nets: a model for diagnostic knowledge representation and reasoning. Trans. Sys. Man Cyber. Part B 27(2), 184–195 (Apr 1997), http://dx.doi.org/10.1109/3477.558794
8. Portinale, L., Magro, D., Torasso, P.: Multi-modal diagnosis combining case-based and model-based reasoning: a formal and experimental analysis. Artif. Intell. 158(2), 109–153 (Oct 2004), http://dx.doi.org/10.1016/j.artint.2004.05.005
9. Schmidt-Schaubß, M., Smolka, G.: Attributive concept descriptions with complements. Artif. Intell. 48(1), 1–26 (Feb 1991), http://dx.doi.org/10.1016/0004-3702(91)90078-X

10. Swift, T., Warren, D.S.: The Coherent Description Framework Manual (2012)
11. Swift, T., Warren, D.S.: The XSB System Programmers Manual (2012)
12. Zhang, X., Jiang, Y., Chen, A.: Diagnosing a system with value-based reasoning. In: Proceedings of the 3rd International Conference on Intelligent Computing: Advanced Intelligent Computing Theories and Applications. With Aspects of Artificial Intelligence. pp. 971–981. ICIC '07, Springer-Verlag, Berlin, Heidelberg (2007), http://dx.doi.org/10.1007/978-3-540-74205-0_101

Strategic Planning Optimisation using Tabu Search Algorithm

Wojciech Chmiel, Piotr Kadłuczka, Joanna Kwiecień, Bogusław Filipowicz, and Przemysław Pukocz

Department of Automatics and Biomedical Engineering, AGH University of Science and Technology
{wch,pkad,kwiecien,fil,pukocz}@agh.edu.pl

Abstract. In this paper we introduce a method for optimisation of strategic tasks using an approximation algorithm. We propose the mathematical model and algorithm for solving this problem near optimality. An overall motivation for the development of the proposed algorithm is discussed with detailed efficiency analysis. From the end users' perspective the proposed method has practical application because it can be used in several practical use cases.

Keywords: Discrete Optimisation, Strategic Planning, Artificial Autonomous Decision Systems, Tabu Search

1 Introduction

Scheduling of strategic tasks can be embedded in creative roadmapping processes of NPD type [6] for a multicriteria model of creative NPD problem solving.
Organizational adaptation of a unit to perform tasks is an important aspect of strategic planning. If their way of realization is dependent on the implemented procedures (legislation), they restrict greatly the freedom of design solutions. In the case of complex units, specialized departments are extracted, which are responsible for homogeneous subtasks, often referred to as operations or activities. Considering the sequence of their realization in a such defined structure, we can apply the models of scheduling theory. They provide a wide range of choice of the criterion function, constraints on resources, priorities, defining the ordering relationships between the operations, the critical deadlines, the efficiency of departments/teams. Due to constraints, the tasks may be interruptible or uninterruptible, and their processing may be serial or parallel.
In the presented case a company carries out a strategic plan - a specific set of objectives, consisting of strategic tasks. Departments, having allocated specific resources, are specialized to perform the subtasks.
The realization of the strategic plan assumes that:

- the processing time of subtasks in the company departments is given,
- subtasks can not be interrupted, executed only once,

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 69-74

Table 1. Experiments results.

Instance	TS			TS*					
	C_{max}	$I_{C_{max}}$	$\overline{C_{max}}$	C_{max}	$I_{C_{max}}$	$\overline{C_{max}}$	$\overline{C^{TS}}$	UB	δ^{UB}
ta002 - 20x5	1359	31	1365	1359	77	1361	-0,32%	1359	0,00%
ta006 -20x5	1195	10	1216	1195	57	1202	-1,20%	1195	0,00%
ta009 - 20x5	1230	14	1251	1230	34	1238	-1,06%	1230	0,00%
ta012 - 20x10	1678	14	1698	1660	581	1676	-1,30%	1659	0,06%
ta016 - 20x10	1408	120	1420	1397	415	1405	-1,05%	1397	0,00%
ta017 - 20x10	1492	24	1507	1486	414	1492	-0,95%	1484	0,13%
ta021 - 20x20	2303	25	2323	2296	421	2311	-0,50%	2297	-0,04%
ta025 - 20x20	2311	9	2332	2291	208	2315	-0,74%	2291	0,00%
ta030 - 20x20	2186	18	2218	2183	143	2196	-0,96%	2178	0,23%
ta033 - 50x5	2623	11	2643	2621	11	2633	-0,37%	2621	0,00%
ta036 - 50x5	2829	15	2844	2829	15	2836	-0,28%	2829	0,00%
ta038 - 50x5	2694	18	2706	2683	79	2695	-0,40%	2683	0,00%
ta041 - 50x10	3046	32	3115	3046	510	3071	-1,41%	3025	0,69%
ta044 - 50x10	3079	11	3144	3064	595	3096	-1,50%	3064	0,00%
ta046 - 50x10	3054	21	3106	3021	850	3063	-1,39%	3006	0,50%
ta051 - 50x20	3944	26	3967	3909	2259	3925	-1,06%	3886	0,59%
ta055 - 50x20	3708	35	3766	3663	1290	3720	-1,20%	3635	0,76%
ta057 - 50x20	3797	28	3845	3722	759	3795	-1,29%	3716	0,16%
ta065 - 100x5	5255	21	5263	5250	34	5255	-0,15%	5250	0,00%
ta067 - 100x5	5246	10	5275	5246	10	5270	-0,10%	5246	0,00%
ta069 - 100x5	5448	37	5504	5448	37	5458	-0,18%	5454	-0,11%
ta071 - 100x10	5800	21	5842	5784	401	5806	-0,61%	5770	0,24%
ta074 - 100x10	5838	39	5894	5826	1946	5852	-0,71%	5791	0,60%
ta078 - 100x10	5685	62	5686	5650	62	5663	-0,41%	5623	0,71%
ta081 - 100x20	6362	60	6427	6313	60	6377	-0,77%	6286	0,43%
ta085 - 100x20	6454	60	6552	6443	1541	6469	-1,28%	6377	1,02%
ta089 - 100x20	6396	40	6495	6374	146	6445	-0,77%	6358	1,34%

larly in strategy planning. The implemented intensification mechanism enables us to improve TS algorithm results above 1%, which is comparable with the distance to reference solutions. However, this improvement was obtained through the increase in computational effort. The approach presented in this paper can be further extended to include tree-like scheduling variants using anticipatory networks [7], [8] and general creativity approaches in MCDM [6] [9]. The next challenge for the authors will be the analysis of business data from company workflows to obtain test instances which describe real cases.

References

1. Chmiel, W.: Conditional expected value of objective function in approximation algorithms for pemutational problems. Automatyka 1-2(136), 31–42 (2002)
2. Chmiel, W., Kadłuczka, P.: Hybrid algorithm using long-term memory. Automatyka 3(1), 59–70 (1999)

3. Chmiel, W., Kadłuczka, P.: Conditional expected value of objective function in approximation algorithms for pemutational problems. Automatyka 1-2(9), 47–56 (2005)
4. Filipowicz, B., Chmiel, W., Kadłuczka, P.: Guided search of the solution space in swarm algorithm. Automatyka 13(2), 247–255 (2009)
5. Glover, F.: Tabu search part i. ORSA Journal on Computing 1(3), 190–206 (1989), http://pubsonline.informs.org/doi/abs/10.1287/ijoc.1.3.190
6. Skulimowski, A.M.J.: Freedom of choice and creativity in multicriteria decision making. Knowledge, Information, and Creativity Support Systems, Lecture Notes in Computer Science 6746, 190–203 (2011)
7. Skulimowski, A.M.J.: Hybrid anticipatory networks. Artificial Intelligence and Soft Computing, Lecture Notes in Computer Science 7268, 706–715 (2012)
8. Skulimowski, A.M.J.: Anticipatory network models of multicriteria decision-making processes. International Journal of Systems Science 45(1), 39–59 (2014), http://www.tandfonline.com/doi/abs/10.1080/00207721.2012.670308
9. Skulimowski, A.M.J., Pukocz, P.: Enhancing creativity of strategic decision processes by technological roadmapping and foresight. KICSS 2012 : 7th international conference on Knowledge, Information and Creativity Support Systems. Vincent CS Lee, Kok-Leong Ong; IEEE Computer Society. CPS Conference Publishing Services. pp. 223–230 (2012)
10. Szymlak, B.: Tabu search algorithm for job scheduling. Master of science thesis, supervisor: Wojciech Chmiel PhD, AGH Kraków (2012)
11. Taillard, E.: Benchmarks for basic scheduling problems. European Journal of Operational Research 64(2), 278 – 285 (1993)

Removing redundant features via clustering: preliminary results in mental task separation

Renato Cordeiro de Amorim[1,2] and Boris Mirkin[2]

[1] Department of Computing, Glyndŵr University, Mold Road, Wrexham LL11 2AW, UK.
[2] Department of Computer Science and Information Systems, Birkbeck University of London, Malet Street, London WC1E 7HX
r.amorim@glyndwr.ac.uk, mirkin@dcs.bbk.ac.uk

Abstract. Recent clustering algorithms have been designed to take into account the degree of relevance of each feature, by automatically calculating their weights. However, as the tendency is to evaluate each feature at a time, these algorithms may have difficulties dealing with features containing similar information. Should this information be relevant, these algorithms would set high weights to all such features instead of removing some due to their redundant nature.
In this paper we introduce an unsupervised feature selection method that targets redundant features. Our method clusters similar features together and selects a subset of representative features for each cluster. This selection is based on the maximum information compression index between each feature and its respective cluster centroid.
We empirically validate out method by comparing with it with a popular unsupervised feature selection on three EEG data sets. We find that ours selects features that produce better cluster recovery, without the need for an extra user-defined parameter.

Keywords: Unsupervised feature selection, feature weighting, redundant features, clustering, mental task separation.

1 Introduction

Given a data set Y of n entities over m features $V = \{v_1, v_2, ..., v_m\}$, feature selection aims to reduce the cardinality of V by removing those features that are redundant or have no relevance to the task at hand. There are a number of reasons to motivate such reduction in V. For instance, (i) the amount of time a classification or clustering algorithm takes to process Y tends to be inversely proportional to the data set size and dimension; (ii) it reduces the chances of issues related to overfitting; (iii) it is possible that there will be a general improvement in the accuracy of predictions [23, 13].

Feature weighting is a generalization of feature selection. While the latter either selects or removes a feature from V, the former assigns a weight w in the interval $[0, 1]$ to each feature in V. This weight, w_v, aims to be directly

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 75-84

use this type of data because of its high-dimensionality (5,680 features), and its widely acknowledge high-level of noise. The features selected by iKFS were used by two clustering algorithms that apply feature weighting, WK-Means [3] and iMWK-Means [8]. For comparison we have run similar experiments selecting features with feature selection using feature similarity (FSFS) [23].

Clustering algorithms that perform feature weighting, such as WK-Means and iMWK-Means, have difficulty dealing with redundant features. Given a set of relevant and redundant features these algorithms set similar weights to all, instead of removing some. We have found that pre-processing a data set by reducing the number of redundant features can be very beneficial for such algorithms, particularly when this feature selection takes into account the data set structure - as its the case with iKFS.

Future research will aim to optimise even further the features selected by iKFS and apply this algorithm as a pre-processing step for a feature weighting clustering algorithm such as iMWK-Means in different scenarios.

References

1. G. H. Ball and D. J. Hall. A clustering technique for summarizing multivariate data. *Behavioral Science*, 12(2):153–155, 1967.
2. M. E. Celebi, H. A. Kingravi, and P. A. Vela. A comparative study of efficient initialization methods for the k-means clustering algorithm. *Expert Systems with Applications*, 40(1):200–210, 2013.
3. E. Y. Chan, W. K. Ching, M. K. Ng, and J. Z. Huang. An optimization algorithm for clustering using weighted dissimilarity measures. *Pattern recognition*, 37(5):943–952, 2004.
4. M. M. T. Chiang and B. Mirkin. Intelligent choice of the number of clusters in k-means clustering: an experimental study with different cluster spreads. *Journal of classification*, 27(1):3–40, 2010.
5. S. Chiappa and S. Bengio. Hmm and iohmm modeling of eeg rhythms for asynchronous bci systems. In *European Symposium on Artificial Neural Networks, ESANN*, pages 193–204, 2004.
6. R. C. de Amorim. An empirical evaluation of different initializations on the number of k-means iterations. *Lecture Notes in Computer Science*, 7629:15–26, 2013.
7. R. C. de Amorim and P. Komisarczuk. On initializations for the minkowski weighted k-means. *Lecture Notes in Computer Science*, 7619:45–55, 2012.
8. R. C. de Amorim and B. Mirkin. Minkowski metric, feature weighting and anomalous cluster initializing in k-means clustering. *Pattern Recognition*, 45(3):1061–1075, 2012.
9. R. C. de Amorim, B. Mirkin, and J. Q. Gan. A method for classifying mental tasks in the space of eeg transforms. Technical report, Technical Report BBKS-10-01, Birkbeck University of London, London, 2010.
10. R. C. de Amorim, B. Mirkin, and J. Q. Gan. Anomalous pattern based clustering of mental tasks with subject independent learning–some preliminary results. *Artificial Intelligence Research*, 1(1):46–54, 2012.
11. H. Frigui and O. Nasraoui. Unsupervised learning of prototypes and attribute weights. *Pattern recognition*, 37(3):567–581, 2004.

12. J. Q. Gan. Self-adapting bci based on unsupervised learning. In *3rd International Workshop on Brain-Computer Interfaces*, pages 50–51, 2006.
13. I. Guyon and A. Elisseeff. An introduction to variable and feature selection. *The Journal of Machine Learning Research*, 3:1157–1182, 2003.
14. J. Z. Huang, M. K. Ng, H. Rong, and Z. Li. Automated variable weighting in k-means type clustering. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 27(5):657–668, 2005.
15. J. Z. Huang, J. Xu, M. Ng, and Y. Ye. Weighting method for feature selection in k-means. *Computational Methods of Feature Selection*, pages 193–209, 2008.
16. A. K. Jain. Data clustering: 50 years beyond k-means. *Pattern Recognition Letters*, 31(8):651–666, 2010.
17. J. MacQueen. Some methods for classification and analysis of multivariate observations. In *Proceedings of the fifth Berkeley symposium on mathematical statistics and probability*, volume 1, pages 281–297. California, USA, 1967.
18. R. Maitra, A. D. Peterson, and A. P. Ghosh. A systematic evaluation of different methods for initializing the k-means clustering algorithm. *Transactions on Knowledge and Data Engineering*, pages 522–537, 2010.
19. V. Makarenkov and P. Legendre. Optimal variable weighting for ultrametric and additive trees and k-means partitioning: Methods and software. *Journal of Classification*, 18(2):245–271, 2001.
20. J. Millan and J. Mouriño. Asynchronous bci and local neural classifiers: an overview of the adaptive brain interface project. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, 11(2):159–161, 2003.
21. G. W. Milligan and M. C. Cooper. A study of standardization of variables in cluster analysis. *Journal of Classification*, 5(2):181–204, 1988.
22. B. Mirkin. *Clustering for data mining: a data recovery approach*, volume 3. CRC Press, 2005.
23. P. Mitra, C. A. Murthy, and S. K. Pal. Unsupervised feature selection using feature similarity. *IEEE transactions on pattern analysis and machine intelligence*, 24(3):301–312, 2002.
24. J. M. Pena, J. A. Lozano, and P. Larranaga. An empirical comparison of four initialization methods for the k-means algorithm. *Pattern recognition letters*, 20(10):1027–1040, 1999.
25. M. Steinbach, G. Karypis, and V. Kumar. A comparison of document clustering techniques. In *KDD workshop on text mining*, pages 525–526. Boston, 2000.
26. D. Steinley and M. J. Brusco. Initializing k-means batch clustering: A critical evaluation of several techniques. *Journal of Classification*, 24(1):99–121, 2007.
27. Douglas Steinley. Standardizing variables in k-means clustering. In *Classification, clustering, and data mining applications*, pages 53–60. Springer, 2004.
28. R. Tibshirani, G. Walther, and T. Hastie. Estimating the number of clusters in a data set via the gap statistic. *Journal of the Royal Statistical Society: Series B (Statistical Methodology)*, 63(2):411–423, 2001.
29. R. Xu and D. Wunsch. Survey of clustering algorithms. *IEEE Transactions on Neural Networks*, 16(3):645–678, 2005.

Machine Understanding for Interactive Storytelling

Wim De Mulder, Quynh Do Thi Ngoc, Paul van den Broek, and Marie-Francine Moens

KU Leuven, Department of Computer Science
Celestijnenlaan 200A, 3000 Heverlee, Belgium
University of Leiden, Department of Social Sciences
Wassenaarseweg 52, 2333 AK Leiden, The Netherlands

Abstract. This paper describes our research-in-progress which integrates several domains, in particular natural language processing and the development of virtual immersive environments. Our research aims at "bringing a given text to life" via an immersive environment where the user can freely explore the surroundings and increase his understanding of the given text. We describe some important challenges in achieving this goal and outline our current research results. Our work is practically oriented, aiming at fulfilling some societal needs related to education on which we also report.

Keywords: Natural language processing, machine learning, cognitive psychology, digital immersive environments

1 Introduction and outline of the paper

In this paper we present an artificial intelligence challenge that is truly interdisciplinary, covering such diverse domains as natural language processing (NLP), machine learning and the development of interactive computer simulated environments, computer graphics and cognitive psychology. The challenge is to develop a methodology that bridges the gap between natural language and the formal representations of interactive storytelling. Although the domains of natural language processing and the development of immersive digital environments have both seen rapid progress in recent years, their integration is an untouched research domain. Thus the intriguing question: how to create immersive environments that are driven by texts that are written in natural language, but that are not especially written for this purpose? That is, whereas virtual worlds are developed by first handcrafting a knowledge base, the ultimate challenge we present is to consistently transform *arbitrary* texts, not only in terms of content but also in terms of genre (scientific articles, blogs, etc.), to virtual worlds in such a way that these worlds become the main source of information.
The challenge we present here regards a project called MUSE (an acronym for Machine Understanding of interactive StorytElling), which recently started at our university, in collaboration with several universities worldwide, representing

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 85-92

Acknowledgments

The presented research was supported by the TERENCE (EU FP7-257410) and MUSE (EU FP7-296703) projects.

References

1. Bethard, S., Martin, J.H.: CU-TMP: Temporal relation classification using syntactic and semantic features. In: 4th International Workshop on Semantic Evaluations, pp. 129–132. ACL (2007).
2. Bus, A.G., Neuman S.B.: Multimedia and Literacy Development: Improving Achievement for Young Learners. Taylor and Francis, New York (2009).
3. Gabrilovich, E., Markovitch, S.: Wikipedia-based semantic interpretation for natural language processing. Journal of Artificial Intelligence Research 34, 443–498 (2009).
4. Goutte, C., Gaussier, E.: A probabilistic interpretation of precision, recall and F-score, with implication for evaluation. In: 27th European Conference on Information Retrieval, pp. 345-359 (2005).
5. Kolomiyets, O., Bethard, S., Moens, M.-F.: Model-portability experiments for textual temporal analysis. In: 49th Annual Meeting of the Association for Computational Linguistics: HLT, pp. 271–276. Association for Computational Linguistics, Stroudsburg, PA, USA (2011).
6. Kolomiyets, O., Bethard, S., Moens, M.-F.: Extracting narrative timelines as temporal dependency structures. In: 50th Annual Meeting of the Association for Computational Linguistics, pp. 87–98. ACL (2012).
7. Kolomiyets, O., Moens, M.F.: MotionML: A shallow approach for annotating motions in text. In: Proceedings of Corpus Linguistics. (2013a).
8. Kolomiyets, O., Moens, M.-F. : Towards animated visualization of actors and actions in a learning environment. In: Proc. 3rd International Workshop on Evidence Based and User-centred Technology Enhanced Learning (2013b).
9. Kordjamshidi, P., van Otterlo, M., Moens, M.-F.: Spatial role labeling: Towards extraction of spatial relations from natural language. ACM Transactions on Speech and Language Processing, 8 (3), article 4 (2011).
10. Miller, G.A.: WordNet: a lexical database for English. Communications of the ACM 38, pp. 39-41 (1995).
11. Miller, S.A., Schubert, L.K.: Time revisited. Computational Intelligence 6(2), pp. 108-118 (1990).
12. Lee, H., Peirsman, Y., Chang, A., Chambers, N.: Stanfords Multi-pass sieve coreference resolution system at the CoNLL-2011 shared task. In: CONLL Shared Task 11 Proc. 15th Conference on Computational Natural Language Learning, pp. 28–34 (2011).
13. Pustejovsky, J., Moszkowicz, J.L.: The qualitative spatial dynamics of motion in language. Spatial Cognition & Computation 11(1), pp. 15-44 (2011).

On the Application of Fourier Series Density Estimation for Image Classification Based on Feature Description

Piotr Duda, Maciej Jaworski, Lena Pietruczuk, Rafał Scherer, Marcin Korytkowski, Marcin Gabryel

Institute of Computational Intelligence, Częstochowa University of Technology
al. Armii Krajowej 36, 42-200 Częstochowa, Poland (http://iisi.pcz.pl)
{piotr.duda,maciej.jaworski,lena.pietruczuk,rafal.scherer,marcin.korytkowski,marcin.gabryel}@iisi.pcz.pl

Abstract. This paper presents an image classification algorithm called Density Based Classifier (DBS). The proposed method puts together the image representation based on keypoints and the estimation of the probability density of descriptors with the application of orthonormal series. For each class of images a separate classifier is constructed. The presented procedure ensures that different descriptors affect the final decision in a different degree. The trained classifier determines whether the query image is assigned to the class or not. The obtained experimental results show that proposed method provides good results. The algorithm can be applied to many tasks in the field of image processing.

Keywords: image classification, image processing, density estimation, orthonormal series

1 Introduction and Motivation

Image processing is a very fast expanding field of knowledge, however there is still a lot of open problems to be solved [5]. Image classification seems to be one of the most important aspects, which still needs to be improved and other approaches should be searched. The most important steps in every image classification system are:

- selection of training samples (which are denoted by T)
- image description
- selection of suitable classification approaches
- accuracy assessment

Choice of a method to execute above steps depends on a few conditions, firstly user's needs. User should determine type of query before selecting type of classifier. Different approach should be applied to find similar image, other to point an object on an image, and another to indicate a class of object, etc. Secondly: scale

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 93-103

6 Conclusion and future work

In this paper the DBC algorithm was introduced. It is used for verifying the membership of the image to the considered class. The obtained experimental results showed the usefulness of the presented solution. The big advantage of the proposed method is the low memory requirement.

The algorithm, however, leaves a lot of space for future consideration. The algorithm should be tested on a larger number of classes. A promising appears to be the extension of the algorithm functionality to other image processing operations. For example, the detection of images in a query image can be accomplished by the application of procedures like the pyramid representation. Also it seems to be justified to search methods of keypoints detection which are dedicated for image classifier.

Acknowledgments

The work presented in this paper was supported by a grant from Switzerland through the Swiss Contribution to the enlarged European Union.

References

[1] H. Bay, T. Tuytelaars, and L. Van Gool. Surf: Speeded up robust features. In *In ECCV*, pages 404–417, 2006.

[2] S. Belongie and J. Malik. Matching with shape contexts. In *IEEE Workshop on Contentbased Access of Image and Video Libraries (CBAIVL-2000)*, 2000.

[3] O. Chapelle, P. Haffner, and V. N. Vapnik. Support vector machines for histogram-based image classification. *Trans. Neur. Netw.*, 10(5):1055–1064, September 1999.

[4] N. Dalal and B. Triggs. Histograms of oriented gradients for human detection. In *IEEE Computer Society Conference on Computer Vision and Pattern Recognition, CVPR 2005*, 2005.

[5] R. Datta, D. Joshi, J. Li, and J. Z. Wang. Image retrieval: Ideas, influences, and trends of the new age. *ACM Comput. Surv.*, 40(2):5:1–5:60, May 2008.

[6] L. Fei-Fei, R. Fergus, and P. Perona. A bayesian approach to unsupervised one-shot learning of object categories. In *Proceedings of the Ninth IEEE International Conference on Computer Vision - Volume 2*, ICCV '03, pages 1134–, Washington, DC, USA, 2003. IEEE Computer Society.

[7] M. Fritz, Geert-Jan M. Kruijff, and B. Schiele. Tutor-based learning of visual categories using different levels of supervision. *Computer Vision and Image Understanding*, 114:564–573, May 2010.

[8] T. Gałkowski and L. Rutkowski. Nonparametric fitting of multivariable functions. *IEEE Transactions on Automatic Control*, AC-31:785–787, 1986.

[9] W. Greblicki, D. Rutkowska, and L. Rutkowski. An orthogonal series estimate of time-varying regression. *Annals of the Institute of Statistical Mathematics*, 35, Part A:215–228, 1983.

[10] W. Greblicki and L. Rutkowski. Density-free bayes risk consistency of nonparametric pattern recognition procedures. In *Proceedings of the IEEE*, volume 69, pages 482–483, 1981.

[11] L. Jiang, W. Wang, X. Yang, N. Xie, and Y. Cheng. Classification methods of remote sensing image based on decision tree technologies. In D. Li, Y. Liu, and Y. Chen, editors, *CCTA (1)*, volume 344 of *IFIP Advances in Information and Communication Technology*, pages 353–358. Springer, 2010.

[12] P. M. Kelly and T. M. Cannon. Candid: Comparison algorithm for navigating digital image databases. In *In Proceedings Seventh International Working Conference on Scientific and Statistical Database Management*, pages 252–258, 1994.

[13] D. Keysers, J. Dahmen, H. Ney, B. Wein, and T. Lehmann. A statistical framework for model-based image retrieval in medical applications, 2002.

[14] M. Korytkowski, L. Rutkowski, and Scherer R. On combining backpropagation with boosting. In *2006 International Joint Conference on Neural Networks, IEEE World Congress on Computational Intelligence, Vancouver, BC, Canada*, pages 1274–1277. IEEE, 2006.

[15] A. Krizhevsky, I. Sutskever, and G. E. Hinton. Imagenet classification with deep convolutional neural networks. In Peter L. Bartlett, Fernando C. N. Pereira, Christopher J. C. Burges, Léon Bottou, and Kilian Q. Weinberger, editors, *NIPS*, pages 1106–1114, 2012.

[16] D. G. Lowe. Object recognition from local scale-invariant features. In *Proceedings of the International Conference on Computer Vision-Volume 2 - Volume 2*, ICCV '99, pages 1150–, Washington, DC, USA, 1999. IEEE Computer Society.

[17] P. Maheshwary and N. Srivastava. Prototype system for retrieval of remote sensing images based on color moment and gray level co-occurrence matrix, August 2009.

[18] K. Mikolajczyk and C. Schmid. A performance evaluation of local descriptors. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 10(27):1615–1630, 2005.

[19] S. C. Orphanoudakis, C. Chronaki, and S. Kostomanolakis. I2c: a system for the indexing, storage, and retrieval of medical images by content. *Med Inform (Lond)*, 19(2):109–122, 1994.

[20] K. Patan and M Patan. Optimal training strategies for locally recurrent neural networks. *Journal of Artificial Intelligence and Soft Computing Research*, 1(2):103–114, 2011.

[21] L. Rutkowski. Sequential estimates of probability densities by orthogonal series and their application in pattern classification. *IEEE Transactions on Systems, Man, and Cybernetics*, SMC-10, No 12:918–920, 1980.

[22] L. Rutkowski. On bayes risk consistent pattern recognition procedures in a quasi-stationary environment. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, PAMI-4(1):84–87, 1982.

[23] L. Rutkowski. On nonparametric identification with prediction of time-varying systems. *IEEE Transactions on Automatic Control*, AC-29:58–60, 1984.

[24] L. Rutkowski. Nonparametric identification of quasi-stationary systems. *Systems and Control Letters*, 6:33–35, 1985.

[25] L. Rutkowski. The real-time identification of time-varying systems by nonparametric algorithms based on the parzen kernels. *International Journal of Systems Science*, 16:1123–1130, 1985.

[26] L. Rutkowski. A general approach for nonparametric fitting of functions and their derivatives with applications to linear circuits identification. *IEEE Transactions Circuits Systems*, CAS-33:812–818, 1986.

[27] L. Rutkowski. Sequential pattern recognition procedures derived from multiple fourier series. *Pattern Recognition Letters*, 8:213–216, 1988.

[28] L. Rutkowski. An application of multiple fourier series to identification of multivariable nonstationary systems. *International Journal of Systems Science*, 20(10):1993–2002, 1989.

[29] L. Rutkowski. Nonparametric learning algorithms in the time-varying environments. *Signal Processing*, 18:129–137, 1989.

[30] L. Rutkowski. Identification of miso nonlinear regressions in the presence of a wide class of disturbances. *IEEE Transactions on Information Theory*, IT-37:214–216, 1991.

[31] L. Rutkowski. Multiple fourier series procedures for extraction of nonlinear regressions from noisy data. *IEEE Transactions on Signal Processing*, 41(10):3062–3065, 1993.

[32] L. Rutkowski. *New Soft Computing Techniques for System Modeling, Pattern Classification and Image Processing*. Springer-Verlag, 2004.

[33] L. Rutkowski and E. Rafajłowicz. On global rate of convergence of some nonparametric identification procedures. *IEEE Transaction on Automatic Control*, AC-34(10):1089–1091, 1989.

[34] S. Shariat, H. R. Rabiee, and M. Khansari. Inferring a bayesian network for content-based image classification. In *13th International CSI Computer Conference*, Kish Island, Iran, 09/03/2008 2008.

[35] O. S. Soliman, A. S. Mahmoud, and S. M. Hassan. Remote sensing satellite images classification using support vector machine and particle swarm optimization. In *Proceedings of the 2012 Third International Conference on Innovations in Bio-Inspired Computing and Applications*, IBICA '12, pages 280–285. IEEE Computer Society, 2012.

[36] B. Xiao, Yi-Zhe Song, and P. M. Hall. Learning invariant structure for object identification by using graph methods. *Computer Vision and Image Understanding*, 115(7):1023–1031, 2011.

[37] M. Xu and Ch. Wei. Remotely sensed image classification by complex network eigenvalue and connected degree. *Comp. Math. Methods in Medicine*, 2012, 2012.

[38] K. Yan and R. Sukhtankar. Pca-sift: a more distinctive representation for local image descriptors. In *Proceedings of the 2004 IEEE Computer Society Conference on Computer Vision and Pattern Recognition, CVPR 2004*, volume 2, pages 506–513, 2004.

[39] C. Yaw, W. Yishi, Ch. Cuixain, and K. Ricanek. Optimal training strategies for locally recurrent neural networks. *Journal of Artificial Intelligence and Soft Computing Research*, 1(3):241–253, 2011.

[40] A. Zygmund. *Trigonometric Series, Cambridge*. UK: Cambridge University Press, 1959.

Idea Planter: A Backchannel Function for Fostering Ideas in a Distributed Brainstorming Support System

Hiroaki Furukawa, Takaya Yuizono, and Susumu Kunifuji

Japan Advanced Institute of Science and Technology
1-1 Asahidai Nomi, Ishikawa 923-1211, Japan
{yuizono, kuni}@jaist.ac.jp

Abstract. This paper describes the development and evaluation of a backchannel function for distributed brainstorming support system. It also considers the effect of backchannels on ideas in a distributed environment. We defined 'Ability to see or sensitivity to problems', 'Originality', and 'Elaboration' as factors of backchannel that contribute to idea creation. The backchannel function was implemented as a single button click. The experiment was carried out with two sets of four people in a distributed environment. The comparison of the quantity of ideas showed that there was no statistical difference (Mann-Whitney U test: $p > 0.75$). Moreover, the ratio of feasibility between created ideas also did not show a statistical difference (Mann-Whitney U test: $p > 0.2$). On the contrary, the ratio of fluency between created ideas showed a statistical difference (Mann-Whitney U test: $p < 0.046$). As a result, it was suggested that a backchannel function might improve the outcome of distributed brainstorming sessions. In particular, the fluency of individual ideas might be improved significantly.

Keywords: Backchannel, Brainstorming Support System, CSCW, Distributed Brainstorming.

1 Introduction

In recent years, the study of groupware in distributed environments has especially attracted attention in computer supported cooperative work (CSCW). In particular, research into brainstorming support systems has progressed significantly.

The distributed environment is non face-to-face, hence communication is limited in comparison with face-to-face communication scenarios. For this reason, it is necessary to develop a new communication function for creative activities between participants in distributed environments.

On the contrary, uncontrolled communication has a high risk of loss of anonymity. As a result, it might inhibit idea creation. Hence, new communication functions that do not disturb brainstorming activities are needed.

In order to meet these requirements, this paper focuses on 'Backchannel' as a means of effective communication in brainstorming activities conducted in distributed environments. A backchannel is a straightforward communication, and is usually used

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 104-115

of our evaluation showed that *Use-BF* is more effective in generating ideas with better quality as compared to *Non-BF*. However, the same cannot be said of the quantity of ideas generated by *Use-BF*.

The results of the experimental evaluation suggested that the effects of the backchannel may depend on the theme. Therefore, it is necessary to conduct experiments with multiple themes that vary according to their purpose. Moreover, a study of the associative process of ideas and types of backchannel, as well as the associative process of newly created ideas and types of backchannel, is not sufficient. It is necessary to increase the number of subjects. We would consider conducting such studies in future.

Acknowledgement

This research was partially supported by Japan Society for the Promotion of Science (JSPS) and the Grant-in-Aid for Scientific Research (C) 24500143

References

1. Altshuller, G. S.: Creativity as an exact science: the theory of the solution of inventive problems. Gordon and Breach Science Publishers (1984)
2. Duncan, S. Jr. and Fiske, D.: FACE-TO-FACE INTERACTION: Research, Methods, and Theory. LAWRENCE ERLBAUM ASSOCIATES (1977)
3. Guilford, J. P.: Traits of creativity. Creativity and its Cultivation (1959) 142-161
4. Hayama, T. and Kunifuji, S.: Effects of Different Idea Layout Methods on Idea Generation in Distributed Brainstorming Environment. Proc. of 3rd International Conference on Knowledge, Information and Creativity Support Systems (2008) 177-184
5. Kawaji, T. and Kunifuji, S.: Divergent Thinking Supporting Groupware by Using Collective Intelligence. Proc. of 3rd International Conference on Knowledge, Information and Creativity Support Systems (2008) 192-199
6. Maynard, S. K.: On back-channel behavior in Japanese and English casual conversation. Linguistics 24 (1986) 1079-1108
7. Neupane, U., Miura, M., Hayama, T. and Kunifuji, S.: Qualitative, Quantitative Evaluation of Ideas in Brain Writing Groupware. IEICE TRANSACTIONS on Information and Systems E90-D(10) (2007) 1493-1500
8. Ohmori, A. and Doi, K.: How does Chiming-in Affect the Number of Ideas? : Its Experiment and Analysis. Cognitive studies : bulletin of the Japanese Cognitive Science Society 7(4) (2000) 292-302
9. Sannomiya, M., Kawaguchi, A., Yamakawa, I. and Morita, Y.: EFFECT OF BACKCHANNEL UTTERANCES ON FACILITATING IDEA-GENERATION IN JAPANESE THINK-ALOUD TASKS. Psychological Reports 93 (2003) 41-46
10. Takahashi, M.: Research on Brainstorming (1) : Effectiveness of “Rules of Idea generation” Journal of Japan Creativity Society 2 (1998) 94-122 (in Japanese)
11. Yngve, V.: ON GETTING AWORD IN EDGEWISE. Chicago Linguistics Society 6 (1970) 567-578

The Impact of Changing the Way the Fitness Function Is Implemented in an Evolutionary Algorithm for the Design of Shapes

Andrés Gómez de Silva Garza

Computer Engineering Department, Instituto Tecnológico Autónomo de México (ITAM),Río Hondo #1, Col. Progreso-Tizapán, 01080—México, D.F., México

agomez@itam.mx

Abstract. Evolutionary algorithms (EA's) have been used in many ways for design and other creative tasks. One of the main elements of these algorithms is the fitness function used by the algorithm to evaluate the quality of the potential solutions it proposes. The fitness function guides, constrains, and biases the algorithm's search for an acceptable solution. In this paper we explore the degree to which the fitness function and its implementation affects the search process in an evolutionary algorithm. To do this, the reliability and speed of the algorithm, as well as the quality of the designs produced by it, is measured for different fitness function implementations.

Keywords: Evolutionary algorithms, fitness function, evolutionary design

1 Introduction

Evolutionary algorithms (EA's) are general-purpose search methods that operate on the individuals in a population of potential solutions to a problem [4]. An EA will evolve these potential solutions through a series of generations until some convergence criterion is reached. They embody such a general-purpose search method that it is no surprise that EA's have often been applied to the support of design and other creative tasks. Two compendia of example systems and applications can be found in [1] and [2]. In many of the examples included in these compendia, the fitness function is not automated. Instead, in some of the example approaches a user is asked to determine the fitness function by tweaking the values of different parameters provided through system interface controls. In some of the other examples, votes are gathered from a large set of users to rank the solutions proposed by the systems and therefore eliminate the need for a fitness function to be explicitly programmed. Instead, in our work we are concerned with the traditional EA method of having a completely preprogrammed, autonomous, fitness function integrated into the EA's functioning.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 116-125

vergence, and the quality of the solutions it produced. In one of the experimental scenarios tested, a slight difference in how the evaluation functions were combined was also the difference between the EA being able to complete its task (the experiment) or not (because the computer ran out of memory space in the middle).

In a typical paper describing a given EA, the way that fitness evaluation is performed by the EA is usually merely described, without any explanation about why it is the "best" way of doing it or whether alternative algorithms/implementations might be feasible or were tested. This leads us to suspect that in most cases alternatives may not have even been considered, and that the implementation that was used was chosen merely because it was the first one that came to mind to the researcher involved in the project, or because it has worked in the past for the same or other researchers (whether the application domain was similar or not), or because the researcher is comfortable with it, or other such possibilities.

However, as we have seen with our experiments, even minor variations in the way that fitness evaluation is implemented can cause large differences in the performance of an EA. What this indicates is that, when using an EA, making a few preliminary trials that evaluate alternate fitness evaluation implementations might enable the construction of more robust, more efficient, more reliable EA's, capable of producing better solutions. If, instead, an EA is simply endowed with whatever the first implementation that comes to mind is, without even thinking about alternatives, there is no guarantee that one has achieved the "best" possible EA for that domain. Taking into account these lessons learned from our experiments can have a major impact on whether a particular EA will be able to successfully provide support for creativity in a given domain or not. Further work would be needed to determine whether general principles or guidelines could be proposed in order to suggest how to implement the fitness evaluation function under different application domains and operating conditions when using EA's for creativity support.

Acknowledgements. This work has been supported by Asociación Mexicana de Cultura, A.C.

References

1. Bentley, P. (ed.): Evolutionary Design by Computers. Morgan Kaufmann, San Francisco CA (1999)
2. Bentley, P., Corne, D.W. (eds.): Creative Evolutionary Systems. Morgan Kaufmann, San Francisco CA (2002)
3. Gómez de Silva Garza, A.: Exploring the Sensitivity to Representation of an Evolutionary Algorithm for the Design of Shapes. In: Proceedings of the Eighth ACM International Conference on Creativity and Cognition (C&C '11), pp. 259-267, Atlanta GA (2011), DOI: http://dl.acm.org/citation.cfm?doid=2069618.2069661
4. Mitchell, M.: An Introduction to Genetic Algorithms. MIT Press, Cambridge MA (1998)

Feature Selection using Cooperative Game Theory and Relief Algorithm

Shounak Gore and Venu Govindaraju

Department of Computer Science
University at Buffalo, Buffalo, NY 14260 {shounakg,govind}@buffalo.edu

Abstract. With the advancements in various data-mining and social network related approaches, data-sets with a very high feature - dimensionality are often used. Various information theoretic approaches have been tried to select the most relevant set of features and hence bring down the size of the data. Most of the times these approaches try to find a way to rank the features, so as to select or remove a fixed number of features. These principles usually assume some probability distribution for the data. These approaches also fail to capture the individual contribution of every feature in a given set of features. In this paper we propose an approach which uses the Relief algorithm and cooperative game theory to solve the problems mentioned above. The approach was tested on NIPS 2003 and UCI datasets using different classifiers and the results were comparable to the state of the art methods.

Keywords:
Feature Selection, Game Theory, Shapley Values, Relief Algorithm

1 Introduction

A lot of modern day machine learning problems, such as social network clustering, gene array analysis and various other bioinformatic problems have to deal with a lot of data in the form of a large number of features. Feature selection is a process of selecting a set of features from the original features such that it boosts the performance of the task at hand. Feature selection is defined by many authors by looking at it from various angles. But as expected, many of those are similar in intuition and/or content. The following lists those that are conceptually different and cover a range of definitions [6].

Idealized : find the minimally sized feature subset that is necessary and sufficient to the target concept [16].

Classical: select a subset of M features from a set of N features, $M < N$, such that the value of a criterion function is optimized over all subsets of size M [22].

Improving Prediction accuracy: the aim of feature selection is to choose a subset of features for improving prediction accuracy or decreasing the size of the structure without significantly decreasing prediction accuracy of the classifier built using only the selected features [15].

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 126-137

Table 5: Comparison of the best results with the state of the art results

Name	Highest Accuracy	State of the Art
Arcene	85.4%	86% [4]
Arrhythmia	81.92%	84.2% [4]
Dexter	96.19%	94% [4]
Isolet	77.59%	83.65% [27]
Musk	94.78%	96.13% [27]
Optical Recognition	98.31%	98.72% [27]

The state of the art results are compiled from various published results.

d reduces the number of computations drastically. α is useful when we have a tradeoff between the final data at hand and the overall accuracy of the system. We prove it experimentally that we can easily change the value of α depending on the problem at hand. β allows us to from a coalition of features such that their overall contribution to the coalition increases, which also means that the importance of the feature towards the overall coalition increases.

As can be seen from the above results, the proposed algorithm is close to the state of the art feature selection techniques in most of the cases and beats some of the others either when it comes to processing time or the accuracy achieved by the classification algorithm. This proves that the proposed approach can easily be used to do a smart feature selection for a lot of real-world problems.

References

1. Albanese, D., Visintainer, R., Merler, S., Riccadonna, S., Jurman, G., and Furlanello, C., mlpy: Machine Learning Python, 2012.
2. Brown, G., Pocock, A., Zhao, M., and Lujan, M., "Conditional Likelihood Maximization: A unifying framework for information theoretic feature selection", *Journal of Machine Learning Research 13*, pp. 27–66, (2012)
3. Cai, R., Hao, Z., Yan, X., and Wen, W., "An efficient gene selection algorithm based on mututal information", *Neurocomputing 72*, pp. 991–999, (2009)
4. Cohen, S., Dror, G., and Rupin, E., "Feature selection via coalitional game theory", *Neural Computation 19*, pp.1939–1961, (2007)
5. Cohen, S., Rupin, E., and Dror, G., "Feature selection based on the Shapley Value", *Proceedings of the Nineteenth International Joint Conference on Artificial Intelligence*, Morgan Kaufmann Publishers, pp. 665–670, (2005)
6. Dash, M., and Liu, H., "Feature Selection for Classification". *Intelligent Data Analysis*, Elsevier, Vol. 1, No. 3, pp. 131–156, (1997)
7. Duch, W., "Feature Extraction: Foundations and applications", *Chapter 3, Studies in Fuzziness and Soft Computing*, Springer, ISBN 3-540-35487-5, pages 89–117, (2006)
8. Fleuret, F., "Fast binary feature selection with conditional mutual information", *Journal of Machine Learning Research 5*, pp.1531–1555, (2004)

9. Frank, A., and Asuncion, A., UCI Machine Learning Repository, Irvine, CA: University of California, School of Information and Computer Science, 2010.
10. Friedman, W., "Game Theory with Applications to Economics", *Oxford University Press, New York*, 1990.
11. Gomez-Verdejo, V., Verleysen, M., and Fleury, J., "Information-theoretic feature selection for functional data classification", *Neurocomputing 72*, pp. 3580–3589, (2009)
12. Guyon, I., Gunn, S., Nikravesh, M., and Zadeh, L., editors. "Feature Extraction: Foundations and Applications", Springer, ISBN 3-540-35487-5, (2006)
13. Hild, K. E., Erdogmus, D., Torkkola, K., and Principe, J.C., "Feature extraction using information theoretic learning", *IEEE Transactions on Pattern Analysis and Machine Intelligence 28*, pp. 1385–1392, (2006)
14. Huang, D., and Chow, T.W.S., "Effective feature selection scheme using mutual information", *Neurocomputing 63*, pp. 325–343, (2005)
15. Jon, G.H., Kohavi, R., and Peger, K., "Irrelevant features and the subset selection problem", *Proceedings of the Eleventh International Conference on Machine Learning*, pp 121–129, (1994)
16. Kira, K., and Rendell, L.A., "The feature selection problem: Traditional methods and a new algorithm", *In Proceedings of Ninth National Conference on AI*, pp. 129–134, (1992)
17. Kira, K. and Rendell, L.A., "A practical approach to feature selection", *Proceedings of International Conference on Machine Learning*, pp. 249–256. (1992)
18. Kononeko, I., "Estimating attributes: Ananlysis and extensions of RELIEF", *European Conference on Machine Learning*, pp. 101–106, (1998)
19. Kwak, N., and Choi, C.-H., "Input feature selection by mutual information based on Parzen windows", *IEEE transactions on Pattern Analysis and Machine Intelligence 24*, pp. 1667–1671, (2002)
20. Liu, H., and Yu, L., "Toward integrating feature selection algorithms for classification and clustering", *IEEE Transactions on Knowledge and Data Engineering*, Vol. 17, No. 4, pp. 491–501, (2005)
21. Liu, J., and Lee, S., "Study on feature select based on coalition game", *Proceedings of the International Conference on Neural Networks and Signal Processing*, pp. 445–450, (2008)
22. Narendra, P. M., and Fukunaga, K., "A branch and bound algorithm for feature selection". *IEEE Transactions on Computers*, C-26(9), pp. 917–922, (1977)
23. Peng, H., Long, F. and Ding, C., "Feature selection based on mutual information: Criteria of max-dependency, max-relevance and min-redundancy", *IEEE Transactions on Pattern Analysis and Machine Intelligence 27*, pp. 1226–1238, (2005)
24. Robnik Sikonja, M., and Kononenko, I., "An adaptation of relief for attribute estimation in regression", *Proceedings of the Fourteenth International Conference*, pp. 296–304, (1997)
25. Shapley, L.S., "A value for n-person games", *in : A.W.T.H.W. Kuhn(Ed.), In contributions to the Theory of Games, vol II Princeton University Press, New York*, 1990.
26. Sun, X., Liu, Y., Li, J., Zhu, J., Liu, X., and Chen, H., "Using cooperative game theory to optimize the feature selection problem", *Neurocomputing 97*, pp. 86–93, (2012)
27. Sun, X., Liu, Y., Li, J., Zhu, J., Liu, X., and Chen, H., "Feature evaluation and selection with cooperative game theory", *Pattern Recognition 45*, pp. 2992–3002, (2012)

Detecting Context Free Grammar for GUI Operation

Ryo Hatano and Satoshi Tojo

School of Information Science, Japan Advanced Institute of Science and Technology
{r-hatano,tojo}@jaist.ac.jp

Abstract. We apply an algorithm of grammar compression to the detection of regularity in our operation of a computer. When we observe only a surface sequence of inputs, we may be able to find a simple grammar as is often the case in usual grammar learning algorithms. In order to learn such regularity, however, we consider the resultant state of each operation, that is, the output when we regard an operation as an input. In this paper, we aim at finding a hidden grammar rules, considering the each state change in a computer system per an input. As a result, we find the regularity of human behavior in system manipulation, as well as hidden grammar rules.

Keywords: Knowledge extraction and integration, Context Free Grammar, Grammar compression, Programming by Example

1 Introduction

Many disciplines of research concern how we can reduce the burden of daily routine work on computers. Automating such routine work will help us to improve our creativity. For such techniques, Programming by Example (PbE) tries to find our intentions, given examples of tasks, and generates a program. PbE has been well studied in relation to program synthesis, and its recent results are shown in [2].

One of the most significant functions of PbE is to learn *macro*s, which is a kind of tape recorder that record and replay sequences of inputs. Recently, the automatic detection of the beginning/terminal points is proposed by [1]. Elliott revised the compression algorithm of Lempel-Ziv78 (LZ78) [7], and proposed to learn a macro from the history of operation from Graphic User Interface (GUI), i.e., desktop appearance. The result of the algorithm is a special representation of Trie tree, i.e., a finite state automaton (FSA).

LZ78 belongs to a class of algorithms of universal data compression, and there exists another class is called grammar compression (GC) [4]. The result of GC algorithm is context free grammar (CFG) which is a different representation of the result by Elliott. Thus, we can consider to apply the criteria of macros by Elliott also to the result of GC without modification of its algorithm, since such repetitive substrings are always regarded as a hierarchical category. Therefore,

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 138-149

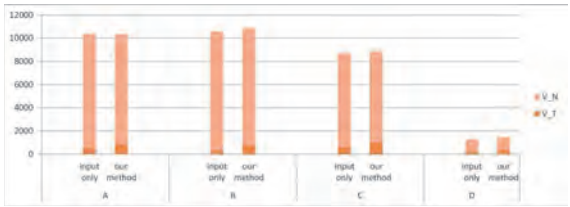


Fig. 8. Ratio between V_T and V_N for each CFG

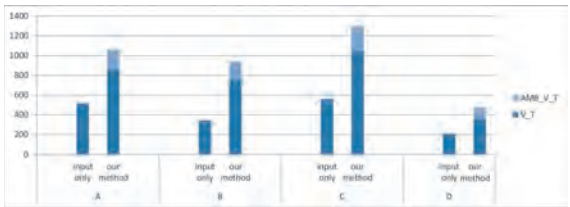


Fig. 9. Normal and ambiguous terminal symbols

and tried to find this hidden CFG rules. As a result, we could find a proper representation of such rules.

We have collected rather limited record of human operations, but still we could find the features of human behavior in such grammar finding process. Our future target is to find regularity in such a complicated situation, with bigger data. The more a result includes such actual information, the more it contributes to our creativity through analyzing and reducing our routine works.

References

1. Elliott, F., Huber, M.: Learning macros with an enhanced lz78 algorithm. In Russell, I., Markov, Z., eds.: FLAIRS Conference, AAAI Press (2005) 412–417
2. Gulwani, S.: Synthesis from examples: Interaction models and algorithms. In: 14th International Symposium on Symbolic and Numeric Algorithms for Scientific Computing. (2012)
3. Ichikawa, H., Hakoda, K., Hashimoto, T., Tokunaga, T.: Efficient sentence retrieval based on syntactic structure. In: Proceedings of the COLING/ACL on Main conference poster sessions, Association for Computational Linguistics (2006) 399–406
4. Kieffer, J.C., Yang, E.h.: Grammar-based codes: a new class of universal lossless source codes. Information Theory, IEEE Transactions on **46**(3) (2000) 737–754
5. Manning, C., Schuetze, H.: Foundations of Statistical Natural Language Processing. The MIT Press (5 1999)
6. Nevill-Manning, C.G., Witten, I.H.: Identifying hierarchical structure in sequences: a linear-time algorithm. Journal of Artificial Intelligence Research **7**(1) (1997) 67–82
7. Ziv, J., Lempel, A.: Compression of individual sequences via variable-rate coding. Information Theory, IEEE Transactions on **24**(5) (1978) 530–536

Creativity Effects of Idea-Marathon System (IMS): Torrance Tests of Creative Thinking（TTCT）Figural Tests for College Students

Takeo Higuchi Takaya Yuizono Kazunori Miyata

School of Knowledge Science
Japan Advanced Institute of Science and Technology, Japan

info@idea-marathon.net,{yuizono,miyata}@jaist.ac.jp

Keizo Sakurai Takahiro Kawaji

Graduate School of Management
Japan University of Economics

Department of Economics
Ohtsuki City College

sakurai@tk.jue.ac.jp kawaji@ohtsuki.ac.jp

Abstract. Idea-Marathon System (IMS) is a creativity training process, based on the use of notebooks, in which we make a daily habit of writing our ideas immediately by managing to create any new idea regardless of any thinking area. This paper presents an experimental analysis conducted at Ohtsuki City College (OCC) to quantitatively measure creativity effect on college students before and after a 3 month IMS training. TTCT (Torrance Tests of Creative Thinking) Figural Pre and Post tests were used to confirm the creativity effects on students quantitatively. The group with 3 months of IMS training showed significant increases in "Total Score", "Fluency," "Originality" and "Resistance to Premature Closure (RPC)" while students in the control group showed a significant increase in "RPC" only. Support system of IMS "e-Training System (ETS)" was found moderately correlated with "Fluency". Top, Middle and Low analysis showed improvement in Middle and Low through 3 month IMS.

Keywords: Idea-Marathon System (IMS), Torrance Tests of Creative Thinking (TTCT) Figural tests, e-Training System (ETS)

1 Introduction

The four P's model of Mel Rhodes: a creative person, a creative product, the creative process and the creative press[13], shows that creativity means wide-ranges, many directions and many fields. In this paper, we discuss the creativity education in college students.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 150-160

Acknowledgement

We thank Professor Bill Holden of Japan Advanced Institute of Science and Technology (JAIST) for his full support of detailed proofreading to this paper in such a short period during his extreme tight schedule.

REFERENCES

1. Cramond, B., Creativity in the Future, Encyclopedia of Creativity, Vol 1.p423, Academic Press, San Diego, 1999
2. EUA Executive Summary of "Creativity in Higher Education, Report on the Creativity Project 2006-2007," European University Association, Belgium
3. Heslin, Peter, Better than brainstorming? Potential contextual boundary conditions to brainwriting for idea, The British Psychological Society, Journal of Occupational and Organizational Psychology, 2009
4. Higuchi, Takeo, "You can get affluent ideas from this book". Diamond Inc, Tokyo, 1992 (in Japanese)
5. Higuchi, Takeo, Ideas in Action, Digital Achievement of Idea Marathon System, Adarsh Books, 2001
6. Higuchi, Takeo, Application of Idea-Marathon for Career Design Class at the University of Electro-Communications, In the 32 Conference of Japan Creativity Society, Tokyo, 2010
7. Higuchi, Takeo, Notebook Technology for Business, Toyo-Keizai Shinposha, Tokyo 2011, (Japanese)
8. Higuchi, Takeo et al., Creativity Improvement by Idea-Marathon Training, Measured by Torrance Tests of Creative Thinking (TTCT) and Its Applications to Laboratories, KICSS 2012
9. Higuchi, Takeo, Idea-Marathon System, Encyclopedia of Creativity, Invention, Innovation, and Entrepreneurs, Springer, UK, 2013
10. Livingston, Larry, Teaching Creativity in Higher Education, Arts Education Policy Review, 111:59-62, USA. 2010
11. NCEE, Executive Summary, p8, National Center on Education and the Economy, Washington DC. 2007
12. Osborn, A., F., Applied Imagination" Charles Scribners Sons, 1957
13. Rhodes, Mel, An Analysis of Creativity, The Phi Delta Kappan, Vol. 42, No. 7 (Apr., 1961), pp. 305-310, Phi Delta Kappa International, USA, 1961
14. Starko, A., Jordan, Creativity in the Classroom, Schools of Curious Delight, Taylor & Francis, New York, 2012
15. Torrance, E., Paul, 1974a Torrance Tests of Creative Thinking: Directions manual and scoring guide, Verbal test booklet A. Bensenville, Il. Scholastic Testing Service, 1974
16. Torrance, E., Paul, Torrance Tests of Creative Thinking Norms-Technical Manual Figural (streamlined) Forms A & B, Scholastic Testing Service, Inc, 1998, 2008
17. UGA Georgia Center, TTCT Figural Workshop Manual, March, 2012

Complementarity and Similarity of Complementary Structures in Spaces of Features and Concepts

Wladyslaw Homenda and Agnieszka Jastrzebska

Faculty of Mathematics and Information Science
Warsaw University of Technology
ul. Koszykowa 75, 00-662 Warsaw, Poland
A.Jastrzebska@mini.pw.edu.pl
http://www.mini.pw.edu.pl/~homenda

Abstract. Authors present an approach to real-life phenomena modeling through concepts' descriptions gathered in features vectors. The start point of analysis are imprecise, fuzzified features, which describe objects. Developed model (feature and concept spaces) formalizes units and groups of knowledge granules. The goal of this study is to discuss complementarity and similarity of complementary features structures. Complementarity of features provides auxiliary knowledge, which should be taken into account. In the article two methodologies for calculating similarity between complementary sets of features are presented. First approach is based on authors generalized similarity measure based on the underlying concept space. The second methodology relies on distance measure, computed directly between features vectors. Addressed issues (most importantly complementarity) are authors contribution to the area of knowledge modeling and structuralization.

Key words: concepts, features, similarity, complementarity

1 Introduction

Real-world phenomena are often very difficult to describe and to process. Conventionally, we are rather using attributes, or in other words features, to characterize objects. Complexity of real-world concepts makes it impossible to precisely define and predict phenomena like unemployment, market fluctuations or consumer behavior. Plenty of contemporary models account only a fraction of influencing attributes, but it is often impossible to identify them all. Moreover, it is often not doable to precisely express knowledge about attributes.

In this article a general approach to phenomena description is discussed. Of interest is the space of concepts (real-world objects), which are being described by their features. Feature and concept spaces contain available knowledge and allow to characterize relations between features and relations between concepts. The nature of analyzed knowledge is imprecise. Features evaluations are fuzzified. We focus on positive information only. Of interest is structuring in the space

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 161-172

5 Conclusions

The paper discusses structuralization in the feature and concept spaces. The nomenclature of formalized units of knowledge - space, which correspond to the real-world objects is introduced. Concepts are described by their features. Particular evaluations of features allow to describe and distinguish different objects. Features evaluations are expressed as numbers from the $[0, 1]$ interval. Valuation mapping links space of descriptions with the space of concepts. Within such formal model authors have developed similarity relation s_G, which allows to calculate similarity between two concepts.

In this study the property of complementarity has been presented. Similarity of complementary structures was discussed. Two distinct methodologies were suggested. First approach allows to compute similarity directly between features vectors. Second methodology relies on the underlying concept space and utilizes similarity relation s_G and the valuation mapping $\mathcal{V}$. In the second approach objects' descriptions are compared indirectly, thorough the space of concepts.

In future research authors plan to analyze different forms of structuring in the space of features. We will also focus on further generalization of our approach and on applying it with bipolar information representation models.

Acknowledgment

The research is partially supported by the National Science Center, grant No 2011/01/B/ST6/06478.

References

1. Belanche L. , Orozco J., *Things to Know about a (dis)similarity Measure*, in: LNAI 6881, 2011, pp. 100-109.
2. Goshtasby A.A., *Image Registration*, in: Advances in Computer Vision and Pattern Recognition Series, London: Springer, 2012.
3. Homenda W., *Balanced Fuzzy Sets*, Information Sciences, Vol. 176, Issue 17, 2006, pp. 2467-2506.
4. Homenda W., Jastrzebska A, *Similarities in Spaces of Features and Concepts: Semantic Approach*, submitted in May 2013
5. Hung W., Yang M., *Similarity measures between type-2 fuzzy sets*, in: International Journal of Uncertainty, Vol. 12, No. 6, 2004, pp. 827-841.
6. Hung W., Yang M., *Similarity measures of intuitionistic fuzzy sets based on Hausdorff distance*, in: Pattern Recognition Letters 25, 2004, pp. 16031611.
7. Szmidt E., Kacprzyk J., *Distances between intuitionistic fuzzy sets*, in: Fuzzy Sets and Systems 114, 2000, pp. 505518.
8. Klawonn F., Kruse R., *Similarity Relations and Independence Concepts*, in: G. Della Riccia, D. Dubois, R. Kruse, H.-J. Lenz (eds.): Preferences and Similarities, Springer, Wien, 2008, pp. 179 - 196.
9. Tversky, A., *Features of Similarity*, in: Psychological Reviews 84 (4), 1977, pp. 327-352.

Classification with rejection: concepts and formal evaluations

Wladyslaw Homenda[1], Marcin Luckner[1] and Witold Pedrycz[2,3]

[1]Faculty of Mathematics and Information Science
Warsaw University of Technology
Plac Politechniki 1, 00-660 Warsaw, Poland
and
[2]System Research Institute, Polish Academy of Sciences
ul. Newelska 6, 01-447 Warsaw, Poland
and
[3]Department of Electrical and Computer Engineering, University of Alberta
Edmonton, Alberta, Canada T6G 2V4

Abstract. Standard classification allocates all processed elements to given classes. Such type of classification assumes that there are only native and no foreign elements, i.e. all processed elements are included in given classes. The quality of standard classification can be measured by two factors: numbers of correctly and incorrectly classified elements, called True Positives and False Positives. Admitting foreign elements in standard classification increases False Positives and, in this way, deteriorates quality of classification. In this context, it is desired to reject foreign elements, i.e. to not assign them to any of given classes. Rejecting foreign elements will reduce the number of False Positives, but can also reject native elements reducing True Positives as side effect. Therefore, it is important to build well designed rejection, which will reject significant part of foreigners and only few natives. In this paper, concepts of evaluations of classification with rejection are presented. Three main models: a classification without rejection, a classification with rejection, and a classification with reclassification are presented. The concepts are illustrated by flexible ensembles of binary classifiers with theoretical evaluations of each model. The proposed models can be used, in particular, as classifiers working with noised data, where recognized input is not limited to elements of known classes.

Key words: rejection rule, ensemble of binary classifiers, reclassification

1 Introduction

Pattern recognition is one of the leading subjects in the field of computer science in its both theoretical and practical aspects. For decades, it has been a subject of intense, purely theoretical research inspired by practical needs. The results have been published in prestigious scientific journals. Example applications are: recognizing printed text, manuscripts, music notation, biometric features, voice, speaker, recorded music, medical signals, images, etc.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 173-184

Acknowledgments

The research is supported by the National Science Center,
grant No 2012/07/B/ST6/01501, decision no DEC-2012/07/B/ST6/01501.

References

1. Chow, C.: On optimum recognition error and reject tradeoff. Information Theory, IEEE Transactions on 16(1), 41–46 (1970)
2. Fumera, G., Roli, F.: Analysis of error-reject trade-off in linearly combined multiple classifiers. Pattern Recognition 37, 1245–1265 (2004)
3. Graves, D., Pedrycz, W.: Kernel-based fuzzy clustering and fuzzy clustering: A comparative experimental study (2010)
4. Ha, T.M.: Optimum tradeoff between class-selective rejection error and average number of classes. Engineering Applications of Artificial Intelligence 10(6), 525–529 (1997)
5. Ishibuchi H., Nakashima T., M.T.: Voting in fuzzy rule-based systems for pattern classification problems. Fuzzy Sets and Systems 103, 223–238 (1999)
6. Jigang Xie and Zhengding Qiu and Jie Wu: Bootstrap Methods for Reject Rules of Fisher LDA.Pattern Recognition, 425-428 (2006)
7. Li, M., Sethi, I.K.: Confidence-based classifier design. Pattern Recogn. 39(7), 1230–1240 (2006)
8. Lou, Z., Liu, K., Yang, J.Y., Suen, C.Y.: Rejection criteria and pairwise discrimination of handwritten numerals based on structural features. Pattern Anal. Appl. 2(3), 228–238 (1999)
9. Luckner, M.: Comparison of hierarchical svm structures in letters recognition task. In: Rutkowski, L., Tadeusiewicz, R., Zadeh, L.A., Zurada, J. (eds.) Computational Intelligence: Methods and Applications, pp. 291–302. Challenging Problems of Science, Academic Publishing House EXIT, Warsaw (2008)
10. Mascarilla, L., Frélicot, C.: Reject strategies driven combination of pattern classifiers. Pattern Anal. Appl. 5(2), 234–243 (2002)
11. Pierce, S.G., Worden, K., Manson, G.: Evaluation of neural network performance and generalisation using thresholding functions. Neural Comput. Appl. 16, 109–124 (2007)
12. Pillai, I., Fumera, G., Roli, F.: A classification approach with a reject option for multi-label problems. In: Maino, G., Foresti, G.L. (eds.) ICIAP (1). Lecture Notes in Computer Science, vol. 6978, pp. 98–107. Springer (2011)
13. Simeone, P., Marrocco, C., Tortorella, F.: Design of reject rules for ecoc classification systems. Pattern Recognition 45(2), 863–875 (2012)

E-Unification of Feature Structures

Petr Homola

Codesign, s.r.o.
phomola@codesign.cz

Abstract. Unlike structural unification, E-unification of feature structures has, to the best of our knowledge, never been used in natural language processing (NLP). We formalize the concept of E-unification for features structures, present a universal E-unification procedure and discuss its computational tractability for arbitrary as well as linguistically motivated E-theories. A number of examples illustrate the usefulness of E-unification in the domain of NLP.

Keywords: feature structures, E-unification, abstract rewriting systems, knowledge representation and reasoning

1 Introduction

The use of E-unification in feature structure based grammar formalisms is investigated in this paper. The reported results are an outgrowth of research on syntactically formed complex predicates [1, 2] and their linguistically motivated formal description and treatment without the use of the so-called restriction operator [9, 10, 17].

The notion of feature as a formal means of linguistic description originated in the tradition of the Prague school of linguistics in the interbellum [14]. The methods described in this paper can be used in any feature structure based formalism such as Lexical-Functional Grammar [8, 7, 5] or Categorial Unification Grammar [15]. Most of the formalisms utilize a context-free or categorial grammar processed by a chart parser as a backbone. The use of charts and unification in natural language processing goes back to Colmerauer [6]. Kay [11, 12] was probably the first to use feature structures and the operation of unification on them in a formal grammar which is an analogue to term unification in first-order logic. E-unification [3, 4] comes into play if we define equality (modulo a theory E) on feature structures. An example from the domain of NLP is presented in the next section.

2 Motivation

Informally, (structural) unification only adds information to feature structures. However, sometimes it seems necessary to "merge" two feature structures in a way that is incompatible with structural unification. A well investigated case are syntactically formed causatives in Romance languages [1, 2]. A Catalan example is given in (1).

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 185-192

An open question is how corresponding E-axioms (or rewrite rules) could be obtained in an unsupervised way. Even though axioms for lexical transfer can be obtained comparatively easily from bilingual dictionaries or corpora, handwritten axioms for structural transfer require deep knowledge of the grammar of both the source and target language. An automatic or at least semiautomatic creation of E-axioms is highly desirable. A detailed discussion cannot be given here due to lack of space, nevertheless let us mention that syntactically annotated parallel corpora would be extremely useful. Our initial experiments with a parallel syntactically annotated English-Aymara corpus reveal that the approach sketched above is viable.

7 Conclusions

We showed how E-unification can be used in the domain of NLP. We have presented a universal E-unification procedure for arbitrary E-theories and an efficient E-unification algorithm for theories that can be converted to a rewriting system. Several linguistically motivated examples have been discussed. Since a declarative notation can be utilized, E-theories can be used to describe linguistic processes and constructions such as syntactically formed causatives in Romance languages or transfer rules in machine translation.

References

[1] Alsina, A.: A Theory of Complex Predicates: Evidence from Causatives in Bantu and Romance. In: Alsina, A., Bresnan, J., Sells, P. (eds.) Complex Predicates, pp. 203–246 (1997)
[2] Alsina, A., Bresnan, J., Sells, P.: Complex Predicates: Structure and Theory. In: Alsina, A., Bresnan, J., Sells, P. (eds.) Complex Predicates, pp. 1–12 (1997)
[3] Baader, F., Nipkow, T.: Term Rewriting and All That. Cambridge University Press (1998)
[4] Baader, F., Snyder, W.: Unification Theory. In: Robinson, A., Voronkov, A. (eds.) Handbook of Automated Reasoning, pp. 439–526 (2001)
[5] Bresnan, J.: Lexical-Functional Syntax. Blackwell Textbooks in Linguistics, New York (2001)
[6] Colmerauer, A.: Les systèmes Q ou un formalisme pour analyser et synthétiser des phrases sur ordinateur. Tech. rep., Mimeo, Montréal (1969)
[7] Dalrymple, M.: Lexical Functional Grammar, Syntax and Semantics, vol. 34. Academic Press (2001)
[8] Kaplan, R.M., Bresnan, J.: Lexical-Functional Grammar: A formal system for grammatical representation. In: Bresnan, J. (ed.) Mental Representation of Grammatical Relations. MIT Press, Cambridge (1982)
[9] Kaplan, R.M., Wedekind, J.: Restriction and Structure Misalignment (1991), ms, Xerox Palo Alto Research Center
[10] Kaplan, R.M., Wedekind, J.: Restriction and Correspondence-based Translation. In: Proceedings of the 6th EACL Conference. pp. 193–202 (1993)
[11] Kay, M.: Functional Grammar. In: Proceedings of the 5th meeting of the Berkeley Linguistics Society (1979)

[12] Kay, M.: Functional Unification Grammar: a formalism for machine translation. In: Proceedings of the 10th International Conference on Computational Linguistics and 22nd annual meeting on Association for Computational Linguistics (1984)
[13] Knuth, D., Bendix, P.: Simple Word Problems in Universal Algebras. pp. 263–297 (1970)
[14] Rounds, W.C.: Feature Logics. In: van Benthem, J.F., ter Meulen, A. (eds.) Handbook of Logic and Language. Elsevier (1996)
[15] Uszkoreit, H.: Categorial Unification Grammars. In: Proceedings of COLING (1986)
[16] Wedekind, J.: Classical Logics for Attribute-Value Languages. In: Proceedings of the 5th EACL conference. pp. 204–209 (1991)
[17] Wedekind, J., Kaplan, R.M.: Type-driven Semantic Interpretation of F-Structures. In: Proceedings of the 6th Conference of the European Chapter of the Association for Computational Linguistics (1993)

Functional Dependency Parsing of Nonconfigurational Languages

Petr Homola

Codesign, s.r.o.
phomola@codesign.cz

Abstract. The paper presents a dependency-based linguistic formalism which defines two syntactic layers, surface and deep, and the formal relationship between them. This relationship forms the basis of a rule-based grammar description that can be straightforwardly implemented to be used in natural language processing.

Keywords: natural language processing, syntactic analysis, unification-based grammar

1 Introduction

Chomsky's original approach to formal syntax which is still the foundation of many computational frameworks assumes that sentences consist of constituents[1] and that the type and order of these constituents define configurations that specify grammatical relations. As has been shown by Hale [7], there are languages in which word order has no or limited relevance for grammatical relations and the respective constituent trees are flat. In most such languages, word order is said to specify information structure (hence the name "discourse-configurational languages" coined by Kiss [10], as opposed to syntax-configurational languages). In this paper we examine parsing techniques for Aymara,[2] an affixal polysynthetic language (according to Mattissen's [12] classification, see also [2]) which is neither syntax-configurational nor discourse-configurational. In Aymaran languages,[3] information structure is expressed morphologically. As an example, consider the following sentences in English (syntax-configurational), Russian (discourse-configurational) and Aymara (**N** marks contextually new, i.e. non-predictable information; * marks an ill-formed sentence):

(1)
(a) *Peter came*$_{\mathrm{N}}$
It's Peter$_{\mathrm{N}}$ *who came* (**Came Peter*)
(b) *Петр пришел*$_{\mathrm{N}}$
Пришел Петр$_{\mathrm{N}}$
(c) *Pedrox jutiwa*$_{\mathrm{N}}$ or *Jutiw*$_{\mathrm{N}}$ *Pedroxa*
Pedrow$_{\mathrm{N}}$ *jutixa* or *Jutix Pedrowa*$_{\mathrm{N}}$

[1] continuous phrases
[2] Detailed information about Aymara can be found in [9, 3, 1, 5].
[3] Aymara, Jaqaru, and Kawki

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 193-200

Bibliography

[1] Adelaar, W.: The Languages of the Andes. Cambridge University Press (2007)
[2] Baker, M.C.: The Polysynthesis Parameter. Oxford University Press (1996)
[3] Briggs, L.T.: Dialectal Variation in the Aymara Language of Bolivia and Peru. Ph.D. thesis, University of Florida (1976)
[4] Cayley, A.: A Theorem on Trees. Quarterly Journal of Pure and Applied Mathematics XXIII, 376–378 (1889)
[5] Cerrón-Palomino, R., Carvajal, J.C.: Aimara. In: Crevels, M., Muysken, P. (eds.) Lenguas de Bolivia. Plural Editores, La Paz, Bolivia (2009)
[6] Cole, P.: Null Objects in Universal Grammar. Linguistic Inquiry 18(4), 597–612 (1987)
[7] Hale, K.L.: Warlpiri and the grammar of non-configurational languages. Natural Language & Linguistic Theory 1, 5–47 (1983)
[8] Hardman, M.: Jaqaru. LINCOM EUROPA (2000)
[9] Hardman, M., Vásquez, J., de Dios, J.Y.: Aymara. Compendio de estructura fonológica y gramatical. Instituto de Lengua y Cultura Aymara (2001)
[10] Kiss, K.E.: Discourse Configurational Languages. Oxford University Press (1994)
[11] Kruijff, G.K.: Basic Dependency-based Logical Grammar. Tech. rep., Charles University, Prague, Czech Republic (1998)
[12] Mattissen, J.: On the Ontology and Diachrony of Polysynthesis. In: Wunderlich, D. (ed.) Advances in the theory of the lexicon, pp. 287–354. Walter de Gruyter, Berlin (2006)
[13] Sgall, P.: Where to look for the fundamentals of language. Linguistica Pragensia 19(1), 1–35 (2009)
[14] Sgall, P., Hajičová, E., Panevová, J.: The Meaning of the Sentence in Its Semantic and Pragmatic Aspects. D. Reider Publishing Company (1986)

How Does Human-Like Knowledge Come into Being in Artificial Associative Systems?

Adrian Horzyk

AGH University of Science and Technology, Department of Automatics and Biomedicine Engineering, 30-059 Krakow, Mickiewicza Av. 30, Poland,
horzyk@agh.edu.pl
WWW home page: http://home.agh.edu.pl/~horzyk

Abstract. Knowledge is fundamental for intelligence and allows us to consider tasks and solve various problems. Knowledge is formed individually in brain during one's whole life. It can be verified, changed, specified and expanded. The knowledge is available through associations that can be automatically triggered in a context of previous thoughts, associations and changing happenings in surroundings. The associations are instantaneously triggered all the time in various brain parts. One association usually triggers another. The way of association can change accordingly to the surroundings, needs, emotions, and the current knowledge in time. The changes in knowledge influence individual processes of association and reasoning. All conclusions are knowledge dependent. This paper reveals and models some associative processes that take place in neural associative systems and enables them to form knowledge in an associative way. Such associative systems allow us also to exploit the knowledge in the similar way people do using associations, various contexts and previous states of neurons of the biological associative systems.

Keywords: knowledge representation, knowledge formation, knowledge engineering, associative knowledge, as-knowledge, artificial associative systems, associative neuron, as-neuron, associative reasoning, semassel.

1 Introduction

Knowledge is essential for intelligent intentional reasoning. Knowledge is nowadays often treated as a set of facts and rules, and implemented using various kinds of data bases and expert systems [6] [7] [9] or as an inner configuration of a neural network that has been created in a training process for a given set of training samples [12]. Human knowledge cannot work as a relational data base because the speed of neurons could not enable people fast associations in a process of looping and searching for suitable data taking into account a large amount of knowledge and remembered data. Moreover, brains of living creatures have no suitable structures for storing data tables that are currently commonly used in today's computer systems. On the other hand, the various kinds of artificial neural networks currently used in computational intelligence can be trained

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 201-212

recalled answers can be sometimes new and creative as a result of generalization. This is possible due to the limited context that as-neurons can take into account because they still gradually return to their resting states. Their under-threshold excitations can affect next activations and the associative process that creates the answers for the asked questions. Finally, the often activated as-neurons in close periods of time can be connected or reinforce existing connections.

The introduced artificial associative systems and their ANAKG subgraphs are able to form knowledge in an associative way. The trained systems can answer questions recalling artificial associations. The training process as well as the process of recalling associations is fast and contextual thanks to the introduced associative model of neurons. The context is not always sufficient for unambiguous activations and recalling trained sequences but this feature is beneficial in view of generalization and creativeness. If the context would be always precise then alternative and new associations will not be possible. Concluding, knowledge can be formed in the as-systems as a result of weighted consolidation of various facts and rules in accordance to their similarities and subsequent occurrences. Knowledge can be contextually evaluated by recalling some facts and rules as the result of activations of as-neurons. Some new facts and rules can be also created thanks to generalization mechanisms that works in these systems.

References

[1] Alberts, B., Bray, D., Hopkin, K., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P.: Basics of Cell Biology. PWN, Warsaw (2007)
[2] Horzyk, A.: Artificial Associative Systems and Associative Artificial Intelligence. EXIT, Warsaw, 1–276 (2013)
[3] Horzyk, A.: Information Freedom and Associative Artificial Intelligence. Springer-Verlag, Berlin - Heidelberg, LNAI 7267:81–89 (2012)
[4] Kalat, J.W.: Biological grounds of psychology. PWN, Warsaw (2006)
[5] Kossut, M.: The mechanisms of brain plasticity. PWN, Warsaw (1993)
[6] Larose, D.T.: Discovering knowledge from data. Introduction to Data Mining. PWN, Warsaw (2006)
[7] Ligeza, A., Kluza, K., Nalepa, G.J., Potempa, T.: Artificial Intelligence for Knowledge Management with BPMN and Rules. Proc. of AI4KM (2012)
[8] Longstaff, A.: Neurobiology. PWN, Warsaw (2006)
[9] Lachwa, A.: Fuzzy world harvest, numbers, relationships, facts, rules and decisions. EXIT, Warsaw (2001)
[101] Maass, W.: Networks of Spiking Neurons: The Third Generation of Neural Network Models. Neural Networks, 10:1659–1671 (1997)
[11] Padadimitriou, C.H.: Computational Complexity. WNT, Warsaw (2002)
[12] Tadeusiewicz, R., Neural networks. Publishing House RM, Warsaw (1993)
[13] Tadeusiewicz, R., New Trends in Neurocybernetics. Computer Methods in Materials Science, 10(1):1–7 (2010)
[14] Tadeusiewicz, R., Figura, I.: Phenomenon of Tolerance to Damage in Artificial Neural Networks, Computer Methods in Material Science, 11(4):501–513 (2011)
[15] Tadeusiewicz, R., Neural Networks as Computational Tool with Interesting Psychological Applications, Chapter in book: Computer Science and Psychology in Information Society, AGH Printing House, 49–101 (2011)

Integrated Analysis System to Improve Performance of Manned Assembly Line

Won K. Hwam, Yongho Chung, Sang C. Park

Dept. of Industrial Engineering, Ajou University, Woncheon, Suwon, Rep. of Korea
{lunacy, yongho1230, scpark}@ajou.ac.kr

Abstract. Presented in this paper is a framework for an integrated analysis system for performance improvement of a manned assembly line. In a manufacturing system, productivity is a key for competitiveness, for product output, and the performance of assembly line operations is one of the decisive factors of productivity. However, existing approaches to the manufacturing systems are limited to matters of the plant layout or the robot tasks design in the automated factory and to the manual work focused on the ergonomic based analysis. Consequently, a modern approach for line performance improvement has been researched as individual elements that contribute the line performance, but it has not been researched a framework to synchronize the elements as a productivity improvement activity in terms of an entire line. In other words, there is not a clear solution to integrate analysis results of micro and macro elements, which represent line capabilities in different levels. As a solution of this problem, this study proposes a framework for a system that focuses on the analysis result integration to improve performance of a manned assembly line, and shows a software tool that is implemented based on the proposed framework.

Keywords: Integrated Analysis, Manned Assembly Line, Performance Improvement, Productivity

1 Introduction

Productivity of a manufacturing system is the most important element that determines the enterprise competitiveness. Manufacturing enterprises must have an activity for productivity improvement continuously. A manned assembly line is one suitable manufacturing system to manufacture for better flexibility than the automated system. This system has been adopted in the industry for electronic appliances, i.e. television and refrigerator. In design of the manufacturing system, fully automated using dedicated tools for the system is hindered, because electronic appliances are many different products with frequent changes. The manned assembly line is structured by three factors of machine, worker and material (see Fig. 1), and the productivity is determined by machine capacity, worker performance and product design. After built up all the equipment and operation plans of assembly lines, it is difficult to modify the layout or replace the equipment. Therefore, improvement of the worker performance is an appropriate approach to the productivity enhancement of installed lines.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 213-222

every workstation of an assembly line are aligned to represent productivity of an assembly line in the line analysis. The line analysis result represent line balance efficiency and poor workstations that are required to be revised in the workstation analysis. Finally, the low line balance efficiency is revised by re-allocation of work elements to workstations of a line.

The implemented system based on the framework was already distributed to workfields. In the future study, we will research whether the system fits all requirements to analyze all issues of performance improvement in a manned assembly line, and show an example of workstation and line performance improvement.

Acknowledgements. This work (Grants No. C00035790100384919) was supported by Business for Cooperative R&D between Industry, Academy, and Research Institute funded Korea Small and Medium Business Administration in 2013. This work is also supported by the Defense Acquisition Program Administration (DAPA), the Agency for Defense Development (ADD) under the Contract No. UD110006MD (DAPA), UD100009DD & UD120035JD (ADD). The authors wish to express sincere gratitude for the financial support.

References

1. Askin, R. G., Chiu, S.: A graph partitioning procedure for machine assignment and cell formation in group technology. In: International Journal of Production Research. vol. 28(8), pp. 1555-1572. (1990)
2. Askin, R. G., Mitwasi, M. G.: Integrating Facility Layout with Process Selection and Capacity Planning. In: European Journal of Operation Research. vol. 57, pp. 162-173. (1992)
3. Bazargan-Lari, M.: Case Study: Layout Designs in Cellular Manufacturing. In: European Journal of Operation Research. vol. 112, pp. 258-272. (1999)
4. Chang, T. -C., Wysk, R. A.: An Introduction to Automated Process Planning Systems. In: Prentice-Hall, New Jersey. (1985)
5. Co, H., Araar, A.: Configuring cellular manufacturing systems. In: International Journal of Production Research. vol. 26(9), pp. 1511-1522. (1988)
6. Deb, S. K., Bhattacharyya, B.: Fuzzy decision support system for manufacturing facilities layout planning. In: Decision Support System. vol. 40, pp. 305-314. (2005)
7. Foulds, L. R., Gibbons, P. B., and Giffin, J.W.: Facilities layout adjacency determination: An experimental comparison three graph theoretic heuristics. In: Operations Research. vol. 33(5), pp. 1091-1106. (1985)
8. Freivalds, A., Niebel, B. W.: Niebel's Methods, Standards, and Work Design: Twelfth Edition. In: McGraw-Hill, New York. (2009)
9. Gilbreth, F. B., Motion Study: a Method for Increasing the Efficiency of the Workman. In: Van Nostrand, New York. (1911)
10. Gilbreth, F. B., Gilbreth, L. M.: Process Charts. In: The American Society of Mechanical Engineers, New York. (1921)
11. Golany, B., Rosenblatt, M. J.: A heuristic algorithm for the quadratic assignment formulation to the plant layout problem. In: International Journal of Production Research. vol. 27(2), pp. 293-308. (1989)

12. Graves, S. C.: Using Lagrangean techniques to solve hierarchical production planning problems. In: Management Science. vol. 28(3), pp. 260-275. (1982)
13. Hillier, F.S., Connors, M. M.: Quadratic assignment problem algorithms and the location of indivisible activities. In: Management Science. vol. 13(1), pp. 42-57. (1966)
14. Johnson, L. A., Montgomery, D. C. Operations Research for Production Planning, Scheduling, and lm'entory Control. In: John Wiley, New York. (1974)
15. Park, S. C., Chang, M.: Hardware-in-the-loop Simulation for a Production System. In: International Journal of Production Research. vol. 50(8), pp. 2321-2330. (2012)
16. Park, S. C., Choi, B. K.: Boundary Extraction Algorithm for Cutting Area Detection. In: Computer-Aided Design. vol. 33, pp. 571-579. (2001)
17. Park, S. C., Chung, Y. C.: Tool-path Generation from Measured Data. In: Computer-Aided Design. vol. 35, pp. 467-475. (2003)
18. Reifur, B.: Optimum Assembly Automation Level Selection Module as the Component of Advisory System. In: Archives of Civil and Mechanical Engineering. vol. 7(1), pp. 75-83. (2007)
19. Ruan, J., Eiamsa-ard, K., Liou, F. W.: Automatic Process Planning and Toolpath Generation of Multiaxis Hybrid Manufacturing System. In: Journal of Manufacturing Processes. vol. 7(1), pp. 57-68. (2005)

Formal Encoding and Verification of Temporal Constraints in Clinical Practice Guidelines

Marco Iannaccone, Massimo Esposito

National Research Council of Italy - Institute for High Performance Computing and Networking (ICAR), Naples, Italy
{iannaccone.m, esposito.m}@na.icar.cnr.it

Abstract. In the last decades, clinical practice guidelines have been formulated in order to help decision making about treating specific diseases and promote standards of care quality. Despite the efforts involved to provide solutions for both specifying and verifying temporal constraints in computerized guidelines, none of them is concerned with directly embedding the theoretic semantics of a formal language as the basis of a guideline formalism in order to easily and directly support the temporal perspective. In such a direction, this paper proposes a formal approach which has been seamlessly embedded into a standards-based verifiable guideline model, named GLM-CDS (GuideLine Model for Clinical Decision Support). Such an approach integrates the theoretic semantics of ontology and rule languages to specify and automatically verify a variety of temporal constraints. Such constraints are formulated according to some time patterns, i.e. task duration, periodicity, deadline, scheduling and time lags, and encoded as axioms/formulae verifiable at run-time during the guideline enactment, in order to detect violations or errors occurred with respect to the temporal perspective. As an example of application of the proposed approach, some temporal constraints have been implemented and integrated in GLM-CDS, according to the time patterns identified.

Keywords: Clinical Practice Guidelines, Decision Support Systems, Time Patterns, Temporal Constraints, Ontology, Rules.

1 Introduction

In the last decades, Clinical Practice Guidelines (hereafter, CPGs), embracing both clinical evidence and expert consensus, have been formulated in order to help decision making about treating specific diseases, promote standards of care quality and focus efforts to improve health outcomes when followed [15]. Several recent studies have suggested that an actual empowerment in the overall quality of care has been realized by encoding CPGs into advanced Decision Support Systems (hereafter, DSSs), i.e. computer-based systems designed to promote a better integration into the

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 223-234

References

1. Anselma, L., Terenziani, P., Montani, S., Bottrighi, A.: Towards a comprehensive treatment of repetitions, periodicity and temporal constraints in clinical guidelines. Artificial intelligence in medicine, 38(2), 171-195 (2006).
2. Boxwala, A.A., Peleg, M., Tu, S., Ogunyemi, O., Zeng, Q.T., Wang, D., Patel, V.L., Greenes, R.A., Shortliffe, E.H.: GLIF3: a representation format for sharable computer-interpretable clinical practice guidelines. J. Biomed. Inform., 37(3),147–161 (2004).
3. Duftschmid G, Miksch S, Gall W.: Verification of temporal scheduling constraints in clinical practice guidelines. ArtifIntell Med, 25(2), 93-121, (2002).
4. Field, M.J., Lohr, K.N.: Guidelines for Clinical Practice: From Development to Use. Washington, DC: Institute of Medicine, National Academy Press, (1992).
5. Fox, J., Johns, N.: Rahmanzadeh A. Disseminating medical knowledge: the PROforma approach. Artif. Intell. Med., 14, 157–181 (1998).
6. Health Level 7. HL7 Reference Information Model, Version 3. Available at http://www.hl7.org/implement/standards/rim.cfm.
7. Iannaccone, M., Esposito, M., De Pietro, G.: A Standards-based Verifiable Guideline Model for Decision Support in Clinical Applications. In Proc. of the Joint International Workshop KR4HC/ProHealth 2013 (2013).
8. International Health Terminology Standards Development Organisation. Systematized Nomenclature of Medicine (SNOMED). Available at http://www.ihtsdo.org/snomed-ct/.
9. Isern, D., Moreno, A.: Computer-based execution of clinical guidelines: a review. Int. J. Med. Inform., 77, 787–808 (2008).
10. Kautz H.A., Ladkin P.B.: Integrating metric and qualitative temporal reasoning. In: Proceedings 9th NationalConference on Artificial Intelligence (AAAI'91). AT&T Bell Laboratories, Murray Hill, NJ, USA. MenloPark (CA, USA): AAAI Press (1991).
11. Lanz, A., Weber, B., Reichert, M.: Time patterns for process-aware information systems. Requirements Engineering, 1-29, (2012).
12. Meiri I.: Combining qualitative and quantitative constraints in temporal reasoning. Artif Intell, 87, 343-385, (1996).
13. Mulyar, N., van der Aalst, W. M. P., Peleg, M.: A Pattern-based Analysis of Clinical Computer-interpretable Guideline Modeling Languages. J. Am. Med. Inform. Assoc., 14(6), 781–787 (2007).
14. Regenstrief Institute, Inc and the LOINC Committee. Logical Observation Identifiers Names and Codes (LOINC). Available at http://loinc.org/.
15. Scott, I.: What are the most effective strategies for improving quality and safety of health care? Internal Medicine Journal., 39(6), 389–400 (2009).
16. Seyfang, A., Miksch, S., Marcos, M.: Combining diagnosis and treatment using Asbru. Int. J. Med. Informat., 68(1–3), 49–57 (2002).
17. Shortliffe, E., Cimino, J.: Biomedical informatics: computer applications in health care and biomedicine (Health Informatics), Springer-Verlag New York, Inc., Secaucus, NJ, (2006).
18. Terenziani P.: Reasoning about time. Encyclopedia of cognitive science Macmillan Reference Ltd., 869-874, (2003).
19. Tu, S.W., Campbell, J. R., Glasgow, J., Nyman, M. A., McClure, R., McClay, J., Parker, C., Hrabak, K. M., Berg, D., Weida, T., Mansfield, J. G. Musen, M. A. Abarbanel R. M.,: The SAGE Guideline Model: Achievements and Overview. J. Am. Med. Inform. Assoc., 14, 589–598 (2007).
20. Tu, S.W., Musen, M. A.: Modeling data and knowledge in the EON guideline architecture. Stud. Health. Technol. Inform., 84(Pt 1), 280–284 (2001).

A Color Extraction Method from Text for Use in Creating a Book Cover Image that Reflects Reader Impressions

Takuya Iida[1], Tomoko Kajiyama[1*], Noritomo Ouchi[1] and Isao Echizen[2]

[1]Aoyama Gakuin University
5-10-1 Fuchinobe, Chuo-ku, Sagamihara-shi, Kanagawa, 252-5258 JAPAN
[*]tomo@ise.aoyama.ac.jp

[2]National Institute of Informatics
2-1-2 Hitotsubashi, Chiyoda-ku, Tokyo, 101-8430 JAPAN

Abstract. The image on a book cover gives potential buyers not only an impression of the book's contents but also a clue for search and browsing before or after buying the book. We propose using a color extraction method as the first step in automatically creating book cover images that reflect readers' impressions. We constructed a database expressing the relationships between adjectives and colors and extracted colors from text such as sentences in the book and user reviews. In an experiment with 20 participants who were tasked with reading a book, writing a review of the book, and drawing an image of the book cover, we demonstrated that the colors extracted using this method were more consistent with the colors in the images drawn by the participants than the colors in the actual cover, especially for novels, regardless of the amount of text in the book.

Keywords: color extraction, adjective, book cover image, user review, color psychology

1 Introduction

The use of electronic devices for reading digital books is quickly spreading, and the market for digital books is growing rapidly [6]. There are two basic types of digital books: printed books that have been digitalized and books prepared only in digital form. The use of electronic devices for reading has changed not only how people read books but also how they select books. Moreover, some digital books come without a cover, unlike printed books.

A book cover serves an important function—it gives potential buyers an impression of the book. Therefore, digital book sold online [2,3] that have been in the public domain or are original digital books and are provided without book cover images. They are often given images containing only the book title with a standard design. The colors in the image are defined on the basis of the genre or are simply random.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 235-244

oped a method for extracting colors from texts such as digital books and user reviews. We evaluated this method experimentally by tasking 20 participants to read a book, write a report about it, and draw an image of the book's cover. We found that (1) the degree of coincidence between colors extracted from our method and colors extracted from p-cover images was higher when the text was extracted from both books and reviews than when it was extracted from only the books, (2) there is sometimes a difference between the actual cover and the readers' impressions after reading it, (3) our method can extract colors related to the reader impressions regardless of the number of letters in the book, and (4) our method is works better for novels than for reviews. We have demonstrated that our method can extract colors for use in creating book cover images that reflect the reader impressions.

To create an effective cover image reflecting readers impressions, it is necessary not only to improve the accuracy of the color extraction by enhancing the word analysis but also to optimize the arrangement of the extracted colors, to extract symbolic objects from body text, and to represent bibliographic information (title, authors, etc.).

References

1. Akamatsu N. The Effects of First Language Orthographic Feature on Second Language Reading in Text, Language Learning, Vol.53, No.2, pp.207-231, 2003.
2. Aozora Bunko, http://www.aozora.gr.jp/
3. Calibre, http://calibre-ebook.com/
4. Choice Stream Survey Reports, http://www.choicestream.com/who/pressrelease.php?id=95
5. Dawes, R.M., Singer, D., Lemons, F. An experimental analysis of the contrast effect and its implications for intergroup communication and the indirect assessment of attitude, Journal of Personality and Social Psychology, Vol.21, No.3, pp.281-295, 1972.
6. ICT Research & Consulting, http://www.ictr.co.jp/topics_20110714.html
7. Interwred TimelyResearch, http://www.dims.ne.jp/timelyresearch/2009/090202/
8. Kobayashi S. Color Image Scale, Kodansha, 2001.
9. Libura, http://libura.com/
10. Miyagawa T. et.al. Automation of back cover image generation in virtual bookshelf, Vol. 30, pp.25-38, 2006.
11. Ohso M. Verbs and Adjectives of Emotion in Japanese, Studies in Language and Culture, Vol.22, No.2, pp.21-30, 2001.
12. Oyama T. Introduction of Color Psychology. Chuokoron-shinsha, 1994.
13. Shinsho-map, http://bookshelf.shinshomap.info/
14. Simazaki K. Psychological Color, Bunka-shobo-hakubunnsha, 1990.
15. Weblio Thesaurus, http://thesaurus.weblio.jp/

Acknowledgments. This research was supported in part by a Japan Society for the Promotion of Science Grant-in-Aid for Young Scientists (B) (No. 20454085) and the Telecommunications Advancement Foundation. We greatly appreciate the help of the participants in the experiment.

On the role of computers in creativity-support systems

Bipin Indurkhya

Department of Computer Science
AGH University of Science and Technology
Cracow, Poland
bipin@agh.edu.pl

Cognitive Science Lab
International Institute of Information Technology
Hyderabad, India
bipin@iiit.ac.in

Abstract. We report here on our experiences with designing computer-based creativity-support systems over several years. In particular, we present the design of three different systems incorporating different mechanisms of creativity. One of them uses an idea proposed by Rodari to stimulate imagination of the children in writing a picture-based story. The second one is aimed to model creativity in legal reasoning, and the third one uses low-level perceptual similarities to stimulate creation of novel conceptual associations in unrelated pictures. We discuss lessons learnt from these approaches, and address their implications for the question of how far creativity can be tamed by algorithmic approaches.

Keywords: Algorithmic creativity, creativity-support systems, conceptual similarities, legal reasoning, perceptual similarities, stimulating creativity.

1 Introduction

Even though the last few decades have seen a steady progress in the development of computer systems that produce artifacts in the domain of visual art [7] [37], music [6] [34] [38], literature [33] [42]; and so on, generally they have received a negative press as regard to their creativity: computers cannot have emotions, programs do not have intents, creativity cannot be algorithmic, etc. etc. [4] [48]. Even designers of computational creativity systems seem to take an apologetic tone when it comes to ascribing creativity to their systems. For example, Colton [8] argues that it is not enough to generate an interesting or creative artifact, but one must also take into account the process by which the artifact was generated. Krzeczkowska *et al*. [32] took pains to project some notion of purpose in their painting tool so that it might be perceived as creative. Such views blatantly expose the implicit assumptions underlying creativity: namely that it crucially needs a creator with emotions, intentions, and such. A consequence of this view is that creativity is considered an essentially human trait, and cannot be ascribed to computer programs or AI systems (or to animals like elephants and gorillas).

We critically examine this traditional view in the light of our previous experiences in designing creativity-support systems and modeling creativity. We present three such

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 245-256

order to be useful for at least some audience [2] [47] [56]. For novelty, research on real-world creativity shows that it is difficult for people to step out of their conventional and habitual conceptual associations. To overcome this inertia, several methods like making the familiar strange [15], concept displacement [49], bisociation [30], lateral thinking [11], estrangement [45], conceptual blending [12], and so on, have been proposed in the literature. However, computers do not have this inertia, and so they can be very effectively used to generate novel ideas. This argument has been presented in more detail elsewhere [26]. Our experience in developing creativity-assistive systems (reviewed in Sec. 2 above) lends supports to this hypothesis.

However, when it comes to incorporating usefulness of the generated perspective or idea, our feeling is that, in principle, it is not possible to capture this aspect of creativity algorithmically. As this is a negative conclusion, we cannot really offer evidence to support it, but we hope that the arguments presented in Sec. 3 above are persuasive. Notwithstanding this hypothesis, we do not rule out the possibility that in limited domains it may be possible to characterize usefulness algorithmically, and design and implement computer systems that can generate statistically a larger number of useful and interesting artifacts and ideas. So combining this with novelty-generating systems, we can have computer systems that are creative. Systems like Aaron exemplify this approach.

Nonetheless, even in a limited domain, once the usefulness is characterized algorithmically, it loses its novelty, and gradually ceases to be creative. (See, for instance, the model of literary style change proposed by Martindale [36].) So while, we may be able to model some aspect of creativity within a style (with respect to usefulness), it remains doubtful whether creative changes in styles can be modeled successfully in a universal way. Again, to emphasize, novelty can be modeled — it is relatively easy to computationally generate new styles, but the problem is incorporate which styles will be successful (meaning people will adapt to them and find them useful). Therefore, our conjecture is that this second aspect of creativity will always remain the last frontier for the computational modeling techniques.

References

1. Abraham, A., Windmann S., McKenna P., Güntürkün, O.: Creative Thinking in Schizophrenia: The Role of Executive Dysfunction and Symptom Severity. Cognitive Neuropsychiatry 12(3), pp. 235–2581 (2007).
2. Amabile, T. M.: Creativity in context. Westview Press, Boulder, CO (1996).
3. Barthes, R.: The Death of the Author. In R. Barthes, Image Music Text (trans. S. Heath), London: Fontana (1977). Original work published 1967.
4. Boden, M. A.: Computer Models of Creativity, AAAI AI Magazine *30*(3), pp. 23-33 (2009).
5. Chalmers, D.J., French, R.M., Hofstadter, D.R.: High-Level Perception, Representation, and Analogy:A Critique of Artificial Intelligence Methodology. Journal of Experimental and Theoretical Artificial Intelligence 4 (3), pp. 185–211, (1992).
6. Chordia, P., Rae, A.: Tabla Gyan: An Artificial Tabla Improviser, Proceedings of the International Conference on Computational Creativity: ICCC-X, Lisbon, Portugal (2010).
7. Cohen, H.: On Modeling of Creative Behavior. Rand Corporation Report Series, P-6681 (1981).

8. Colton, S.: Creativity versus the Perception of Creativity in Computational Systems. Proceedings of the AAAI Spring Symposium on Creative Systems (2008).
9. Cropley, D.H., Kaufman, J.C., Cropley, A. J.: Measuring Creativity for Innovation Management, Journal of Technology Management & Innovation 6(3), pp. 13-30 (2011).
10. Csikszentmihalyi, M.: Creativity: Flow and the psychology of discovery and invention. New York: HarperCollins (1996).
11. de Bono, E.: New Think: The Use of Lateral Thinking in the Generation of New Ideas. Basic Books, New York (1975).
12. Fauconnier, G., Turner, M.: The Way We Think: Conceptual Blending and the Mind's Hidden Complexities. Basic Books, New York (2002).
13. Gineste, M.-D., Indurkhya, B., Scart, V.: Emergence of features in metaphor comprehension. Metaphor and Symbol 15(3), pp. 117-135 (2000).
14. Glicksohn, J.: Schizophrenia and Psychosis. In M.A. Runco & S.R. Pritzker (Eds.) Encyclopedia of Creativity, (2nd ed.), New York: Academic Press (2011).
15. Gordon, W.J.J.: Synectics: The Development of Creative Capacity. Harper & Row, New York (1961).
16. Harry, H.: On the role of machines and human persons in the art of the future. Pose 8, pp. 30–35 (1992).
17. Hart, C.: The prehistory of flight. University of California Press (1985).
18. Hofstadter, D., The Fluid Analogies Research Group: Fluid Concepts and Creative Analogies. Basic Books, New York (1995).
19. Horn, D., Salvendy, G.: Consumer-based assessment of product creativity: A review and reappraisal. Human Factors and Ergonomics in Manufacturing & Service Industries 16(2), pp. 155-175 (2006).
20. Indurkhya, B.: Metaphor and Cognition. Kluwer Academic Publishers, Dordrecht, The Netherlands (1992).
21. Indurkhya, B.: On Modeling Creativity in Legal Reasoning. In Proceedings of the Sixth International Conference on AI and Law, pp. 180-189. Melbourne, Australia (1997).
22. Indurkhya, B.: An Algebraic Approach to Modeling Creativity in Metaphor. In C.L. Nehaniv (ed.) Computation for Metaphors, Analogy and Agents. LNAI, Vol. 1562, pp. 292–306. Springer-Verlag, Berlin (1999).
23. Indurkhya, B.: Emergent representations, interaction theory, and the cognitive force of metaphor. New Ideas in Psychology 24(2), pp. 133–162 (2006).
24. Indurkhya, B.: On the role of metaphor in creative cognition. Proceedings of the International Conference on Computational Creativity: ICCC-X, Lisbon, Portugal (2010).
25. Indurkhya, B.: Thinking like a child: the role of surface similarities in stimulating creativity. In G. Stojanov and B. Indurkhya (Eds.) Proceedings of the AAAI Spring Symposium on Creativity and (Early) Cognitive Development, pp. 38–43. Palo Alto, CA: AAAI Press (2013).
26. Indurkhya, B.: Computers and creativity. In T. Veale, K. Feyaerts, & C. J. Forceville (eds.) Creativity and the Agile Mind, pp. 61-79. Berlin: De Gruyter Mouton (2013).
27. Indurkhya, B., Kattalay, K., Ojha, A., Tandon, P.: Experiments with a Creativity-Support System based on Perceptual Similarity. In H. Fujita and I. Zualkernan (eds.) New Trends in Software Methodologies, Tools and Techniques, pp. 316–327. IOS Press: Amsterdam (2008).
28. Indurkhya, B., Ogawa, S.: An Empirical Study on the Mechanisms of Creativity in Visual Arts. In N. Miyake, D. Peebles & R.P. Cooper (Eds.) Proceedings of the 34th Annual Conference of the Cognitive Science Society, pp.1727-1732. Austin, TX: Cognitive Science Society (2012).
29. Ishii, Y., Indurkhya, B., Inui, N., Nose, T., Kotani, Y., Nishimura, H.: A System Based on Rodari's 'Estrangement' Principle to Promote Creative Writing in Children. Proceedings of Ed-Media & Ed-Telecom 98, pp. 1685–1686, Freiburg, Germany (1998).

30. Koestler, A.: The Act of Creation. Hutchinsons, London (1964).
31. Kozbelt, A.: Factors Affecting Aesthetic Success and Improvement in Creativity: A Case Study of the Musical Genres of Mozart. Psychology of Music 33(3), pp. 235–255 (2005).
32. Krzeczkowska, A., Colton, S., Clark S.: Automated Collage Generation – With Intent. Proceedings of the International Conference on Computational Creativity: ICCC-X, Lisbon, Portugal (2010).
33. Kurzweil, R.: Cybernetic Poet. http://www.kurzweilcyberart.com/poetry/ (2001). Last accessed on 29 January, 2012.
34. López, A.R., Oliveira, A.P., & Cardoso, A.: Real-Time Emotion-Driven Music Engine. Proceedings of the International Conference on Computational Creativity: ICCC-X, Lisbon, Portugal (2010).
35. Maher, M.L.: Evaluating Creativity in Humans, Computers, and Collectively Intelligent Systems, DESIRE'10: Creativity and Innovation in Design, Aarhus, Denmark (2010).
36. Martindale, C.: The clockwork muse: The predictability of artistic change. New York: Basic Books (1990).
37. McCorduck, P.: Aaron's code: Meta-art, artificial intelligence, and the work of Harold Cohen. New York: W. H. Freeman (1991).
38. Monteith, K., Martinez, T., Ventura, D.: Automatic Generation of Music for Inducing Emotive Response. Proceedings of the International Conference on Computational Creativity: ICCC-X, Lisbon, Portugal (2010).
39. Ni, Y., Santos-Rodriguez, R., Mcvicar, M., & De Bie, T.: Hit Song Science Once Again a Science? Presented at the 4th International Workshop on Machine Learning and Music: Learning from Musical Structure, Sierra Nevada, Spain (2011).
40. Ojha, A. & Indurkhya, B.: Perceptual vs. conceptual similarities and creation of new features in visual metaphor. In B. Kokinov, K. Holyoak & D. Gentner (Eds.) New Frontiers in Analogy Research, Sofia: New Bulgarian University Press (2009).
41. Painter, K.: Mozart at Work: Biography and a Musical Aesthetic for the Emerging German Bourgeoisie. The Musical Quarterly 86(1), 186–235 (2002).
42. Pérez y Pérez, R., Negrete, S., Peñalosa, E., Ávila, R., Castellanos, V., Lemaitre, C.: MEXICA-Impro: a Computational Model for Narrative Improvisation. Proceedings of the International Conference on Computational Creativity: ICCC-X, Lisbon, Portugal (2010).
43. Ramachandran, V.S., Hirstein, W.: The Science of Art: A neurological theory of aesthetic experience, Journal of Consciousness Studies 6(6-7), pp. 15–51 (1999).
44. Riesbeck C.K., Schank R.C.: Inside case-based reasoning. Hillsdale (New Jersey): Lawrence Erlbaum & Associates (1989).
45. Rodari, G.: The Grammar of Fantasy (J. Zipes, Trans.) Teachers & Writers Collaborative, New York (1996).
46. Sacks, O.: An Anthropologist on Mars: Seven Paradoxical Tales. New York: Alfred A. Knopf (1995).
47. Sarkar, P. & Chakrabarti, A.: Development of a method for assessing design creativity. International Conference on Engineering Design ICED'07, pp. 28-31 August, Cite des Sciences et de L'Industrie, Paris, France (2007).
48. Sawyer, K.: Explaining Creativity. Oxford University Press (2006).
49. Schön, D.A.: Displacement of Concepts. Humanities Press, New York (1963).
50. Singh, S.: Big Bang. New York: Harper Collins (2004).
51. Suzuki, H., Hiraki, K. : The constraint relaxation process as theory change: Toward theorizing the process of insight. (In Japanese.) Proceedings of the Japanese Cognitive Science Society's Special Interest Group on Language & Learning 97 (1), pp. 33–42 (1997).
52. Szabo, G., Huberman, B.A.: Predicting the Popularity of Online Content. Communications of the ACM 53(8), pp. 80–88 (2010).

53. Tandon, P., Nigam, P., Pudi, V. and Jawahar, C.V.: FISH: A Practical System for Fast Interactive Image Search in Huge Data bases. Proceedings of 7th ACM International Conference on Image and Video Retrieval (CIVR '08), Niagara Falls, Canada (2008).
54. Veale, T.: Re-Representation and Creative Analogy: A Lexico-Semantic Perspective. New Generation Computing, 24 (3), pp. 223-240 (2006).
55. Veale, T., Hao, Y.: A Fluid Knowledge Representation for Understanding and Generating Creative Metaphors. Proceedings of COLING 2008, pp. 1–5. Manchester (2008).
56. Yong, K., Lander, M.W. & Mannucci, P.V.: Novelty x Usefulness: Actor-level Effects and Cultural Influences on Creativity in Organizations. 35th DRUID Celebration Conference, Barcelona, Spain, June 17-19 (2013).
57. Zeki, S.: Inner Vision: An Exploration of Art and the Brain. Oxford (UK): Oxford University Press (2000).

Similarity of Exclusions in the Concept Space

Agnieszka Jastrzebska

Faculty of Mathematics and Information Science
Warsaw University of Technology
ul. Koszykowa 75, 00-662 Warsaw, Poland
A.Jastrzebska@mini.pw.edu.pl

Abstract. The study is devoted to a developed model of formal knowledge representation. The author presents concept and feature spaces. Concepts correspond to existing entities and are described by their features. Valuation mapping matches evaluated features with the underlying concept space. The author is interested in relations structuring knowledge. The goal of this article is to investigate exclusion and similarity in the spaces of features and concepts. Three types of exclusions: weak, strict, and multiple qualitative are defined and discussed. Similarity of features evaluation vectors satisfying relations of weak or strict exclusion is thoroughly analyzed. Research on similarity is presented from two distinct points of view. First approach relies on direct features comparison. Second methodology uses dedicated similarity relation rooted in the underlying concept space.

Key words: concept space, feature space, similarity, exclusion, similarity of excluding features

1 Introduction

Formal models of knowledge and relations within data are important not only from theoretical, but also from applicational point of view. The literature discusses various approaches to knowledge representation and structuralization, for example ontologies or cognitive maps. In this paper the author presents a model of concept and feature spaces. The aim is to investigate relations in feature and concept spaces. In this study attention is paid to similarity and exclusion. Author's inspiration was the world of consumers. Hence, examples are related to common life situations, including purchasing choices.

The paper is structured as follows. In Section 2 a framework which formalizes feature and concept spaces is presented and a vector-based representation model is described. Valuation mapping, which allows to relate feature space with concepts, is introduced. Similarity relation customized for the developed model is presented. Section 3 is devoted to exclusion relations. Three distinct definitions of strict, weak and multiple qualitative exclusions are given. Section 4 discusses similarity of features satisfying weak or strict exclusion relations. Two distinct methodologies of calculating similarity for such features vectors are investigated.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 257-268

To take full advantage of dependencies in the concept space, the second proposed methodology should be used. It calculates similarity of concepts' descriptions through the underlying concept space. The key is the valuation mapping, which relates features with concepts. An alternative and very flexible way of obtaining similarity of two vectors of features evaluations satisfying the relation of weak or strict exclusion is to calculate dependency directly with a distance-based measure.

In future, the author plans to extend the scope of research on other information representation models.

Acknowledgment

A. Jastrzebska contribution is supported by the Foundation for Polish Science under International PhD Projects in Intelligent Computing. Project financed from The European Union within the Innovative Economy Operational Programme (2007-2013) and European Regional Development Fund.

References

1. Atanassov K. T., *Intuitionistic fuzzy sets*, Fuzzy Sets and Systems 20, 1986, pp. 87-96.
2. Goshtasby A.A., *Image Registration*, in: Advances in Computer Vision and Pattern Recognition Series, London: Springer, 2012.
3. Homenda W., *Balanced Fuzzy Sets*, Information Sciences, Vol. 176, Issue 17, 2006, pp. 2467-2506.
4. Homenda W., Pedrycz W., *Symmetrization of fuzzy operators: Notes on data aggregation*, in: Computational Intelligence for Modelling and Prediction. Studies in Computational Intelligence, Vol. 2, 2005, pp. 1-17.
5. Homenda W., Pedrycz W., *Balanced fuzzy computing unit* in: International Journal of Uncertainty Fuzziness and Knowledge-Based Systems, Vol. 13, Issue 2, 2005, pp. 117-138.
6. Homenda W., Pedrycz W., *Balanced fuzzy gates*, in: LNAI 4259, 2006, pp. 107-116.
7. Hung W., Yang M., *Similarity measures of intuitionistic fuzzy sets based on Hausdorff distance*, in: Pattern Recognition Letters 25, 2004, pp. 16031611.
8. Julian-Iranzo P., *A procedure for the construction of a similarity relation*, in: proc. of IPMU'08, 2008, pp. 489 - 496.
9. Klawonn F., Kruse R., *Similarity Relations and Independence Concepts*, in: G. Della Riccia, D. Dubois, R. Kruse, H.-J. Lenz (eds.): Preferences and Similarities, Springer, Wien, 2008, pp. 179 - 196.
10. Lin D., *An Information-Theoretic Definition of Similarity*, in: ICML '98 Proceedings, 1998, pp. 296-304.
11. Orozco J., Belanche L. ,*On Aggregation Operators of Transitive Similarity and Dissimilarity Relations*, in: FUZZ-IEEE, 2004, pp. 1373-1377.
12. Schoenauer S., *Efficient Similarity Search in Structured Data*, PhD Dissertation defended at the Ludwig-Maximilians-Universitaet Muenchen, 2003.
13. Szmidt E., Kacprzyk J., *A Similarity Measure for Intuitionistic Fuzzy Sets and Its Application in Supporting Medical Diagnostic Reasoning*, LNAI 3070, pp. 388-393, 2004.
14. Tversky, A., *Features of Similarity*, Psychological Reviews 84(4), 1977, pp. 327-352.
15. Information on ECTS system:
`http://ec.europa.eu/education/lifelong-learning-policy/ects_en.htm`

Modeling Behavioral Biases Using Fuzzy and Balanced Fuzzy Connectives

Agnieszka Jastrzebska[1] and Wojciech Lesinski[2]

[1] Faculty of Mathematics and Information Science
Warsaw University of Technology
ul. Koszykowa 75, 00-662 Warsaw, Poland
A.Jastrzebska@mini.pw.edu.pl
[2] Faculty of Mathematics and Computer Science
University of Bialystok
ul. Sosnowa 64, 15-887 Bialystok, Poland
wlesinski@ii.uwb.edu.pl

Abstract. Authors present consumer decision making model built with respect to Lewin's field theory and Maslow's needs theory. A two-phase procedure for obtaining the decision is introduced. Consumer's opinions regarding arguments speaking for or against the decision are gathered in premises (general opinions) and priorities (particular attitudes) vectors. Premises and priorities are aggregated with balanced norms. The authors set focus on capturing complex aspects of the decision making process, namely imprecise, gradual information and behavioral biases. Various balanced norms, which allow to include biases and compute decisions, are investigated and described. Presented model joins psychological theories of motivation and decision making with balanced norms. The aim of this study is to show that well-known operators have powerful modeling capabilities and may be applied to describe complex aspects of human behavior.

Key words: multiple criteria decision making, behavioral biases, triangular norms, balanced norms

1 Introduction

Decision making is a cognitive process, which aims at expressing individual's preferences. It is based on input arguments and on subject's cognitive abilities. Cognitive abilities determine how one processes information. Specialists have observed systematic deviations from behavior considered as rational. These unexpected, but yet often occurring phenomena are called behavioral or cognitive biases. The research on cognitive biases is crucial in decision making.

Decision making has been discussed by scientists representing fields of economics, information sciences, mathematics and psychology. This article presents an interdisciplinary approach to decision making. The objective of this paper is to discuss various fuzzy sets connectives generalizations and their application to decision making modeling with behavioral biases taken into account.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 269-278

The article presents how, using various pairs of balanced t-norms and t-conorms, we can model decision making based on both unipolar and bipolar information. Developed approach enables to capture complex aspects of this process, including imprecise, gradual knowledge and behavioral biases. The choice of operators determines the output. It is beneficial to apply balanced norms obtained with generating functions, adjusted to modeled phenomena. Balanced norms provide a solid framework for consumer decision making modeling. Modeling complex phenomena, like consumer behavior requires careful model preparation. In future research we plan to look closer into other information representation models, especially ones based on bivariate scales (with separate scale for negative and positive influences).

Acknowledgment

The research is partially supported by the National Science Center, grant No 2011/01/B/ST6/06478.

A. Jastrzebska contribution is supported by the Foundation for Polish Science under International PhD Projects in Intelligent Computing. Project financed from The European Union within the Innovative Economy Operational Programme (2007-2013) and European Regional Development Fund.

References

1. Dubois D., Fargier H., *Qualitative Decision Making with Bipolar Information*, in: KR 2006, pp. 175-186.
2. Dubois D., Prade H., *Gradualness, uncertainty and bipolarity: Making sense of fuzzy sets*, in: Fuzzy Sets and Systems Vol. 192, 2012, pp. 324.
3. Homenda W., *Triangular norms, uni- and nullnorms, balanced norms: the cases of the hierarchy of iterative operators*, in: Proc. of the 24th Linz Seminar on Fuzzy Set Theory, 2003, pp. 27-35.
4. Homenda W., *Balanced Fuzzy Sets*, in: Information Sciences 176, 2006, pp. 2467-2506.
5. Homenda W., Pedrycz W., *Processing of uncertain information in linear space of fuzzy sets*, in: Fuzzy Sets and Systems 44, 1991, pp. 187-198.
6. Jastrzebska A., *Modeling Decision Making with Respect to Consumers Psychographical Portrait*, in: reports of ICS PAS, in press.
7. Klement E. P., Mesiar R., Pap E., *Triangular norms*, Kluwer Academic Publishers, Dordrecht, 2000.
8. Lewin K., *Field theory in social science; selected theoretical papers.*, D. Cartwright (Ed.)., USA, New York: Harper & Row, 1951.
9. Maslow A., *A Theory of Human Motivation*, in: Psychological Review, 50(4), 1943, pp. 370-396.
10. Maslow A., *Towards a Psychology of Being, 2nd ed.*, D. Van Nostrand Co., New York, 1968.
11. Simon H. A., Egidi M., Viale R., Marris R. L., *Economics, Bounded Rationality and the Cognitive Revolution*, Edward Elgar Publishing, 2008.
12. Wakker P. P., *Prospect Theory: For Risk and Ambiguity*, New York: Cambridge University Press, 2010.

Optical Music Recognition as the Case of Imbalanced Pattern Recognition: a Study of Single Classifiers

Agnieszka Jastrzebska[1] and Wojciech Lesinski[2]

[1]Faculty of Mathematics and Information Science, Warsaw University of Technology
Plac Politechniki 1, 00-660 Warsaw, Poland
and
[2]Faculty of Mathematics and Computer Science, University of Bialystok
ul. Sosnowa 64, 15-887 Bialystok, Poland

Abstract. The article is focused on a particular aspect of classification, namely the imbalance of recognized classes. The paper contains a comparative study of results of musical symbols classification using known algorithms: k-Nearest Neighbors, k-means, Mahalanobis minimal distance and decision trees. Authors aim at addressing the problem of imbalanced pattern recognition. Firstly, we theoretically analyze difficulties entailed in classification of music notation symbols. Secondly, in the enclosed case study we investigate the fitness of named single classifiers on real data. Conducted experiments are based on own implementations of named algorithms with all necessary image processing tasks. Results are highly satisfying.
Keywords: pattern recognition, classification, imbalanced data

1 Introduction

The problem of pattern recognition is a data mining branch studied and developed for many years now. In a number of its applications, satisfying results have already been achieved, however, in many fields it is still possible to obtain better results. Certainly, one of the possible research fields is the issue of imbalanced data. For the purposes of this paper, the issue of imbalanced data can be defined as a case in which there are one or more of the following characteristics:

1. there are significant differences in the number of elements between classes;
2. elements within the same class have shapes that do not overlap;
3. objects belonging to different classes are very different in size;
4. objects in different classes are both simple and complex.

In this paper, the issue of imbalanced data is illustrated on the example of music notation symbols. The characters on the score have all of the four characteristics given above.

Musical notation symbols appear with varied frequency. Some of them, such as quarter and eighth notes, are very common, often appearing several times

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 279-290

References

1. Bishop C. M., Pattern Recognition and Machine Learning. Springer, 2006
2. Breiman L., Friedman J., Stone C. J., and Olshen R. A., Classification and Regression Trees. Wadsworth, Belmont, 1984
3. Chen C., Liaw A., and Breiman L. Using random forest to learn imbalanced data. Technical report, Dept. of Statistics, U.C. Berkeley, 2004.
4. Cover T. M. and Hart P. E. Nearest neighbor pattern classification. IEEE Transaction on Information Theory, 1(13):21 - 27, 1967.
5. Duda R. O., Hart P. E. and Stork D. G. (2001) Pattern Classification, John Wiley & Sons, Inc., New York, 2001
6. Garcia V., Sanchez J. S., Mollineda R. A., Alejo R. and Sotoca J. M. The class imbalance problem in pattern recognition and learning. In II Congreso Espanol de Informatica, pp. 283 - 291, 2007
7. Hartigan J. A. and Wong M. A. A k-means clustering algorithm. Applied Statistics, 28, pp. 100 - 108, 1979
8. Homenda W., Balanced Fuzzy Sets, in: Information Sciences 176, pp. 2467 2506, 2006.
9. Homenda W., Optical Music Recognition: the Case Study of Pattern Recognition, in: Computer Recognition Systems, Kurzyski et al (Eds.), pp. 835-842, 2005.
10. Homenda W., Pedrycz W., Balanced Fuzzy Gates, in: S. Greco et al. (Eds.), LNAI 4259, pp. 107116, 2006.
11. Homenda W., Pedrycz W., Symmetrization of Fuzzy Operators: Notes on Data Aggregation, in: Studies in Computational Intelligence, (Eds.), S. K. Halgamuge, L. Wang, pp. 1-18, 2005.
12. Kurzynski M. Statistical pattern recognition (in Polish), Publishing House of Wroclaw University of Technology, Wroclaw, 1997
13. Rebelo A., Fujinaga I., Paszkiewicz F., Marcal A. R. S., Guedes C. and Cardoso J. S. Optical music recognition: state-of-the-art and open issues. International Journal of Multimedia Information Retrieval, 1, pp. 173- 190, 2012.
14. Quinlan, J. R. Induction of Decision Trees. Machine Learning 1, pp. 81-106, 1986
15. Breaking accessibility barriers in information society. Braille Score - design and implementation of a computer program for processing music information for blind people, the research project no N R02 0019 06/2009 supported by by The National Center for Research and Development 2009-2012
16. Cognitive maps with imperfect information as a tool of automatic data understanding. Ideas, methods, applications, the research project no 2011/01/B/ST6/06478 supported by the National Science Center, 2011-2014

Building Internal Scene Representation in Cognitive Agents

Marek Jaszuk[1] and Janusz A. Starzyk[2,1]

[1] University of Information Technology and Management, ul. Sucharskiego 2, Rzeszów, Poland,
[2] School of Electrical Engineering and Computer Science, Ohio University, Athens, OH 45701 USA
marek.jaszuk@gmail.com,starzykj@ohio.edu

Abstract. Navigating in realistic environments requires continuous observation of a robots surroundings, and creating internal representation of the perceived scene. This incorporates a sequence of cognitive processes, including attention focus, recognition of objects, and building internal scene representation. The paper describes selected elements of a cognitive system, which implement mechanisms of scene observation based on visual saccades, followed by creating the scene representation based on a distance matrix. Such internal representation is a foundation for scene comparison, necessary for recognizing known places, or changes in the environment.

Keywords: visual saccades, scene model, episodic memory

1 Introduction

Humans are capable of intelligently acting in complex environments. For instance, we can find our destination in a city, interact with other people to exchange information or arrange objects in a room in a suitable way. In these tasks, we outperform current men built systems such as autonomous robots. Thus it is highly desirable to develop artificial agents, which will be able to support us in performing a rich variety of tasks, both in our daily environment, as well as in dangerous and inaccessible places.

For this purpose we devise computer models of intelligent information processing called cognitive systems [5]. Such systems should be able to collect and process a stream of sensory data to create internal representation of the environment, and undertake the proper actions. The original foundations for cognitive systems come from psychological theories and are also a part of artificial intelligence research. Such systems are composed of various components that mimic different mental functions. Among their most important elements are: sensory and motor functions, as well as different kinds of memory, including semantic, episodic, procedural, and working memory.

It is known that to carry out a successful navigation in complex environments, mobile robots must acquire and maintain internal representation of the

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 291-302

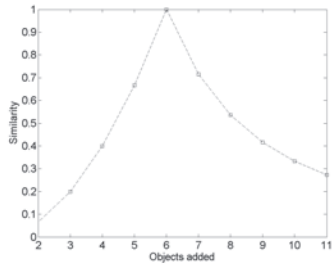


Fig. 8. Similarity for each step of the experiment

comparison, which can be used for comparing the currently observed scene with the contents of the episodic memory. The same mechanism can be applied to analysis of complex objects contained within scenes.

Sample experiments based on a virtual 3D environment were performed, in which the performance of the proposed similarity measure was demonstrated. The results show, that the proposed methodology gives satisfying results, however, the scene created in the virtual environment is simplified, and of much smaller complexity, than real world scenes. Thus the aim of future work will be extending the system to be able to process all the data delivered by a video stream, either registered in the virtual simulation or in real environment. The other research direction is developing a method for objects representation. In the current version of our system the objects have no internal structure.

Acknowledgement

The research is supported by The National Science Centre,
grant No. 2011/03/B/ST7/02518.

References

1. Begum, M., Karray, F.: Visual Attention for Robotic Cognition: A Survey. IEEE Trans. Auton Ment. Devel. 3(1), 92-105 (2011)
2. Brooks, R.: Intelligence without representation, Artif. Int. 47, 139-159 (1991)
3. Frintrop, S., Rome, E., Christensen H.I.: Computational Visual Attention Systems and their Cognitive Foundation: A Survey, ACM T. Appl. Percept. 7(1), 1-39 (2010)
4. Hartley, R., Zisserman, A.: Multiple view geometry in computer vision. Cambridge University Press, Cambridge (2003)
5. Langley, P., Laird, J.E., Rogers, S.: Cognitive architectures: Research issues and challenges. Cogn. Syst. Res. 10, 141-160 (2009)
6. The NeoAxis Game Engine, http://www.neoaxis.com/
7. Starzyk, J.A., Graham, J.T., Raif, P., Tan, A-H.: Motivated Learning for the Development of Autonomous Systems, Cogn. Syst. Res. 14, 10-25 (2012)
8. Yarbus, A.: Movements of the eyes, Plenum Press, New York (1967)

Selflocalization and Navigation in Dynamic Search Hierarchy for Video Retrieval Interface

Tomoko Kajiyama[1] and Shin'ichi Satoh[2]

[1]Aoyama Gakuin University
5-10-1 Fuchinobe, Chuo-ku, Sagamihara-shi, Kanagawa, 252-5258 JAPAN
tomo@ise.aoyama.ac.jp

[2]National Institute of Informatics
2-1-2 Hitotsubashi, Chiyoda-ku, Tokyo, 101-8430 JAPAN
satoh@nii.ac.jp

Abstract. We have improved previously proposed graphical search interface, 'Revolving Cube Show,' for multi-faceted metadata. This interface can treat discrete, continuous, and hierarchical attributes, enabling users to search flexibly and intuitively by using simple operations to combine attributes. We added two functions, one for displaying a search hierarchy as a guide tree and one for moving to a specific position in the search hierarchy, to solve problems identified through user testing. We created a video retrieval application using the improved interface for the iPad and tested it using data for 10,352 Japanese TV programs. The improved interface enabled users to easily understand the current position in the overall hierarchy and to quickly change specific attribute values.

Keywords: Multi-faceted navigation, Dynamic hierarchy, Video collection, Interactive visualization, iPad application

1 Introduction

A graphical search interface called *Revolving Cube Show* (*Cube* for short) for multi-faceted metadata has been proposed [10]. *Cube* can treat discrete, continuous, and hierarchical attributes, enabling users to search flexibly and intuitively by combining attributes with simple operations. A video navigation system implementing this interface for use with Japanese TV programs has been developed; it supported five attributes: channel, time zone, performer, genre, and airtime. Users were able to search intuitively by creating dynamic search hierarchies. However, *Cube* had two problems: (i) a user sometimes misunderstood the current position in the overall hierarchy because *Cube* displays only the previous and next values, and (ii) a user had to change the attribute values in the order specified by the system. That is, the user could not specify an attribute other than the previous or next attribute as a search key. To solve these problems, we added two functions: one for displaying a search hierarchy as a guide tree and one for moving to a specific position in the search hierarchy.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 303-309

7am,' 'start time: morning - 8am' would appear after the user flicked the right side of the frame to the left. Although several faceted navigation approaches have been reported [1,12], they do not take into account the features of each attribute value.

5 CONCLUSION

We improved 'Revolving Cube Show' graphical search interface on the basis of user testing. We added two functions, one for displaying a search hierarchy as a guide tree and one for moving to a specific position in the search hierarchy. We created a video retrieval application for the iPad that takes into account attribute features and tested it using data for 10,352 Japanese TV programs. The improved interface enabled users to easily understand the current position in the overall hierarchy and to quickly change attribute values.

References

1. Andrew S. Gordon. 2000. Using annotated video as an information retrieval interface. In Proceedings of the 5th international conference on Intelligent user interfaces (IUI '00). ACM, New York, NY, USA, 133-140. DOI= http://doi.acm.org/10.1145/325737.325808
2. Burke, R. D., Hammond, K. J., and Young, B. C. 1996. Knowledge-based Navigation of Complex Information Spaces. In Proceedings of *the 13th National Conference on Artificial Intelligence*, 462–468.
3. Christel M. G. 2007. Establishing the Utility of Non-text Search for News Video Retrieval with Real World Users. In Proceedings of *ACMMM '07*, 707-716. DOI= http://doi.acm.org/10.1145/1291233.1291395
4. Debowski, S. 2001. Wrong way: Go back! An Exploration of Novice Search Behaviors While Conducting an Information Search, *The Electronic Library*, 19 (60), 371–382.
5. Hearst M. A. and Karadi C. 1997.Cat-a-cone: An Interactive Interface for Specifying Searches and Viewing Retrieval Results Using a Large Category Hierarchy. In Proceedings of *SIGIR'97*, 246-255. DOI= http://doi.acm.org/10.1145/278459.258582
6. Hearst M. A. 2006. Clustering Versus Faceted Categories for Information Exploration. *Communications of the ACM*, 49(4), 59–61. DOI= http://doi.acm.org/10.1145/1121949.1121983
7. Hearst M. A. 2008. UIs for Faceted Navigation: Recent Advances and Remaining Open Problems, In Proceedings of the *2nd Workshop on Human-Computer Interaction and Information Retrieval, HCIR 2008*, 13-27.
8. Hürst W. and Darzentas D. 2012. Quantity Versus Quality: the Role of Layout and Interaction Complexity in Thumbnail-based Video Retrieval Interfaces. In Proceedings of *ICMR '12*, Article 45, 8 pages. DOI= http://doi.acm.org/10.1145/2324796.2324849
9. Hutchinson H.B., Bederson B.B., and Druin A. 2006. The Evolution of the International Children's Digital Library Searching and Browsing Interface. In Proceedings of *the 2006 conference on Interaction Design and Children*, 105–112.
10. Kajiyama T. and Satoh S. 2013. A Video Navigation Interface Using Multi-faceted Search Hierarchies. In Proc. of *ACM Multimedia Systems 2013, MMSys'13*, 5 pages.

11. Li J., Wang Z., Wang D., and Zhang B. 2008. Interactive Video Retrieval with Rich Features and Friendly Interface. In Proceedings of *CIVR '08*, 567-568. DOI= http://doi.acm.org/10.1145/1386352.1386434
12. Villa R., Gildea N. and Jose J.M. 2008. A Faceted Interface for Multimedia Search. In Proceedings of *SIGIR '08*, 775-776. DOI= http://doi.acm.org/10.1145/1390334.1390498
13. Zhang J. and Marchionini G. 2005. Evaluation and Evolution of a Browse and Search Interface: Relation Browser++. In Proceedings of *the 2005 National Conference on Digital Government Research*, 179–188.

Creativity in online communication. Empirical considerations from a connectivist background

INVITED LECTURE

Thomas Köhler

TU Dresden, Germany
Thomas.Koehler@tu-dresden.de

Abstract.

Computer-mediated communication (CMC) influences the user`s self. Different predictions were made how users' self and creativity may arise in an 'a-social' setting during the use of modern information and communication technologies. Some of these discourses even observe a new potential for creative self-constructions. The conceptual frame of this paper is delivered by the combination of different social scientific approaches coming from Social Psychology, Sociology and Communications Studies (cp. Köhler, 2003). Based upon a series of experiments, this paper investigates how the social self develops in CMC. Overall, the self is moderated by the characteristics of the channel, by psycho-social and finally by socialization variables. The influence of the channel is marked by immediate effects of certain cues, the psycho-social variable is the individual versus joint usage of CMC and the sociological dimension is the familiarity with CMC. All those influences have a specific meaning for the Creativity development in online communication. From a connectivist background it is discussed why and to what extent CMC has a prototype character for creative co-constructions in further forms of mediated interpersonal communication.

Keywords: Co-constructivist learning, social creativity, online user's self-development, computer-mediated communication.

1 Introduction

1.1 Influences of information and communication technologies of the users' identity and creativity

In recent years, information and communication technologies (ICT) have taken an increasing position of utmost importance in our private and business living environments. A great number of such social communities are nowadays inconceivable without using this technology, while other moulds emerge completely new, e.g. chatrooms. The term computer-mediated communication (CMC) has been established in psychological research and has been adopted by Sociology and Communication Sciences.

The user's self is treated as a theoretical construct describing a hypothetical cognitive structure. A theoretical background of the user's self advises the existence of at least two core components: can a personal individual and a social identity (cp. Mummendey, 1985). Whereas the individual identity involves the idiosyncratic aspects of a

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 310-320

5 Acknowledgement

Studies, on which the research is based, were supported through grants of the Hans-Böckler-Foundation, the German Studies Foundation and the German Research Council.

6 References

1. Arrow, H. (1997). Stability, bistability and instability in small group influence patterns; In: Journal of Personality and Social Psychology, 1 (75-85).
2. Becker, B. (1997). Virtuelle Identitäten: Die Technik, das Subjekt und das Imaginäre. In: Becker B. & Pateau, M.: Virtualisierung des Sozialen; Frankfurt am Main: Campus (163-184).
3. Bolter, J. D. (1997). Das Internet in der Geschichte der Technologie des Schreibens; In: Münker, S. & Rösler, A.: Mythos Internet; Frankfurt am Main: Suhrkamp (37-56).
4. Bruckman, A. (1992). Emergent social and psychological phenomena in text-based virtual reality; ftp://ftp.parc.xerox.com/pub/Moo/papers/identity-workshop.rtf.
5. Capurro, R. (1995). Leben im Informationszeitalter; Berlin: Akademie-Verlag.
6. Curtis, P. (1997). Mudding: social phenomena in text-based Virtual Realities; In: Kiesler, S.: Culture of the Internet; Mahwah: Lawrence Erlbaum (121-142).
7. Daft, R. L. & Lengel, R. H. (1984). Information richness: a new approach to managerial information processing and organization design; In: Cummings, L. L. & Staw, B. M.: Research in organizational behaviour; Greenwich: JAI Press (554-571).
8. Fenigstein, A., Scheier, M. F. & Buss, A. H. (1975). Public and private self-consciousness: Assessment and theory; In: Journal of Consulting and Clinical Psychology, 4 (522-527).
9. Filipp, S.-H. & Freundenberg, E. (1989). Der Fragebogen zur Erfassung dispositioneller Selbstaufmerksamkeit; Göttingen: Hogrefe.
10. Frindte, W. & Köhler, T.: Kommunikation im Internet. Peter Lang Verlag, Frankfurt am Main 1999
11. Gibson, W. (1984). Neuromancer; New York: Ace Books.
12. Helmers, S. (1994). Internet im Auge einer Ethnographin; In: WZB-Papers, 102.
13. Hoffmann, U. (1996). „Request for comments“: Das Internet und seine Gemeinde; In: Kubicek, H., Klumpp, D., Müller, G., Neumann, K. H., Raubold, E. & Rossnagel, A.: Jahrbuch Telekommunikation und Gesellschaft; Heidelberg: Decker (104-117).
14. Kawalek, J. (1997). Unterricht am Bildschirm; Frankfurt am Main: Peter Lang.
15. Kerr, E. B. & Hiltz, S. R. (1982). Computer-mediated communication systems. Status and evaluation; New York: Academic Press.
16. Kiesler, S. & Sproull, L. (1986). Response effects in the electronic survey; In: Public Opinion Quarterly, 3 (402-413).
17. Köhler, T. (1997). Kommunikationstheorie, Computervermittelte Kommunikation und Soziale Identität; In: Soziale Wirklichkeit, 2 (135-145).
18. Köhler, T. (2003). Selbst im Netz? Die Konstruktion des Selbst unter den Bedingungen computervermittelter Kommunikation; Opladen, Westdeutscher Verlag.
19. Lehnhardt, M. (1996). Identität im Netz: Das Reden von der „Multiplen Persönlichkeit“; In: Rost, M.: Die Netz-Revolution: Auf dem Weg in die Weltgesellschaft; Frankfurt am Main: Eichborn (108-124).

20. Luhtanen, R. & Crocker, J. (1992). A collective self-estem scale: self evaluation of one's social identity; Personality and Social Psychology Bulletin, 3 (302-318).
21. McKenna, K. & Bargh, J. (1998). Coming out in the age of Internet: Identity „Demarginalization" through virtual group participation; In: Journal of Personality and Social Psychology, 3 (681-694).
22. Mummendey, A. (1985). Verhalten zwischen sozialen Gruppen: Die Theorie der sozialen Identität; In: Frey, D. & Irle, M.: Theorien der Sozialpsychologie. Band II: Gruppen- und Lerntheorien; Bern: Hans Huber (185-216).
23. Pateau, M. (1996). Kommunikationsweise und sozialer Raum; In: Bulmahn, E., Van Haaren, K., Hensche, D., Kiper, M., Kubicek, H., Rilling, R. & Schmiede, R.: Informationsgesellschaft - Medien - Demokratie; Marburg: BdWi-Verlag (168-173).
24. Reid, E. (1995). Virtual Worlds: Culture and Imagination; In: Jones, S. G.: Cybersociety; London: Sage (164-183).
25. Postmes, T. (1997). Social influence in computer-mediated groups; Enschede: Print Partners Iskamp.
26. Scholl, W. & Pelz, J. (1997). Computervermittelte Kommunikation in der deutschen Wissenschaft; Münster: Waxmann.
27. Schumacher, A. (1992). Eine deutsche Fassung des Rochester-Interaktionsfragebogens: Anwendbarkeit und erste Ergebnisse; In: Zeitschrift für Sozialpsychologie, 1 (140-149).
28. Short, J., Williams, E. & Christie, B. (1976). The social psychology of telecommunications; Chichester: Wiley.
29. Spears, R. & Lea, M. (1992). Social influence and the influence of the ‚social' in computer-mediated communication; In: Lea, M.: Contexts of computer-mediated communication; Hemel Hempstead: Harvester Wheatsheaf (30-65).
30. Spears, R., Lea, M. & Lee, S. (1990). De-individuation and group polarization in computer-mediated communication; British Journal of Social Psychology, 2 (121-134).
31. Sproull, L. & Kiesler, S. (1986). Reducing social context cues: electronic mail in organizational communication; In: Management Science, 11 (1492-1512).
32. Sproull, L. & Kiesler, S. (1991). Connections: New ways of working in the networked organization; London: MIT Press.
33. Taylor, J. & MacDonald, J. (1997). The impact of computer-group interaction on group decision making, communication and inter-personal perception; Bournemouth: unpublished paper.
34. Turkle, S. (1995). Life on the Screen; New York: Simon and Schuster.
35. Turkle, S. (1997). Constructions and reconstructions of the self in Virtual Reality: Playing in the MUDs; In: Kiesler, S.: Culture of the Internet; Mahwah: Lawrence Erlbaum (143-156).
36. Wagner, U. & Zick, A. (1993). Selbstdefinition und Intergruppenbeziehungen. Der Social identity approach; In: Pörzgen, B. & Witte, E.H.: Selbstkonzept und Identität; Braunschweig: Universitätsverlag (109-130).
37. Walther, J. B. (1995a). Computer-mediated communication: Impersonal, Interpersonal and hyperpersonal interaction; Albuquerque: Paper presented on the annual conference of the International Communication Association.
38. Walther, J. B. (1995b). Relational aspects of computer-mediated communication: experimental observations over time; In: Organization Science, 2 (186-203).
39. Wehner, J. (1997). Medien als Kommunikationspartner - Zur Entstehung elektronischer Schriftlichkeit im Internet; In: Gräf, L. & Krajewski, M.: Soziologie des Internet. Handeln im elektronischen Web-Werk; Frankfurt am Main: Campus (125-149).

ALMM Approach for Optimization of the Supply Routes for Multi-location Companies Problem

Edyta Kucharska[1], Lidia Dutkiewicz[1], Krzysztof Rączka[1] and Katarzyna Grobler-Dębska[1]

AGH University of Science and Technology,
Department of Automatics and Biomedical Engineering,
30 Mickiewicza Av, 30-059 Krakow, Poland,
{edyta, lidia, kjr, grobler}@agh.edu.pl

Abstract. Algebraic-logical meta model (ALMM) is a mathematical model of multistage decision process. This formal schema is knowledge representation of a problem and allows to optimize difficult problems on the basis of simulation. It is specially designed for decision problems for which it is impossible to establish all values and parameters a priori. One of such problems is the supply routes for multi-location companies problem. The aim of the paper is to present substitution tasks method (an optimization method based on ALMM) applied to mentioned problem. A formal algebraic-logical model of this problem, an algorithm based on substitution tasks method and results of computer experiments are presented.

Keywords: algebraic-logical meta model (ALMM), substitution tasks method (ST method), multistage decision process, scheduling problem, Multiple Traveling Salesman Problem (mTSP)

1 Introduction

Most of real optimization problems in logistic and manufacturing processes are NP-hard problems. Different exact and approximate methods are used to solve them, such as: mathematical methods (e.g. petri net, branch and bound, integer programming), heuristics (e.g. constructive heuristics, improvement heuristics) [9], metaheuristics (genetic algorithm, tabu search, simulated annealing) [10, 11] and agent methods [8, 12, 13]. Furthermore, there are numbers of problems for which values of some important parameters can not be determined a priori, because they depend on current state of the process. For example, time or cost of activities (job) performance depends on type and number of available resources in a current time - some resources can be already in use or new ones can be created during process. Also ability to start some job can depend on combination of different factors. Thus, in that case, it is impossible to determine a priori value of variables, parameters and constrains. In consequence it is hard or even impossible to implement the methods mentioned above. Such problem needs approach that allows to construct the solution sequentially, during simulation of

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 321-332

extensional research are planned, i.a. a comparison of ST method and SSIG method (learning method of Solution Search with Information Gathering [5]) and a possibility of changing (during process) an earlier made decision.

References

1. Bubnicki, Z.: Introduction to expert systems., PWN, (1990) (in Polish).
2. Dudek-Dyduch, E.: Formalization and Analysis of Problems of Discrete Manufacturing Processes. Scientific bulletin of AGH UST, Automatics 54, (1990) (in Polish)
3. Dudek-Dyduch, E.: Learning based algorithm in scheduling. Journal of Intelligent Manufacturing 11(2), 135-143 (2000)
4. Dudek-Dyduch, E., Dutkiewicz, L.: Substitution Tasks Method for Discrete Optimization. In:Rutkowski,L., Korytkowski,M., Scherer,R., Tadeusiewicz,R. ,Zadeh, L.A., Żurada, J.M. (eds.) ICAISC 2013, Part II. LNCS, vol. 7895, pp. 419–430. Springer, Heidelberg (2013).
5. Dudek-Dyduch, E., Kucharska, E.: Learning method for co-operation. In: Jędrzejowicz, P., Nguyen, N.T., Hoang K. (eds.) ICCCI 2011 Part II. LNCS, vol. 6923, pp. 290-300. Springer, Heidelberg (2011)
6. Dutkiewicz, L., Kucharska, E., Kraszewska, M.: Scheduling of preparatory work in mine - simulation algorithms, Mineral Resources Management, t. 24, pp. 79–93 (2008).
7. Grobler-Dębska, K., Kucharska, E., Dudek-Dyduch, E.: Idea of switching algebraic-logical models in flow-shop scheduling problem with defects, The 18th International Conference on Methods and Models in Automation and Robotics, MMAR proceedings, pp. 532-537 (2013). (to appear)
8. Jędrzejowicz P., Ratajczak-Ropel, E.: A-Team for Solving the Resource Availability Cost Problem, Computational Collective Intelligence, Technologies and Applications, LNCS, Volume 7654, pp. 443-452, (2012).
9. Oberlin, P., Rathinam, S., Darbha, S.: A Transformation for a Multiple Depot, Multiple Traveling Salesman Problem, American Control Conference, ISBN: 978-1-4244-4523-3, pp. 2636 - 2641 (2009).
10. Shafie, A.A.: Optimal tour construction for multiple mobile robots, Journal of Engineering Science and Technology, Vol.6, No.2, pp. 215-227 (2011).
11. Sze, S.N., Tiong, W.K.: A Comparison between Heuristic and Meta-Heuristic Methods for Solving the Multiple Traveling Salesman Problem, World Academy of Science, Engineering and Technology, pp. 300-303 (2007).
12. Wąs, J., Kułakowski, K.: Agent-based approach in evacuation modeling., Agent and Multi-agent Systems: Technologies and Applications - Lecture Notes in Computer Science, Springer-Verlag, pp. 325-330 (2010).
13. Zachara, M., Pałka, D., Majchrzyk-Zachara, E.: Agent based simulation of the selected energy commodity market, Proceedings of 30th International Conference Mathematical Methods in Economics, pp. 534-546 (2012).

A Japanese problem solving approach: the KJ-Ho method

INVITED LECTURE

Susumu Kunifuji
Professor & Vice President, Japan Advanced Iinstitute for Science and Technology, Kanazawa, Japan
kuni@jaist.ac.jp

Abstract. In Japan, by far the most popular creative problem-solving methodology using creative thinking is the KJ Ho method. This method puts unstructured information on a subject matter of interest into order through alternating divergent and convergent thinking steps. In this paper we explain basic procedures associated with the KJ Ho.

Keywords: creative thinking, W-shaped problem-solving methodology, the KJ-Ho method

1 Outline

There is a number of creative thinking methods in existence, for example, brainstorming, brain-writing, mind-mapping, the KJ Ho (method) [1], the NM method, the Equivalent Transformation method, etc. Human thinking processes for creative problem solving typically consist of four sub-processes: divergent thinking, convergent thinking, idea crystallization, and idea-verification. In Japan, the most popular creative thinking method by far is the KJ Ho [6].

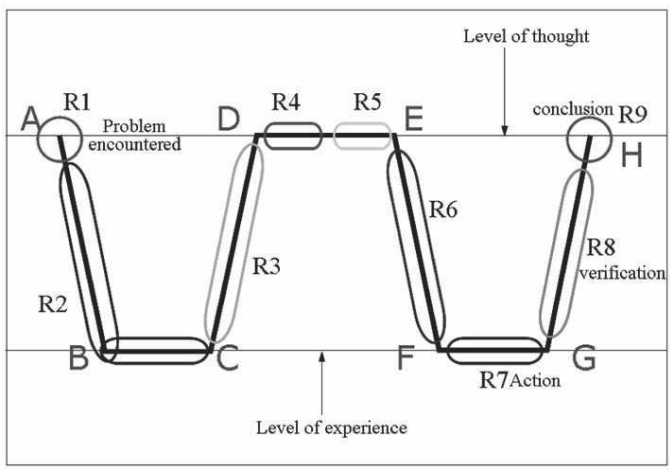


Fig. 1. The W-shaped problem-solving Methodology [5]

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 333-338

Round 8: Verification by testing. If the hypothesis is rejected, then retry another hypothesis generation by backtracking to Round 3.5. If it is acceptable, move to next Round 9. If all hypotheses are rejected, then go back to the checkpoint of Round 1.

Round 9: Conclusion and Reflection process. Accepted hypothesis must be added to our knowledge base.

4 Applications of the Cumulative KJ Ho

The Nomadic University [3,4] is a form of project where the cumulative KJ Ho as a W-shaped problem solving method is applied to a specific problem. These Nomadic Universities are typically held at the locations where the problems exist. The first Nomadic University was founded by Prof Jiro Kawakita (then, a Professor at Tokyo Institute of Technology) in August 1969, in Kurohime, Nagano, in the midst of student uprisings in Japan. This first event was called the Kurohime Nomadic University [3], a two week workshop in an outdoor campus, with attendants staying in tents. The author participated in this first event and this series continued to be held twenty five times in Japan up until 1999.

Further to this, there have also been numerous projects, seminars and mini Nomadic Universities [7] (shorter events, from 2008), which still take place today covering a very wide range of domains, including management and administration, energy and environment, health services, psychotherapy, regional development, engineering, construction, etc. in Japan.

References

1. Kawakita J., Hasso-Ho (発想法), Chuko Shinsho (no. 136) (in Japanese) (1966)
2. Kawakita J., Makishima S., Problem Solving - KJ Ho Workbook (問題解決 - KJ法ワークショップ), Kodansha, Japan (in Japanese) (1970)
3. Kawakita, J. (ed), Clouds and Water – Nomadic University Chronicle of Hard Working (雲と水と - 移動大学奮戦記), Kodansha, Japan (in Japanese) (1971)
4. Kawakita, J. (ed), Nomadic University – Japanese Islands are my Textbook (移動大学 - 日本列島を教科書として), Kashima Kenkyujo Shuppankai, Japan (in Japanese) (1971)
5. Kawakita, J., The Original KJ Method (Revised Edition), Kawakita Research Institute (1991)
6. Kunifuji S., Kato N., Wierzbicki A.P., Creativity Support in Brainstorming, in A.P. Wierzbicki and Y. Nakamori (eds.), Creative Environment: Issues of Creativity Support for the Knowledge Civilization Age, Springer (2007)
7. Naganobu, M., Maruyama, S., Sasase M., Kawaida S., Kunifuji S., Okabe A. (the Editorial Party of Field Science KJ Ho) eds., Exploration of Natural Fusion, Thought and Possibility of Field Science. Shimizu-Kobundo-Shobo, Japan (in Japanese) (2012)
   (Note: Published as a Kawakita Jiro Memorial Collection issue covering various topics of Fieldwork Science and the KJ Ho)

8. Viriyayudhakorn, Kobkrit: Creativity Assistants and Social Influences in KJ-Method Creativity Support Groupware, Dissertation of School of Knowledge Science, JAIST, March 2013

Modeling and Empirical Investigation on the Microscopic Social Structure and Global Group Pattern

Zhenpeng Li

Department of Applied Statistics, Dali University, Dali 671003, China

Xijin Tang
Academy of Mathematics and Systems Sciences, Chinese Academy of Sciences,

Beijing 100190, China

{lizhenpeng,xjtang}@amss.ac.cn

Abstract. In this paper, we investigate the microscopic social mechanisms through agent based modeling and empirical data analysis with the aim to detect the intrinsic link between local structure balance and global pattern. Both investigations suggest that three types of social influences give rise to the emergence of macroscopic polarization, and the polarization pattern is closely linked with local structure balance.

Keywords: social influences, agents based modeling, empirical data analysis, structure balance, macroscopic polarization

1 Introduction

Global polarization is widely observed in human society. Examples about the group behaviors patterns include culture, social norms, political election and on-line public debates on highlighted issues. From decision-making perspective, the global pattern of collective dynamics is rooted from individuals' micro-level decision making processes where social influence, as one of the important social psychological factors, plays a dominant role. Generally to say, from the social influence point of view, three types of impact run through the whole processes of group decision-making especially in voting. One is positive influence among in-group members; this kind of social force accelerates intra-group opinion convergence. The second one is the negative social impact which may block the formation of consensus among different groups. The third type refers one kind of special individuals' attitudes, or a state that the individuals do not belong to any labeled subgroups; members in the group have no common social identity, no firm stand about some opinions and are in a state of neither fish nor fowl [10-12].

From a bottom-up point of view, in modeling social processes, individuals' local cumulative interacting behaviors would evolve into different global patterns. The emergence of global features comes from the local interconnecting mechanism, e.g., short average path and high clustering coefficients contribute to small world mechanism [14]. However, it is difficult to infer how the global patterns are generated from

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 339-349

References

1. Adamic, L., and Glance, N.: The political blogosphere and the 2004 U.S. election: Divided they blog. In Proc. 3rd Intl. Workshop on Link Discovery (LinkKDD), 36–43 (2005)
2. Butts, C.T.: Social Network Analysis with SNA. Journal of Statistical Software. 24(6), 1-51(2008)
3. Cartwright, D. and Harary, F.: Structural balance: A generalization of Heider's theory. Psychological Review. 63, 277-292 (1956)
4. Conover, M.D., et al.: Political polarization on twitter, in Proceedings of the 5th International Conference on Webblogs and Social Media. Spain: Barcelona. 237-288 (2011).
5. Davis, J.A. and Leinhardt, S.: The Structure of Positive Interpersonal Relations in Small Groups.' In J. Berger (Eds.), Sociological Theories in Progress, Volume 2, Boston: Houghton Mifflin. 218-251 (1972).
6. Facchetti, G., Iacono, G. and Altafini, C.: Computing global structural balance in large-scale signed social networks. *PNAS*, 108: 20953-2095 (2011).
7. Hargittai, E.; Gallo, J.; and Kane, M.: Cross ideological discussions among conservative and liberal bloggers. Public Choice, 134(1): 67–86 (2007)
8. Heider, F.: Attitudes and Cognitive Organization. Journal of Psychology. 21,107-112 (1946)
9. Holland, P. W. and Leinhardt, S. A method for detecting structure in sociometric data. American Journal of Sociology 70:492-513 (1970).
10. Li, Z. P. and Tang, X. J.: Polarization and Non-Positive Social Influence: A Hopfield Model of Emergent Structure. International Journal of Knowledge and Systems Science, 3(3): 15-25 (2012)
11. Li, Z. P. and Tang, X. J.: Group Polarization: Connecting, Influence and Balance, a Simulation Study Based on Hopfield Modeling. PRICAI 2012: 710-721(2012)
12. Li, Z. P. and Tang, X. J.: Group Polarization and Non-positive Social Influence: A Revised Voter Model Study. Brain Informatics. 95-303 (2011)
13. Macy M, W., Kitts, J. A. and Flache, A.: Polarization in Dynamic Networks A Hopfield Model of Emergent Structure. In: Dynamic Social Network Modeling and Analysis: Workshop Summary and Papers. Breiger R, Carley K, and Pattison P, (eds.). Washington DC. The National Academies Press, 162-173 (2003)
14. Watts, D. J. and Strogatz, S.: Collective dynamics of "small-world" networks. Nature, 393 (6684): 440–442,(1998)

Mining Music Social Networks from an Independent Artist Perspective

Ewa Łukasik

Poznań University of Technology, Institute of Computing Science
ul. Piotrowo 2, 60-369 Poznań, Poland
Ewa.Lukasik@cs.put.poznan.pl

Abstract. The goal of this paper is to discuss various aspects of composing music in the computer era and mining music social networks from the independent artist perspective. Amateur pop composers search for music similar to their composition in order to be sure that certain aspects of their music are common to others, or, on the contrary, to be sure that they did not commit plagiarism. Others are interested in surprising effects of automated composing and put some demands on the produced music, e.g. required emotional character. As an illustration of the support that mining social networks may bring to independent artists some projects related to this subject, accomplished in the Institute of Computing Science, Poznan University of Technology, are presented.

Keywords: creativity, collaborative music composition, music social networks, music retrieval, music genre classification, music emotions recognition.

1 Introduction

Modern technologies have entered into the advanced process of audio creating, recording and processing. They also gave birth to new forms of distribution of recorded music among listeners. Traditional media, e.g. compact discs are constantly being replaced by the delivery of sound files via the Internet. As a result, we can observe an increasing number of sites offering large collections of musical works, counting millions of music tracks, requiring not only efficient database systems, but also advanced functionality, consistent with the growing user requirements for audio services.

Music, like any artwork, involves the activity of a number, often a large number of people. The expansion of Web 2.0, cheap music production possibilities and the *anybody-can-do it* paradigm enables many independent artists to create, perform and disseminate music. According to Chris Anderson [1], *The future of entertainment is in the millions of niche markets at the shallow end of the bitstream*. All these facts entail varying social dimensions and occur across an expansive range of social networks, often structured in completely different ways.

The common problem related to the Internet music consumption as well as independent music production is the search for musical pieces from huge variety of tracks – the search appropriate to the listener preferences or needs. Selection of music is a subjective task with fuzzy boundaries and thus it is difficult to be systemized. How-

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 350-359

The architecture of the system has been inspired by the modular system proposed in 1995 by B.L. Jacob [7] with the additional module responsible for the recognition of emotions. Even if the system automatically generates music, it still needs social network to mine the music according to emotions, which is needed to train the assessing module. Therefore, the emotional character of the music will be built on existing pieces and their emotional labels.

Conclusions

The development of Web 2.0 and 3.0 brought new opportunities for creative people and also changed the way of creating, distributing and listening to music. All these changes have influenced and will stimulate the creativity in general and music creation in particular. The paper has highlighted some problems related to music composing, that are related to amateur independent creators and their use of digital technology and social networks. The interest in utilizing digital technologies and machine learning in creative process depends on the musical interests of young composers and also change in time. Deeper insight into this problem needs more space and hopefully it will be possible to extend this topic in the near future.

References

1. Andersson, Ch.: The Long Tail: Why the Future of Business is Selling Less of More, Hyperion (2006)
2. Cope, D.: Experiments in Music Intelligence, Madison, Wisconsin: A-R Editions, (1996)
3. Dartnall, T.: Artificial Intelligence and Creativity: an Interdisciplinary Approach. Kluwer, Dordrecht (1994)
4. Dropik, L., Lukasik, E.: Two-level Hierarchical Classification of Music Genre for Music Social Netwoks, FCDS, vol. 35 no 4, pp. 261-282 (2010)
5. Hevner K.: Experimental Studies of the Elements of Expression in Music, The American Journal of Psychology, Vol. 48, No. 2, pp. 246-268 (1936)
6. Hornby, A.S.: Oxford Advanced Learner's Dictionary of Current English, New Edition, Oxford University Press (1974)
7. Jacob, B.L.: Composing with genetic algorithms. In: Proceedings of the 1995 International Computer Music Conference, pp. 452–455 (1995)
8. Jehan, T.: Creating Music by Listening, PhD, MIT (2005)
9. Jordà, S., Wüst O.: FMOL- A System for Collaborative Music Composition over the Web, Proc. of Web Based Collaboration DEXA, Munich, pp. 537-542 (2001)
10. Kostek B., Plewa M.: Parametrisation and correlation analysis applied to music mood classification" Int. J. of Computational Intelligence Studies, Vol. 2, No 1 (2013)
11. Laurier C., Lartillot O., Eerola T., Toiviainen P.; Exploring relationships between audio features and emotion in music, Triennial Conference of European Society for the Cognitive Sciences of Music, Jyväskylä, pp. 260-264, (2009)
12. Madsen, S., Widmer, G.: A Complexity-based Approach to Melody Track Identification in MIDI Files, Proc. of the International Workshop on Music and Artificial Intelligence, 20th Int. Joint Conference on AI, Hyderabad, India, pp. 459-464 (2007)

13. Molino J., Underwood J. A., Craig A.: Musical Fact and the Semiology of Music, Music Analysis Vol. 9, No. 2, pp. 105-111+113-156 (1990)– translated version of "Fait musical et semiologie de la musique", Musique en Jeu 17, pp. 37-62 (1976)
14. Nattiez, J.-J., Abbate C.: Music and Discourse: Toward a Semiology of Music, Princeton University Press (1990).
15. Oswald J.: Plunderphonics, or Audio Piracy as a Compositional Prerogative Wired Society Electro-Acoustic Conference, Toronto (1985) http://www.plunderphonics.com/xhtml/xplunder.html
16. Pachet, F.: Continuator, http://www.csl.sony.fr/~pachet/Continuator/
17. Papadopoulos G.; Wiggins G.: AI Methods for Algorithmic Composition: A Survey, a Critical View and Future Prospects, AISB Symposium on Musical Creativity, pp 110-117 (1999)
18. Philosophy of music, Stanford Encyclopedia of Philosophy, http://plato.stanford.edu/entries/music/#2
19. Rizo D., León P, Pertusa A., Iñesta J.: Melodic track identification in MIDI files, Proc. of the 19th Int. FLAIRS Conference, pp. 254-259 (2006)
20. Rizo, D., León, P., Pedro, J., Prez-Sancho, C., Pertusa, A., Iñesta, J.: A pattern recognition approach for melody track selection in MIDI files, Distribution, Proc. of the 7th Int. Symp. on Music Information Retrieval ISMIR 2006, pp. 61-66 (2006)
21. Rose F.C.: The neurology of music, Imperial College Press (2010)
22. Schaeffer B.: The history of music (in Polish), WSiP, Warszawa (1983)
23. Skraburski, P.; Algorithm for musical motifs retrieval from the MIDI database based on MIDI pattern example, MSc. Thesis (in Polish), E. Łukasik supervisor, Poznan Univ. of Technol. (2005)
24. Tanaka A., Tokui N., Momeni A.: Facilitating Collective Musical Creativity, Proc. of MM'05, Singapore (2005)
25. Tzanetakis G. and Cook P.: Musical genre classification of audio signals. IEEE Trans. Speech Audio Processing, no 10, pp. 293–302 (2002)
26. Uitdenbogerd, A., Zobel, J.: Melodic matching techniques for large music databases, Proc. of the seventh ACM international conference on Multimedia (Part 1), pp. 57–66. ACM Press, (1999)
27. Wendel, E.L.; New Potentials for "Independent" Music Social Networks, Old and New, and the Ongoing Struggles to Reshape the Music Industry, PhD Thesis, MIT (2008)
28. Wieczorkowska A., Synak P., Lewis R.A., Ras Z.W.: Creating reliable database for experiments on extracting emotions, Proc. of the IIS'2005 Symposium, Gdansk, Poland, Springer, 395-404 (2005)
29. Wieczorkowska A., Synak P.: Quality Assessment of k-NN Multi-label Classification for Music Data. Proc. ISMIS 2006, pp. 389-398 (2006)
30. Winiarz Sz.: Automated composition of music with the determined emotional character", MSc Thesis (in Polish), E. Lukasik supervisor, Poznan Univ. of Technol. (2013)
31. Yang Y.: Chen H, Music emotion ranking, Proc. ICASSP 2009, Taipei, Taiwan, pp. 1657-1660 (2009)
32. Zanette D. H.: Music, complexity, information http://fisica.cab.cnea.gov.ar/estadistica/zanette/papers/zanette_eni.pdf (2008)
33. All Music Guide: Allmusic, http://allmusic.com,
34. Creative Commons: http://creativecommons.org/.
35. FreeDB service: www.freedb.org
36. Jamendo; http://www.jamendo.com
37. Last.fm; http://www.last.fm
38. Wikipedia; www.en.wikipedia.org

An Intelligent System with Temporal Extension for Reasoning about Legal Knowledge

Maria Mach-Król, Krzysztof Michalik

University of Economics, Katowice, Poland

maria.mach-krol@ue.katowice.pl

krzysztof.michalik@ue.katowice.pl

Abstract. Any enterprise has to adjust its strategy to environmental aspect, one of elements of which is legal environment. This environment is partly of temporal nature, so time has to be taken into account by an intelligent tool. In the paper we present first results of research aimed at building an intelligent system capable of reasoning about legal knowledge with its temporal aspects.

Keywords: temporal legal knowledge, intelligent systems, temporal reasoning, temporal logic and representation

1 Introduction

In the field of artificial intelligence, there are at least six "traditional" areas, in which temporal reasoning is needed. These are temporal databases, expert systems, planning, robotics, naïve physics, natural language understanding [5]. In contrast to classical logic, in temporal logic the same sentence can have different boolean values at different time (see e.g. [21]). Taking into account some ontology aspects, a strong connection of rules with logic makes it easier than other ways of knowledge representation to link them to temporal logic.

We would like to address in our paper the area of law. In 1992 Bench-Capon and Coenen [2] pointed out the need for using knowledge based systems in law. Law changes over time, and the structure of legal knowledge is of critical importance. Therefore knowledge based systems – if properly built – may constitute a great help for lawyers. Why legal knowledge is specific? As Mommers points out, this knowledge is of dual nature: it can concern legal rules and legal cases, or it can concern factual aspects of cases. This in turn causes different types of belief in the legal domain (for further details see [12]). Moreover, legal domain is nondeterministic, which makes reasoning even more complicated. Reasoning tasks must replace traditional analytical ones, as analytical tools are not applicable here [1].

Temporal aspects of legal rules were very well visible in one of the first experiments with formalization of British Nationality Act (1981), defining British citizen-

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 360-369

effectively solve certain classes of problems. The lack of ability of mapping/codification of the time in knowledge bases can limit range of applications of artificial intelligence systems as a tools for decision support in legal area. We are convinced that an important role after the acquisition and codification of legal knowledge in the knowledge base plays a process of validation and verification. So as far as temporal knowledge bases and reasoning are concerned, some of the possible future directions of Logos development are embracing among others: extension of its V & V functionality, taking into account aspects of temporality as well as implementation of selected temporal relations. From this perspective, Logos seems to be a ready environment for various experiments related to the testing of selected aspects of temporality. Using this system we plan to build more realistic temporal knowledge base in the legal domain having status of research prototype. If we succeed we will try to implement it in the selected organization.

As for representational issues, we are currently working on adapting temporally extended Situation Calculus to formalize temporal legal knowledge.

References

1. Aggarwal A. K., *A Taxonomy of Sequential Decision Suport Systems*. Proc. IS-2001: 4th Annual Informing Science Conference, e-Proceedings, June 19-22, 2001, Kraków, pp. 1-11.
2. Bench-Capon T., Coenen F., *The maintenance of legal knowledge based systems*. „Artificial Intelligence Review", Vol. 6, No. 2, 1992, Kluwer Academic Publishers.
3. Broersen J., Gabbay D., Herzig A., Lorini E., Meyer J.-J., Parent X., van der Torre L., *Deontic Logic*. In: Ossowski S. (Ed.), *Agreement Technologies*. Law, Governance and Technology Series Volume 8, Springer Science+Business Media, 2013, pp. 171-179
4. Chemilieu-Gendrau M., *Le rôle du temps dans la formation du droit international*. „Droit International", Editions Pedone, 1987.
5. Galton A., *Time and Change for AI*, In: Gabbay D. M., Hogger C. J., Robinson J. A. (Eds.), *Handbook of Logic in Artificial Intelligence and Logic Programming*, Volume 4: *Epistemic and Temporal Reasoning*. Clarendon Press, Oxford 1995.
6. Jakubczyc J. A., Mach M., *Remarks on some Problems in Temporal Reasoning*. In: Baborski A. J., Bonner R. F., Owoc M. L. (Eds.), *Knowledge Acquisition and Distance Learning in Resolving Managerial Issues*. Mälardalen University Press, Sweden, 2001, pp. 16-27.
7. Jones, S. P., "Haskell 98 language and libraries: the Revised Report," Cambridge University Press, 2003.
8. Kaźmierczak P., Pedersen T., Agotnes T., *NORMC: a Norm Compliance Temporal Logic Model Checker*. Proc. STAIRS 2012, IOS Press, 2012, pp. 168-179.
9. Mackaay E., Poulin D., Frémont J., Bratley P., Deniger C., *The logic of time in law and legal expert systems.* „Ratio Juris" 3(2), 1990, pp. 254-271.
10. Mackaay E., Poulin D., Frémont J., Deniger C., *La composition du temps dans les systèmes experts juridiques*, w: *Les annales de l'IRETIJ*, No 1: *Actes du Colloque sur les "Apports de l'informatique à la connaissance du droit"*, Montpellier, les 10 et 11 mars 1989, pp. 33-47.
11. Malhotra N. K., *Marketing Research: an Applied Orientation*. Third Edition. Prentice Hall, 1999.

12. Mommers L., Transfer of knowledge in the legal domain, In: Postma E., Gyssens M. (Eds.), BNAIC-99: Proceedings of the Eleventh Belgium/Netherlands Artificial Intelligence Conference, Maastricht, November 3-4, 1999, pp. 171-178.
13. Michalik K., PC-Shell/SPHINX as a Tool for Building Expert Systems, [in:] Proc. Of Conf. "Expert Systems Yesterday, Today and Tomorrow", Scientific Works of UE in Katowice, Katowice 2010.
14. Michalik K. et al., Application of Knowledge Engineering Methods in Medical Knowledge Management, [in:] Fuzziness and Medicine: Philosophical Reflections and Application Systems in Health Care, R. Seizing, M. Tabacchi (Eds.) Springer, Berlin 2013.
15. Michalik K., Rule-based Expert Systems as a Tool Supporting Knowledge Management in Public Administrations, Proc. of conf. "TIAPISZ'2012", SGH, Warszawa 2013 (in Polish).
16. Nitta K., Nagao J., Tetsuya M., *A knowledge representation and inference system for procedural law*. „New Generation Computing" 5, 1988, pp. 319-359.
17. Poulin D., Mackaay E., Bratley P., Frémont J., *Time Server – a legal time specialist.* Proc. Third International Conference on Logic, Informatics, Law. Florence, 2-5 November 1989.
18. Theodoulidis B., Loucopoulos P., Kopanas V., *A Rule-Oriented Formalism for Active Temporal Databases*. 1992. http://citeseer.nj.nec.com/43336.html.
19. Vila L., *Revisiting Time and Temporal Incidence*. http://www.lsi.upc.es/~vila/vila/papers.html.
20. Vila L., Schwalb E., *A Theory of Time and Temporal Incidence based on Instants and Periods*. TIME-96: Third International Workshop on Temporal Representation and Reasoning. Key West, Florida, USA, May 19-20, 1996.
21. Turner R., *Logics for Artificial Intelligence*, Ellis Horwood, Chichester 1984.
22. Vila L., Yoshino H., *Time in automated legal reasoning*, In: Martino A., Nissan E. (Eds.), "Information and Communications Technology Law", Special issue on formal models of legal time. Vol. 7 No. 3, 1998.
23. M.J. Sergot et al., *The British Nationality Act as a Logic Program*, Communications of the ACM May 1986 Volume 29 Number 5.

Structural modeling approach to management of innovation projects

Jerzy Michnik

University of Economics in Katowice
ul. 1 Maja 50, 40-287 Katowice
jerzy.michnik@ue.katowice.pl

Abstract. In the global and highly competitive economy innovativeness becomes the key factor of competitive advantage. Selecting the proper direction of projects development is the vital point of the innovation management. Such a decision is characterized by many conflicting objectives that additionally influence each other. To overcome the problem of interrelations between criteria the structural approach has been proposed. Two such methods, ANP and WINGS, have been applied to the choice of innovations' development. Their procedures and results have been also compared.

Keywords: innovation management, decision analysis, structural modeling, ANP, WINGS

1 Introduction

Innovation management belongs to the most important processes in many enterprises. Especially those that are active in high technology sector. Choosing the right way for future development of innovations is a crucial decision that needs processing a large amount of information coming from various resources. The competencies of different firm's divisions should be evaluated against the market conditions and their potential development. Taking into account the complexity of the problem the properly constructed model can become the important part of efficient decision making.

We propose a systematic approach to potential criteria that can appear in innovation management using the 5 main categories. It is argued that the interrelations between criteria do not permit the use of traditional model with the assumption of independence. Consequently, we need the appropriate methods that can cope with interdependencies. Currently there are not many possible approaches of this kind. We construct the multiple criteria model and solve it with the two currently available methods: Analytical network Process (ANP) and Weighted Influence Non-linear Gauge System (WINGS).

The rest of the paper is organized as follows. In Section 2 the criteria of innovation management are discussed. The multiple criteria model and its components are presented in Section 3. In Section 4 and Section 5 we show the solutions of the model received with two structural methods. Summary (Section 6) concludes the paper.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 370-378

Table 3. *Total engagement* $(r + c)$ and *net position* $(r - c)$ received in WINGS

		$r + c$	$r - c$
Leader in production line	S1	0,213	−0,173
Enhance competitive advantage	S2	0,227	−0,174
Technological competencies	T1	0,119	0,028
R&D Competencies	T2	0,147	0,042
NPV	F1	0,216	−0,103
Financial risk	F2	0,208	−0,102
Stage of life-cycle	M1	0,099	0,001
Competitors' reaction	M2	0,085	−0,005
Customer satistisfaction	M3	0,154	0,042
Logistic competencies	O1	0,122	0,025
Marketing competencies	O2	0,136	0,045
Alternative 1	A1	0,106	0,106
Alternative 2	A2	0,075	0,075
Alternative 3	A3	0,082	0,082
Alternative 4	A4	0,112	0,112

The multiple criteria model that has been constructed can serve as the framework of decision support system for innovation management. It comprise 11 criteria grouped in 5 general categories. The decision alternatives represent the 4 possible directions of firm's innovation policy. They are based on the real options that can help to lower the risk of the decision.

Two structural approaches – ANP and WINGS – have been used to solve the model. It appeared that in similar circumstances and with similar evaluations they led to different decisions. To some extend, a choice of the method is the arbitrary decision and may be based on the user feelings. However, the direct comparison of the procedures shows that WINGS has some advantages. It is less demanding because, in contrast to the ANP, it uses the direct evaluations instead of pair-wise comparisons. WINGS does not need any specialized software as it employs only elementary matrix algebra. In addition WINGS always lead to non-ambiguous result. In the case of the ANP, an analysis is much more complicated since the final result depends on reducibility, primitivity and cyclicity of the stochastic matrix and, in many cases, some additional manipulations are needed [9].

Acknowledgments

Research partly supported by Polish Ministry of Science and Higher Education, Research Grant no. NN111 438637.

References

1. SuperDecisions, (http://www.superdecisions.com)

2. Baruk, J.: Knowledge and innovation management (in Polish). Wydawnictwo Adam Marszalek (2006)
3. Cooper, R.G., Edgett, S.J., Kleinschmidt, E.J.: New product portfolio management: practices and performance. Journal of Product Innovation Management 16(4), 333–351 (1999)
4. Danneels, E., Kleinschmidt, E.J.: Product innovativeness from the firm's perspective: its dimensions and their relation with project selection and performance. Journal of Product Innovation Management 18(6), 357–373 (2001)
5. Dodgson, M., Gann, D., Salter, A.: The Management of Technological Innovation. Oxford University Press (2008)
6. Jasinski, A.H.: Innovations and technology transfer during the processs of transformation (in Polish). Centrum Doradztwa i Informacji Difin (2006)
7. Michnik, J.: Weighted influence non-linear gauge system (WINGS) – an analysis method for the systems of interrelated components. European Journal of Operational Research 228(3), 536–544 (2013)
8. Michnik, J.: Analysis of criteria in innovation management (in Polish). In: Trzaskalik, T. (ed.) Modelowanie preferencji a ryzyko '10, pp. 107–117. Wydawnictwo AE w Katowicach, Katowice (2010)
9. Saaty, T.L.: Theory and Applications of the Analytic Network Process. Decision Making with Benefits, Opportunities, Costs and Risks. RWS Publications, Pittsburgh (2005)
10. Siguaw, J.A., Simpson, P.M., Enz, C.A.: Conceptualizing innovation orientation: A framework for study and integration of innovation research. Journal of Product Innovation Management 23(6), 556–574 (2006)
11. Westland, J.C.: Global Innovation Management. Palgrave, Macmillan (2008)

A Fuzzy Knowledge-Editing Framework for Encoding Guidelines into Clinical DSSs

Aniello Minutolo[1], Massimo Esposito[1], Giuseppe De Pietro[1]

[1]Institute for High Performance Computing and Networking, ICAR-CNR
via P. Castellino, 111-80131, Napoli, Italy

{minutolo.a, esposito.m, depietro.g}@na.icar.cnr.it

Abstract. Clinical guidelines have been more and more promoted as a means to foster effective and efficient medical practices and improve health outcomes, especially when implemented in clinical Decision Support Systems (DSSs). In this context, Fuzzy Logic has been proposed as the most suitable approach for profitably tackling uncertainty and vagueness in both clinical recommendations and signs triggering them. In this respect, since the task of building and maintaining a fuzzy knowledge base can be very complex and must be carried out carefully, this paper proposes AFEF (A Fuzzy knowledge Editing Framework), an editing and visualization framework for encoding fuzzy linguistic guidelines into clinical DSSs with the aim of providing intuitive solutions specifically devised to: i) define block of rules pertaining the positive evidence of the same abnormal situation; ii) compose ELSE rules for modeling the negative evidence associated to a block of rules; iii) customize the rules inside a block of rules through a common configuration for the inference; iv) simulate an actual DSS for testing the fuzzy rules inserted; v) automatically encode into a machine executable language the fuzzy clinical knowledge that could be functional in the context of clinical DSSs.

Keywords: Clinical DSS, Knowledge Editor, Fuzzy Rules.

1 Introduction

Recently [5, 6, 16], Decision Support Systems (DSS) have been proposed for medical scenarios in order to support physicians and patients in their daily activities by embedding a set of clinical recommendations of interest, with the final aim of simulating the process followed by the physicians. In medical settings, the use of clinical guidelines has been more and more promoted since they are able to foster effective and efficient medical practices and improve health outcomes when followed [17]. In this respect, the relevant medical knowledge formalized into a clinical DSS, coming from the encoded clinical recommendations, represents an active knowledge resource that uses patient data to generate case-specific advices, supporting health professionals, the patients themselves or other concerned about them [10]. With respect to mechanisms for embedding guidelines into clinical DSSs, on the one hand, some

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 379-390

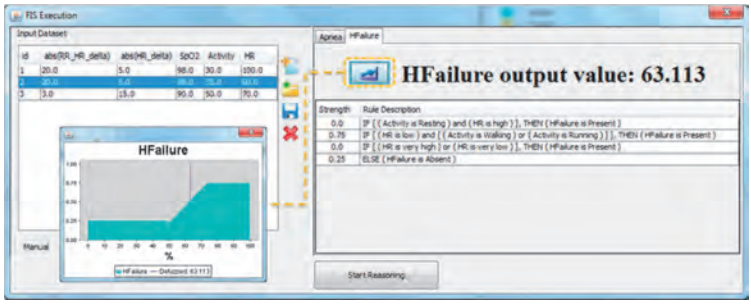


Fig. 10. The interfaces for visualizing the reasoning outcomes.

5 Conclusions

This paper described AFEF, a knowledge editing and visualization framework for guiding and assisting users in the creation and formalization of clinical practice guidelines. The driving philosophy of AFEF is to provide simple and intuitive interfaces for composing and verifying the parameters of the fuzzy inference system underpinning a clinical DSS so that a desired behavior is attained.

Differently from existing solutions, which do not provide any form of vertical arrangement for the particular domain of interest, AFEF has been mainly designed to face medical requirements, such as the coherent grouping of rules pertaining to a same conclusion (e.g. a particular diagnosis or therapy), explicit specification of rules for the positive evidence and the implicit formalization of rules for the negative one, intuitive facilities for a simple graphical formalization of guidelines, automatic encoding into an executable language for the final DSSs.

The key issue of AFEF relies on graphical facilities offered for easily creating and updating clinical guidelines, where each guideline pertaining a patient condition is composed by defining a strict relation between the linguistic variable modeling a patient condition, and the group of rules that contribute to make inference on such a variable. Next step of the research activities will also regard the improvement of AFEF by means of new intuitive facilities to automatically optimize the parameters of the fuzzy inference system underpinning a clinical DSS, such as data-driven techniques for tuning the knowledge base, and more advanced verification facilities to evaluate the consistency of the clinical guidelines encoded as fuzzy rules.

References

1. Acampora, G., Loia, V.: Fuzzy Markup Language: A new solution for transparent intelligent agents. IEEE Symposium on Intelligent Agent, pp. 1-6, 11-15 April 2011.
2. Adeli, A., Neshat, M.: A fuzzy expert system for heart disease diagnosis. In Proceedings of International Multiconference of engineering and computer scientists, pp.134–139, 2010.

3. Alayón, S., Robertson, R., Warfield, S.K., Ruiz-Alzola, J.: A fuzzy system for helping medical diagnosis of malformations of cortical development. J. Biomed. Inf. 40 (3), 221-235 (2007).
4. Alonso, J.M., Magdalena L., Guillaume, S.: KBCT: a knowledge extraction and representation tool for fuzzy logic based systems. IEEE Int. Conference on Fuzzy Systems. July, 25-29, 2004, Budapest, Hungary. Proceed. vol. 2, pp. 989-994.
5. Coronato A., De Pietro, G.: Formal Design of Ambient Intelligence Applications. Computer, vol. 43, no. 12, pp. 60-68, Dec. 2010.
6. De Maio, C., Fenza, G., Gaeta, M., Loia, V., Orciuoli, F.: A knowledge-based framework for emergency DSS. Knowledge-Based Systems 24 (8), pp. 1372-1379, 2011.
7. Guillaume, S., Charnomordic, B.: Learning interpretable fuzzy inference systems with FisPro. Information Sciences, vol. 181, pp. 4409–4427, 2011.
8. Lahsasna, A., Ainon, R.N., Zainuddin, R., Bulgiba, A.: Design of a Fuzzy-based Decision Support System for Coronary Heart Disease Diagnosis. Journal of Medical Systems, 2012, v. 36, pp 3293-3306.
9. Lasierra, N., Alesanco, A., Garcia, J.: Home-based telemonitoring architecture to manage health information based on ontology solutions. In the IEEE International Conference on Information Technology and Applications in Biomedicine (ITAB), pp.1-4, 3-5 Nov. 2010.
10. Liu, J., Wyatt, J.C., Altman, D.G.: Decision tools in health care: focus on the problem, not the solution. BMC Medical Informatics And Decision Making 6, pp. 1-7, 2006.
11. Lv, Z., Xia, F., Wu, G., Yao, L., Chen, Z.: Icare: A mobile health monitoring system for the elderly. In IEEE-ACM Int'l Conf. Green C. and C. and Int'l Conf. Cyber, Physical and Social Computing, Los Alamitos, CA, USA, 2010, pp. 699-705.
12. Minutolo, A., Esposito, M., De Pietro, G.: A Mobile Reasoning System for Supporting the Monitoring of Chronic Diseases. Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering, 1, Volume 83, Wireless Mobile Communication and Healthcare, Part 6, Pages 225-232.
13. Minutolo, A., Esposito, M., De Pietro, G.: A Fuzzy Decision Support Language for building Mobile DSSs for Healthcare Applications. In MobiHealth 2012: Proc. of the 3rd International Conference on Wireless Mobile Communication and Healthcare, Paris, France.
14. Moreno-Velo, F. J., Baturone, I., Sanchez-Solano, S., Barriga, A.: XFuzzy 3.0 A Development Environment for Fuzzy Systems, in Proceeddings of the 2nd IEEE Int. Conf. on Fuzzy Logic and Technology (EUSFLAT' 2001), pp. 93-96, Leicester, 2001.
15. Peña-Reyes, C.A., Sipper, M.: A fuzzy-genetic approach to breast cancer diagnosis. Artificial Intelligence in Medicine 17 (2), 131-155, October 1999.
16. Sari, A.K., Rahayu, W., Bhatt, M.: Archetype sub-ontology: Improving constraint-based clinical knowledge model in electronic health records. K. B. Syst., vol. 26, pp.75-85, 2012.
17. Scott, I.: What are the most effective strategies for improving quality and safety of health care?. Internal Medicine Journal, vol. 39, pp. 389-400, 2009.
18. Shiffman, R.: Representation of clinical practice guidelines in conventional and augmented decision tables. Journal of the American Medical Inf. Association 4(5), 382-393, 1997.
19. Thomas, O., Dollmann, T.: Fuzzy-EPC markup language: XML based interchange formats for fuzzy process models. Soft Computing in XML Data Manag. 255, pp. 227-257, 2010.
20. Tseng, C., Khamisy, W., Vu, T.: Universal fuzzy system representation with XML. Computer Standards & Interfaces, 28, pp. 218–230, 2005.
21. Warren, J., Beliakov, G., Zwaag, B.: Fuzzy logic in clinical practice decision support system. Proceedings of the 33rd Hawaii Inter. Conference on System Sciences, 2000.
22. Zadeh, L.A.: A theory of approximate reasoning. Machine Intelligence, John Wiley & Sons, New York, 1979, pp. 149–194.

Evacuation Assist from a Sequence of Disasters by Robot with Disaster Mind

Taizo Miyachi[1], Gulbanu Buribayeva[1], Saiko Iga[2] and Takashi Furuhata[3]
[1] School of Information Science and Technology, Tokai University
4-1-1 Kitakaname, Hiratsuka, Kanagawa 259-1292, Japan

[2] Keio Research Institute of SFC, [3] University of Utah, USA
miyachi@keyaki.cc.u-tokai.ac.jp

Abstract. Great East Japan Earthquake in 2011 caused 118,549 people lost their lives. Especially, 70% of residents around the shore area could not evacuate immediately from the devastated Tsunami by the earthquake. Additionally, the devastated Tsunami by the earthquake caused Fukushima nuclear power plants explosions and nuclear spread influenced that 315,196 people evacuated from their home town. We propose a disaster robot as assistant robot "ACROS" including "disaster mind" to help people to avoid people's frequent psychological problems ("Normalcy Bias" and "Catastrophe Forgetting") and guide them to a safer place. ACROS could provide the latest information to the residents such as real-time Big Data emergency support, a map of radioactive contaminant, etc. We also discuss refugees support simulation by showing the warning pictures on a screen in a prototype of ACROS.
Keywords. safe evacuation guide, disaster robot, normalcy bias, catastrophe forgetting, collaboration among human and robot

1 Introduction

A sequence of the great disasters [8, 9, 10 and 14] such as the Great East Japan Earthquake in 2011 (See Fig. 1) and the devastated Tsunami by the earthquake caused Fukushima nuclear power plants explosion and nuclear spread. Especially 18,549 residents in many towns of about 400 kilo meters length near the earthquake area have lost their lives and 315,196 people needed to move out from their home towns, then. Therefore, many people in Japan aware the needs of emergency support to residences. In the disaster time, people suffered from psychological problems such as "Normalcy Bias (NB)" and "Catastrophe Forgetting (CF)." For example, In the Great East Japan Earthquake, about 70% of residents in the beachside

Figure.1 Great earthquake with fire, giant tsunamis and an explosion of Fukushima III [12]

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 391-401

References

[1] AIST, “Paro,” “http://paro.jp/,” 2013.
[2] Imamura, F., D. et al. “Earthquake and tsunami cause serious damage,” Eos Trans. AGU, 78(19), 197, doi:10.1029 /97EO00128, 1997.
[3] Kahneman, D. and Tversky, A., “Prospect theory: An analysis of decisions under risk,” Econometrica, 47(2), 313-327, (1979).
[4] Kawasaki City, “Communication robot. Friends of Human, Kawasaki science world,” “http://www.keins.city.kawasaki.jp/content/ksw/1/ksw1_036-043.pdf,” 2005.
[5] McCloskey, M. and Cohen, N., “Catastrophic interference in connectionist networks: The sequential learning problem.” in G. H. Bower (ed.) ***The Psychology of Learning and Motivation: Vol. 24***, 109-164, NY: Academic Press, 1989.
[6] Miyachi T. et al. “Structuring spatial knowledge and fail-safe expression for directive voice navigation,” Springer Berlin Heiderberg, LNCS, Vol. 5172, pp. 664-672, 2008.
[7] New Jersey Personal Defense Academy, “Normalcy Bias: Cause, Effect, Cure,” “http://njpersonaldefense. com/normalcy-bias-cause-effect-cure/,” 2013.
[8] NHK, “Great tsunami, How people moved at the great tsunami,” NHK Special, Oct. 2, 2011.
[9] NHK, “Records of the life to the future,” “http://www.nhk.or.jp/special/detail/2013/0303/index.html,” NHK Special, March 7, 2013.
[10] Nomura S, et al. "Mortality risk amongst nursing home residents evacuated after the Fukushima nuclear accident," PLOSE ONE, February 26, 2013.
[11] Stake S. et al. “How to Approach Humans?: Strategies for Social Robots to Initiate Interaction,” The Robotic Society of Japan, 28(3), pp. 327-337, 2010-04-15 , 2010.
[12] TEPCO: “Fukushima nuclear power plant III,” “http://www.afpbb.com/article/disaster-accidents-crime/accidents /2846228/8206622?ref=ytopics,” March 21, 2011.
[13] Tokyo pollen net: “Map of the density of pollen,” “http://rocketnews24.com/2013/03/08/302211/,” rocketnews24, 2013.
[14] U.S. Department of Energy, “Aerial Monitoring Results Cumulative,” “http://energy.gov/downloads/ radiation-monitoring-data-fukushima-area-32511,” March 25, 2011.
[15] Yousuf A. M. et al. “Development of a Mobile Museum Guide Robot That Can Configure Spatial Formation with Visitors,” Springer, LNCS, Vol. 7389, pp. 423-432, 2012.

Tree Representation of Image Key Point Descriptors

Patryk Najgebauer, Marcin Gabryel, Marcin Korytkowski, Rafał Scherer

Institute of Computational Intelligence, Częstochowa University of Technology
al. Armii Krajowej 36, 42-200 Częstochowa, Poland (http://iisi.pcz.pl)
{patryk.najgebauer, marcin.gabryel, marcin.korytkowski,
rafal.scherer}@iisi.pcz.pl

Abstract. This paper describes a concept of image comparison method based on descriptors of key points generated by SURF algorithm. Proposed method for speed up comparison process uses tree-based representation of descriptors. We assume that descriptors tree representation of image key points is more efficient than standard list representation. The number of steps to compare sets of image descriptors will be smaller than in a case of list-based, all to all methods.
The proposed method assumes generation of a tree structure from a set of image descriptors generated by SURF algorithm. The descriptors are stored as leaves in the tree structure and other parent tree nodes are used to group similar descriptors. Each next parent node of the tree forms a wider, more general, group of descriptors. We store average values of the descriptors in the nodes making it possible to quickly compare sets of descriptors by traversing the tree from the root to a leaf by choosing the smallest deviation between searched descriptor and values of nodes. Each step in a tree traversing can drastically reduce the final number of descriptors that will be needed to compare. The proposed structure also allows for the comparison of whole trees of descriptors that speed up the process of images comparison.
Our method involves generating trees of descriptors for single images or groups of related images accelerating the process of searching for similarities among others. In future the method will be used as a base to develop tools for indexing images by their context.

Keywords: image processing, key points comparing, comparing trees

1 Introduction.

Recognizing and comparing images by their content is increasingly applied in many aspects of human life. These methods allow improving a lot of human activities that tend to be monotonous and grudgingly performed. Growing popularity of these methods is mainly due to development and increasing efficiency of electronic devices. It is closely related because image processing methods are very demanding in terms of the required number of operations and the amount of data that need to be processed.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 402-412

5 Conclusions

The proposed method can speed up images comparison thanks to building descriptors tree. It requires only approximately 5% comparison operations of all possible key point combinations. Generated tree requires more memory than a list of all descriptors but its size is reduced by grouping similar descriptors. Number of similar descriptors depends on the amount of image details. The method obtained the worst results on images representing nature. In such a case, background contains a lot of unimportant and difficult to group details. These key points expand the descriptor tree by insignificant details of the compared images.

The method obtained the best results by processing artificial images created by humans, such as logos, diagrams, schematic. This is caused by a greater number of similar key points which mostly are related to the characteristic elements of the image that allows for better grouping of key points.

Acknowledgments

The work presented in this paper was supported by a grant from Switzerland through the Swiss Contribution to the enlarged European Union.

Patryk Najgebauer received a scholarship from the project DoktoRIS - Scholarship program for innovative Silesia co-financed by the European Union under the European Social Fund.

References

1. Bay H., Ess A., Tuytelaars T., Van Gool L.: SURF: Speeded Up Robust Features. Computer Vision and Image Understanding (CVIU), Vol. 110, No. 3 (2008) pp. 346–359
2. Bazarganigilani M.: Optimized Image Feature Selection Using Pairwise Classifiers. Journal of Artificial Intelligence and Soft Computing Research. Volume 1. Number 2 (2011) pp. 147–154
3. Chang Y., Wang Y., Chen C. and Ricanek K.: Improved Image-Based Automatic Gender Classification by Feature Selection. Journal of Artificial Intelligence and Soft Computing Research. Vol.1. No.3 (2011) pp. 241–253
4. Górecki P. , Artiemjew P., Drozda P., Sopyla K.: Categorization of Similar Objects Using Bag of Visual Words and Support Vector Machines. In: Proceedings of 4th International Conference on Agents and Artificial Intelligence, ICAART'12, Vilamoura, Algarve, Portugal (2012) pp. 231–236
5. Górecki P., Sopyla K., Drozda P.: Ranking by K-Means Voting Algorithm for Similar Image Retrieval. Artificial Intelligence and Soft Computing. Lecture Notes in Computer Science Volume 7267 (2012) pp. 509–517
6. Guerrero M.: A Comparative Study of Three Image Matching Algorithms: Sift, Surf, and Fast, (2011).All Graduate Theses and Dissertations.Paper 1040.
7. Wang L., Ju H.: A Robust Blob Detection and Delineation Method. Education Technology and Training, 2008. and 2008 International Workshop on Geoscience and Remote Sensing. ETT and GRS 2008. International Workshop on. 21-22 Dec. 2008, vol.1, pp.827–830

Recognition of Agreement and Contradiction between Sentences in Support-Sentence Retrieval

Hai-Minh Nguyen and Kiyoaki Shirai

School of Information Science, Japan Advanced Institute of Science and Technology
{nhminh,kshirai}@jaist.ac.jp

Abstract. Automatically classifying semantic relations between sentences is important for text understanding, specifically in helping users collect various viewpoints on a given topic (statement). This paper considers two main semantic categories which are agreement and contradiction in the scope of an application, namely support-sentence retrieval. We present here new sentence classification algorithms based on rules and bootstrapping method. Our initial seed data for training the bootstrapping-based classifiers is automatically built. Our best configuration of bootstrapping-based classifiers yields 5.9% higher result than the word overlap baseline in the agreement category. For the contradiction category, applying bootstrapping learning increases the P@10 by 12.1% when compared to the rule-based approach. These results are promising due to the fact that the whole process requires no human interaction.

Keywords: sentence classification, bootstrapping, text similarity

1 Introduction

Computing has realized human dreams of storing and transferring knowledge, which is primary represented by text. There have been a number of computer systems that can read text as good as a human and search for text faster than a human does. However, understanding text is still a difficult problem for a computer as natural language is so flexible. Humans can explain an idea in various ways (e.g., using synonym, altering sentence structure) while a computer could not learn such changes as easily as us. In the field of natural language processing, there are many tasks that deal with this issue, such as Word Sense Disambiguation [10], Semantic Role Labeling [7], Classification of Semantic Relations [8], Semantic Textual Similarity [1], etc. Recently, the task to recognize textual entailment (RTE task [5]) between two text fragments has been proposed as a generic task that captures major semantic inference for many NLP applications such as Question Answering, Information Retrieval, Information Extraction and Text Summarization. However, besides entailment, there are more semantic relations among text. Cross-document Structure Theory (CST) attempts to characterize 18 kinds of relationships that exist between pairs of sentences coming

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 413-424

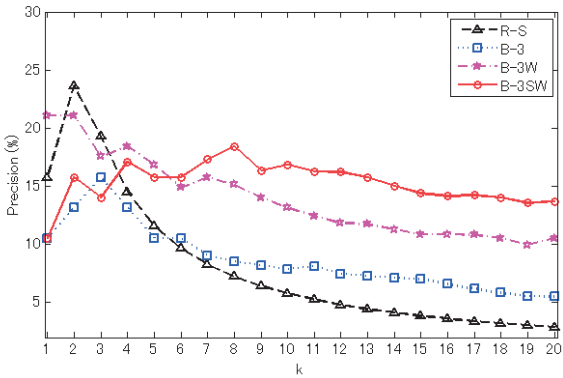


Fig. 3. P@k with different k in contradiction category

and contradiction sentences. The best classifier is 5.9% higher than the baseline on the agreement class, and 12.1% higher than the best rule-based classifier on the contradiction class. Given the fact that our bootstrapping-based classifiers are trained from untagged data, we believe that applying bootstrapping learning into the classification module of SSR system is promising. Nevertheless, the extraction of contradiction sentences is still a problem in our algorithms due to the complexity of different types of controversy. In the future, we would like to explore more effective ways to learn the characteristic of contradiction sentences in order to acquire better performance on the contradiction class. Moreover, we would also move forward to the next step of sentence classification, that is recognizing more specific semantic classes such as refinement, subsumption and cross-reference.

References

1. Agirre, E., Diab, M., Cer, D., and Gonzalez-Agirre, A. Semeval-2012 task 6: a pilot on semantic textual similarity. In *Proceedings of the First Joint Conference on Lexical and Computational Semantics*, SemEval'12, 385–393, 2012.
2. Allan, J., Wade, C., and Bolivar, A. Retrieval and novelty detection at the sentence level. In *Proceedings of the 26th annual international ACM SIGIR conference on Research and development in informaion retrieval*, SIGIR'03, 314–321, 2003.
3. Banea, C., Hassan, S., Mohler, M., and Mihalcea, R. Unt: a supervised synergistic approach to semantic text similarity. In *Proceedings of the First Joint Conference on Lexical and Computational Semantics*, SemEval'12, 635–642, 2012.
4. Bentivogli, L., Dagan, I., Dang, H. T., Giampiccolo, D., and Magnini, B. The fifth pascal recognizing textual entailment challenge. In *Proceedings of Text Analysis Conference Workshop*, TAC'09, 2009.
5. Dagan, I. and Glickman, O. The pascal recognising textual entailment challenge. *LNCS*, 3944:177–190, 2005.

6. Gaonac, M. A. R., Gelbukh, A., and Bandyopadhyay, S. Recognizing textual entailment using a machine learning approach. In *Proceedings of the 9th Mexican international conference on Artificial intelligence conference on Advances in soft computing: Part II*, MICAI'10, 177–185, 2010.
7. Gildea, D. and Jurafsky, D. Automatic labeling of semantic roles. *Comput. Linguist.*, 28(3):245–288, sep 2002.
8. Girju, R., Nakov, P., Nastase, V., Szpakowicz, S., Turney, P., and Yuret, D. Classification of semantic relations between nominals. *Language Resources and Evaluation*, 43:105–121, 2009.
9. Harabagiu, S., Hickl, A., and Lacatusu, F. Negation, contrast and contradiction in text processing. In *Proceedings of the 21st national conference on Artificial intelligence - Volume 1*, AAAI'06, 755–762, 2006.
10. Lesk, M. Automatic sense disambiguation using machine readable dictionaries: how to tell a pine cone from an ice cream cone. In *Proceedings of the 5th annual international conference on Systems documentation*, SIGDOC '86, 24–26, 1986.
11. Losada, D. E. and Fernández, R. T. Highly frequent terms and sentence retrieval. In *Proceedings of the 14th international conference on String processing and information retrieval*, SPIRE'07, 217–228, 2007.
12. Marcu, D. The automatic construction of large-scale corpora for summarization research. In *Proceedings of the 22nd annual international ACM SIGIR conference on Research and development in information retrieval*, SIGIR'99, 137–144, 1999.
13. Marneffe, M.-C. D., Rafferty, A. R., and Manning, C. D. *Identifying conflicting information in texts.* 2012.
14. Marneffe, M.-C. D., Rafferty, A. N., and Manning, C. D. Finding contradictions in text. In *Proceedings of Human Language Technology Conference*, HLTf08, 1039–1047, 2008.
15. Miller, G. A. Wordnet: a lexical database for english. *Commun. ACM*, 38:39–41, 1995.
16. Murakami, K., Nichols, E., Inui, K., Mizuno, J., Goto, H., Ohki, M., Matsuyoshi, S., and Matsumoto, Y. Automatic classification of semantic relations between facts and opinions. In *The Second International Workshop on NLP Challenges in the Information Explosion Era*, NLPIX'10, 21–30, 2010.
17. Nguyen, H.-M. and Shirai, K. Exploitation of query sentences using specific weighting in support-sentence retrieval. In *17th International Conference on Knowledge-Based and Intelligent Information & Engineering Systems*, KES'13, 2013.
18. Radev, D. R. A common theory of information fusion from multiple text sources step one: cross-document structure. In *Proceedings of the 1st SIGdial workshop on Discourse and dialogue - Volume 10*, SIGDIAL'00, 74–83, 2000.
19. Ritter, A., Downey, D., Soderland, S., and Etzioni, O. It's a contradiction—no, it's not: a case study using functional relations. In *Proceedings of the Conference on Empirical Methods in Natural Language Processing*, EMNLP '08, 11–20, 2008.
20. Voorhees, E. M. Contradictions and justifications: Extensions to the textual entailment task. In *Proceedings of the 46th Annual Meeting of the Association for Computational Linguistics*, ACL'08, 63–71, 2008.

Eval-net: implementation evaluation nets elements as Petri net extension

Michał Niedźwiecki[1], Krzysztof Rzecki[2], and Krzysztof Cetnarowicz[1]

[1] AGH University of Science and Technology
al. Mickiewicza 30, 30-059 Krakow, Poland
[2] Cracow University of Technology
ul. Warszawska 24, 31-155 Krakow, Poland

Abstract. Evaluation nets are an easy, readable and functional method for visualizing states and communication between computer systems using diagrams. They are, unfortunately not so popular and there are no tools to help their creation, verification and simulation. However evaluation nets have many common characteristics with Petri nets; and Petri nets have many such tools. In this article an extension to Petri nets called Eval-nets is presented. Eval-nets introduce the most useful elements of evaluation nets. This extension is capable of being used in existing tools and it is not necessary to implement the common elements for Petri and evaluation nets to achieve new functionality. As a result a functional tool for creating, analysing, running, debugging and simulating communication protocols may be build based on Petri nets.

Keywords: evaluation nets, eval-net, petri net, simulation

1 Introduction

Evaluation nets [18] were invented at the beginning of '70 and became an alternative to Petri net [23]. This method has some restrictions and is not so easy in automated analysis, so is not so popular.

Evaluation nets consists of two parts: a frontend and a backend.

The frontend is similar to a Petri net. The backend is the source code that is executed at the appropriate time and has an impact on the future flow of tokens. The backend determines which of the enabled transitions will be firing.

It allows for easily linking a visualization state and sending messages to the actual source code. However, this relationship makes it difficult or even impossible to use mathematical tools to analyse the entire system because these tools examine only the graph and not the source code. For example, a reachability graph based on Petri net can be built. A similar graph can be built on the basis of the evaluation nets frontend. However, when you start such evaluation nets it may be the case that the backend will never run some routes and some states of the reachability graph will became unattainable.

The properties of evaluation nets had been very useful for modeling and verifying negotiation protocols (e.g. Complex Negotiations protocol [15]) and

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 425-436

This mix gives a simple to implement extension. Simplicity is available because it is based on solutions built for Petri nets and does not create conflicts with many existing extensions for Petri nets.

The described solution is a part of a simulation platform that consists of Eval-net interpreter, editor and tools for simulation and analysis. The interpreter runs within an agent that acts on the JADE platform. It passes net evaluation (created in the editor) and executes the source code backed (written in Python). The editor allows you to create and view the current state of the network together with the history of transitions. It also allows you to make changes to on-line in both the frontend and the backend. The analysis tools are adapted from Petri net tools, while the simulator allows you to perform a specific scenario, to generate test data and visualize simulation results.

Acknowledgements

The research leading to these results has received funding from the dean grant no. 15.11.230.082, AGH University of Science and Technology, Faculty of Computer Science, Electronics and Telecommunications.

Author Michał Niedźwiecki would like to thank EFS of POKL 4.1.1 (POKL.04.01.01-00-367/08-00), European Union programme for support.

References

1. André, F., (Grup), C.: Distributed Computing Systems: Communication, Cooperation, Consistency. Elsevier Science Pub. (1985)
2. Balbo, G.: Introduction to stochastic petri nets. In: Brinksma, E., Hermanns, H., Katoen, J.P. (eds.) Lectures on Formal Methods and PerformanceAnalysis, Lecture Notes in Computer Science, vol. 2090, pp. 84–155. Springer Berlin Heidelberg (2001)
3. Cabasino, M., Giua, A., Pocci, M., Seatzu, C.: Discrete event diagnosis using labeled petri nets. an application to manufacturing systems. Control Engineering Practice 19(9), 989 – 1001 (2011)
4. Christensen, S., Hansen, N.D.: Coloured petri nets extended with place capacities, test arcs and inhibitor arcs. In: Applications and Theory of Petri Nets, volume 691 of LNCS. pp. 186–205. Springer Verlag (1992)
5. Dingle, N.J., Knottenbelt, W.J., Suto, T.: Pipe2: a tool for the performance evaluation of generalised stochastic petri nets. SIGMETRICS Perform. Eval. Rev. 36(4), 34–39 (Mar 2009)
6. Dufourd, C., Finkel, A., Schnoebelen, P.: Reset nets between decidability and undecidability. In: Larsen, K., Skyum, S., Winskel, G. (eds.) Automata, Languages and Programming, Lecture Notes in Computer Science, vol. 1443, pp. 103–115. Springer Berlin Heidelberg (1998)
7. Eckleder, A., Freytag, T.: Woped – a tool for teaching, analyzing and visualizing workflow nets. Petri Net Newsletter 75 (Dec 2008)
8. FIPA: FIPA Contract Net Interaction Protocol Specification. FIPA (2001)

9. He, X.: A formal definition of hierarchical predicate transition nets. In: Billington, J., Reisig, W. (eds.) Application and Theory of Petri Nets 1996, Lecture Notes in Computer Science, vol. 1091, pp. 212–229. Springer Berlin Heidelberg (1996)
10. van Hee, K., Oanea, O., Post, R., Somers, L., an der Werf, J.M.v.: Yasper: a tool for workflow modeling and analysis. In: Proceedings of the Sixth International Conference on Application of Concurrency to System Design. pp. 279–282. ACSD '06, IEEE Computer Society, Washington, DC, USA (2006)
11. Heitmann, F., Moldt, D.: Petri nets tools and software (Accessed in 20130514)
12. Holloway, L., Krogh, B.: Controlled petri nets: A tutorial survey. In: Cohen, G., Quadrat, J.P. (eds.) 11th International Conference on Analysis and Optimization of Systems Discrete Event Systems, Lecture Notes in Control and Information Sciences, vol. 199, pp. 158–168. Springer Berlin Heidelberg (1994)
13. Janoušek, V., Kočí, R.: Pntalk project: Current research direction. In: Simulation Almanac 2005. pp. 50–62. Faculty of Electrical Engineering, Czech Technical University (2005)
14. Köhler, M.: Object Petri Nets: Definitions, Properties, and Related Models. Univ., Bibliothek des Fachbereichs Informatik (2003)
15. Niedźwiecki, M., Rzecki, K., Cetnarowicz, K.: Complex negotiations in the conclusion and realisation of the contract. Procedia Computer Science 18(0), 1525 – 1534 (2013)
16. Niedźwiecki, M., Rzecki, K., Cetnarowicz, K.: Using the evaluation nets modeling tool concept as an enhancement of the petri net tool. In: 2013 Federated Conference on Computer Science and Information Systems (2013)
17. Noe, J.D., Nutt, G.: Macro e-nets for representation of parallel systems. Computers, IEEE Transactions on C-22(8), 718–727 (1973)
18. Nutt, G.J.: Evaluation nets for computer system performance analysis. In: Proceedings of the December 5-7, 1972, fall joint computer conference, part I. pp. 279–286. AFIPS '72 (Fall, part I), ACM, New York, NY, USA (1972)
19. Petri, C.A.: Kommunikation mit Automaten. Ph.D. thesis, Universität Hamburg (1962)
20. Ramchandani, C.: Analysis of asynchronous concurrent systems by timed petri nets. Tech. rep., Cambridge, MA, USA (1974)
21. Ratzer, A.V., Wells, L., Lassen, H.M., Laursen, M., Frank, J., Stissing, M.S., Westergaard, M., Christensen, S., Jensen, K.: Cpn tools for editing, simulating, and analysing coloured petri nets. In: Applications and Theory of Petri Nets 2003: 24th International Conference, ICATPN 2003. pp. 450–462. Springer Verlag (2003)
22. Reinhardt, K.: Reachability in petri nets with inhibitor arcs. Electron. Notes Theor. Comput. Sci. 223, 239–264 (Dec 2008)
23. Rozenberg, G., Engelfriet, J.: Elementary net systems. In: Reisig, W., Rozenberg, G. (eds.) Lectures on Petri Nets I: Basic Models, Lecture Notes in Computer Science, vol. 1491, pp. 12–121. Springer Berlin Heidelberg (1998)
24. Zurawski, R., Zhou, M.: Petri nets and industrial applications: A tutorial. Industrial Electronics, IEEE Transactions on 41(6), 567–583 (1994)
25. Żabińska, M., Cetnarowicz, K.: Application of m-agent multi-profile architecture and evaluation nets to negotiation algorithm design. In: Amin, K.Y.M. (ed.) ISSPIT' 2002 : the 2nd IEEE International Symposium on Signal Processing and Information Technology : December 18–21. pp. 214–219 (2002)

The use of evaluation nets in Complex Negotiations modelling

Michał Niedźwiecki[1], Krzysztof Rzecki[2], and Krzysztof Cetnarowicz[1]

[1] AGH University of Science and Technology
al. Mickiewicza 30, 30-059 Krakow, Poland
[2] Cracow University of Technology
ul. Warszawska 24, 31-155 Krakow, Poland

Abstract. In this work Complex Negotiations are presented by use of evaluation nets. Complex Negotiations is a protocol for negotiating the terms and conditions of a contract to provide a particular service. It includes negotiation of terms prior to concluding a contract as well as their renegotiation while the contract is being executed. Evaluation nets constitute a sort of Petri net extension and they are well-suited for modelling communication protocols. Their application facilitates graphical visualisation, analysis and verification of the validity of Complex Negotiations performed by particular participants.

Keywords: evaluation nets, petri net, complex negotiation

1 Introduction

The problem of negotiation is very often invoked in communications. Negotiations are talks between two participants, the objective of which is to make some arrangements (concerning terms and conditions of a contract) between them.

The life of a contract can be divided into two phases: the phase of concluding it and the phase of executing it. During the first phase the parties make an agreement concerning the terms and conditions of their mutual obligations. In the second phase these obligations are executed, but it may be necessary to renegotiate the terms and conditions (e.g. in the case of a failure, changes in the market of goods and service etc.). The automatic negotiation systems that are described in the literature mainly focus on the first phase of the contract or just on negotiations. Only specialist systems focus on the second phase of a contract's life, such as e.g. renegotiation of a data link protocol between network devices when the types of disturbances or network traffic intensity have changed. This has become the motivation to develop Complex Negotiations [15], which take both contract phases into account.

In that work we assumed that none of the parties to a contract would optimise its activities by terminating the contract and concluding a new one with another partner.

Complex Negotiations is a communication protocol. In this work the authors chose to use evaluation nets as Petri net extension [16]. The motivation for using

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 437-448

due to many similarities that they share with Petri nets, it is possible to adjust programming tools made for Petri nets to work with evaluation nets. Further works will focus on developing such tools.

Acknowledgements

The research leading to these results has received funding from the dean grant no. 15.11.230.082, AGH University of Science and Technology, Faculty of Computer Science, Electronics and Telecommunications.

Author Michał Niedźwiecki would like to thank EFS of POKL 4.1.1 (POKL.04.01.01-00-367/08-00), European Union programme for support.

References

1. An, B., Sim, K., Tang, L., Miao, C., Shen, Z., Cheng, D.: Negotiation agentsd́ecision making using markov chains. In: Ito, T., Hattori, H., Zhang, M., Matsuo, T. (eds.) Rational, Robust, and Secure Negotiations in Multi-Agent Systems, Studies in Computational Intelligence, vol. 89, pp. 3–23. Springer Berlin Heidelberg (2008)
2. André, F., (Grup), C.: Distributed Computing Systems: Communication, Cooperation, Consistency. Elsevier Science Pub. (1985)
3. Bellifemine, F.L., Caire, G., Greenwood, D.: Developing Multi-Agent Systems with JADE. Wiley (2007)
4. Coltman, T., Bru, K., Perm-Ajchariyawong, N., Devinney, T.M., Benito, G.R.: Supply chain contract evolution. European Management Journal 27(6), 388 – 401 (2009)
5. Conway, J.H.: Regular Algebra and Finite Machines. Chapman and Hall, London (1971)
6. De Marco, M., Trecordi, V.: Bandwidth re-negotiation in atm networks for high-speed computer communications. In: Global Telecommunications Conference, 1995. GLOBECOM '95., IEEE. vol. 1, pp. 393 –398 vol.1 (nov 1995)
7. FIPA: FIPA Contract Net Interaction Protocol Specification. FIPA (2001), `http://www.fipa.org/specs/fipa00029/`
8. Hoare, C.A.R.: Communicating sequential processes. Commun. ACM 21(8), 666–677 (Aug 1978)
9. International Telecommunication Union: A digital modem and analogue modem pair for use on the public switched telephone network (pstn) at data signalling rates of up to 56'000 bit/s downstream and up to 33'600 bit/s upstream. ITU-T Recommendation V.90 (September 1998)
10. Information technology — open systems interconnection — basic reference model: The basic model. ISO/IEC 7498-1:1994, ISO, Geneva, Switzerland (Nov 1994)
11. Kucukyilmaz, A., Oguz, S., Sezgin, T., Basdogan, C.: Improving human-computer cooperation through haptic role exchange and negotiation. In: Peer, A., Giachritsis, C.D. (eds.) Immersive Multimodal Interactive Presence, pp. 229–254. Springer Series on Touch and Haptic Systems, Springer London (2012)
12. Lau, H.C., Lim, W.S.: Multi-agent coalition via autonomous price negotiation in a real-time web environment. In: Intelligent Agent Technology, 2003. IAT 2003. IEEE/WIC International Conference on. pp. 580 – 583 (oct 2003)

13. Martinovski, B.: Emotion in negotiation. In: Kilgour, D.M., Eden, C. (eds.) Handbook of Group Decision and Negotiation, Advances in Group Decision and Negotiation, vol. 4, pp. 65–86. Springer Netherlands (2010)
14. Mealy, G.H.: A method for synthesizing sequential circuits. Bell System Technical Journal 34(5), 1045–1079 (1955)
15. Niedźwiecki, M., Rzecki, K., Cetnarowicz, K.: Complex negotiations in the conclusion and realisation of the contract (July 2013), international Conference on Computational Science
16. Niedźwiecki, M., Rzecki, K., Cetnarowicz, K.: Eval-net: implementation evaluation nets elements as petri net extension. In: KICSS'2013 Proceedings (2013)
17. Niedźwiecki, M., Rzecki, K., Cetnarowicz, K.: Using the evaluation nets modeling tool concept as an enhancement of the petri net tool. In: 2013 Federated Conference on Computer Science and Information Systems (2013)
18. Noe, J.D., Nutt, G.: Macro e-nets for representation of parallel systems. Computers, IEEE Transactions on C-22(8), 718–727 (1973)
19. Nutt, G.J.: Evaluation nets for computer system performance analysis. In: Proceedings of the December 5-7, 1972, fall joint computer conference, part I. pp. 279–286. AFIPS '72 (Fall, part I), ACM, New York, NY, USA (1972)
20. Nutt, G.J.: The Formulation and Application of Evaluation Nets. Ph.D. thesis, University of Washington (1972)
21. Pnueli, A.: The temporal logic of programs. In: Proceedings of the 18th Annual Symposium on Foundations of Computer Science. pp. 46–57. SFCS '77, IEEE Computer Society, Washington, DC, USA (1977)
22. Rahwan, I., Ramchurn, S.D., Jennings, N.R., Mcburney, P., Parsons, S., Sonenberg, L.: Argumentation-based negotiation. Knowl. Eng. Rev. 18(4), 343–375 (Dec 2003)
23. Rozenberg, G., Engelfriet, J.: Elementary net systems. In: Reisig, W., Rozenberg, G. (eds.) Lectures on Petri Nets I: Basic Models, Lecture Notes in Computer Science, vol. 1491, pp. 12–121. Springer Berlin Heidelberg (1998)
24. Song, H., Lee, K.M.: Adaptive rate control algorithms for low bit rate video under networks supporting bandwidth renegotiation. Signal Processing: Image Communication 17(10), 759 – 779 (2002)
25. Titchiev, I.: Modeling of the communication protocol by means of colored petri nets. case study. In: Proceedings of the International Workshop on Intelligent Information Systems IIS'2011. pp. 203–206. Institute of Mathematics and Computer Science, Chisinau, Republic of Moldova (2011)
26. Wagner, F., Schmuki, R., Wagner, T., Wolstenholme, P.: Modeling Software with Finite State Machines: A Practical Approach. Modeling Software with Finite State Machines: A Practical Approach, Taylor & Francis (2006)
27. Winikoff, M.: Defining syntax and providing tool support for agent uml using a textual notation. Int. J. Agent-Oriented Softw. Eng. 1(2), 123–144 (Jul 2007)
28. Zinnikus, I., Cao, X., Fischer, K.: Agent-supported collaboration and interoperability for networked enterprises: Modeling interactions and service compositions. Computers in Industry (0), – (2013)
29. Żabińska, M., Cetnarowicz, K.: Application of m-agent multi-profile architecture and evaluation nets to negotiation algorithm design. In: Amin, K.Y.M. (ed.) ISSPIT' 2002 : the 2nd IEEE International Symposium on Signal Processing and Information Technology : December 18–21. pp. 214–219 (2002)

Exploring Associations between the Work Environment and Creative Design Processes

Mobina Nouri & Neil Maiden

Centre of creativity in professional practice, City University London, UK
{mobina.nouri.1,n.a.m.maiden}@city.ac.uk

Abstract. Creative thinking is a critical activity in design work, and it can be influenced by the climate of a space that designers work in, either individually or in groups. Designers experience different emotions during creative design processes, and these emotions can influence their levels of both creativity and productivity, so modifying the environments in which design work is done can impact on creative design outcomes. In this paper we report some first empirical research that investigates associations between environment, emotion and creative design work undertaken using different creativity and design techniques.

Keywords: creativity, environment, emotion, and design

1 Introduction

Characteristics of workspace are similar to body language and both reflect the attitudes of people to work and afford different behaviors of the people in that space. Indeed, space designers argue that an environment that is more creative can foster the people's creativity [2]. Not only can the characteristics of a space directly afford more creative behavior, for example through collaborative working around shared artifacts [16], but the qualities of the space can influence peoples' emotions so that they are more predisposed to be creative [1]. In this paper we empirically explore the link between environment, emotion and creative outcomes in a collaborative creative tasks.

We have previously investigated emotions in collaborative design work by observed post-graduate design students during face-to-face creative tasks over a 5-week period. Results revealed that, at the beginning of each session, most students reported more negative and uncertain emotions such as *unsure*, *confused* and *frustrate,* whilst most students at the end of the same creative tasks reported emotions such as *progress*, *relief*, *funny* and *productive*. Designers' emotions appeared to change during creative work, but reasons for these changes were unclear, leaving scope for more empirical research.

5th Knowledge, Information and Creativity Support Systems Conference
7th to 9th November 2013, Krakow, Poland

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 449-460

References

1. Baas M., De Dreu C.K.W. & Nijstad B.A, A Meta-Analysis of 25 years of Mood-Creativity Research: Hedonic Tone, Activation, or Regulatory Focus? Psychological Bulletin, 134, 779-806. , (2008)
2. Doorley S. &Witthoft S. Make space, Wiley, Hoboken, New Jersey. (2012)
3. Ekvall .G, Organizational climate for creativity and innovation, European Journal of Work and Organizational Psychology, Volume 5, Issue 1, 105-123, (1996)1
4. Gray Z.M. Creativity Through the Use of Color as an External Stimulus, Master Thesis, Auburn University. (2010)
5. Isaksen S.G., Dorval K.B. & Treffinger K.J., Creative Approaches to Problem Solving: A Framework for Innovation and Change. (2009)
6. Isaksen, S. G. & Laure, K.J. The climate for creativity and change in teams, Creativity and Innovation Management, 11, 74-86. (2002)
7. Isaksen, S. G. & Laure, K.J. & Ekvall, G & Britz, A. Perceptions of the best and worst climates for creativity: Preliminary validation evidence for the Situational Outlook Questionnaire, Creativity Research Journal, Vol 13(2), 171-184, (2001)
8. Kozlowski, S. W., & Klein, K. J. A multilevel approach to theory and research in organizations: contextual, temporal and emergent processes. In K. J. Klein, & S. W. Kozlowski (Eds.), Multilevel theory, research and methods in organizations: Foundations, extensions and new directions (pp. 3–90). San Francisco, (2000).
9. Maher M.L., Brady K. & Fisher D.H. Computational Models of Surprise in Evaluating Creative Design. Proceedings 5th International Conference on Computational Creativity, 156-160. (2013)
10. McCoy J.M. & Evans G.W.The Potential Role of the Physical Environment in Fostering Creativity, Creativity Research Journal, 14(3&4), 409–426. (2002)
11. Michalko M. Thinkertoys: a Handbook of Creative-Thinking Techniques, Ten Speed Press. (2006)
12. Norman, D. A. Emotional Design: Why We Love (or Hate) Everyday Things. New York. (2004).
13. Onarheim B. Creativity under Constraints: Creativity as Balancing 'Constrainedness', PhD Thesis, Copenhagen Business School, December (2012).
14. Ravi M., Zhu R. & Cheema A., Is Noise Always Bad? Exploring the Effects of Ambient Noise on Creative Cognition, Journal of Consumer Research, 39(4), 784-799. (2012)
15. Stickdorn M. & Schneider J. This is Service Design Thinking, BIS Publishers. (2010)
16. Warr A. & O'Neill E. Tool Support for Creativity using Externalizations, Proceedings ACM Conference on Creativity and Cognition, 127-136. (2007)

An interactive procedure for multiple criteria decision tree

Maciej Nowak

University of Economics, Katowice
maciej.nowak@ue.katowice.pl

Abstract. A lot of real-world decision problems are dynamic, which means that not a single, but a series of choices must be made. Additionally, in serious problems, multiple criteria and uncertainty have to be considered. In the paper an interactive algorithm for multiple criteria decision tree is proposed. Various types of criteria are taken into account, including expected value, conditional expected value and probability of success. The procedure consists of two steps. First, non-dominated strategies are identified. Next, the final solution is selected using interactive technique. An example is presented to show the applicability of the procedure.

Keywords. multiple criteria decision making, dynamic decision problems, decision making under risk, decision tree.

1 Introduction

The dynamics characterize numerous decision problems. In real-world the decision process can rarely be posed in terms of a single choice. Often, a series of interdependent decisions must be made at different periods of time in order to achieve an overall goal. Moreover, as the future is unknown, the results of these decisions are usually uncertain. A decision tree is well-known tool to model and to evaluate such processes. In classical version it provides a method for identifying a strategy maximizing expected profit or minimizing expected loss. Thus, it's application is limited to single criteria problems in which consequences are measured on cardinal scale. Real-world decision problems, however, usually involve multiple criteria. In addition, at least some of them are qualitative in nature, and as a result cardinal scale cannot be used.

In this paper, we analyze sequential multiple criteria decision making problems under risk, which can be characterized as follows:

1. The decision process consists of T periods. At each period, a decision must be made. Any decision made at period t determines the characteristics of the problem at period $t + 1$.
2. Risk is taken into account. It is assumed that states of nature are defined for each period and are modeled by probabilistic distributions.
3. Multiple conflicting criteria, both quantitative and qualitative in nature, are considered.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 461-472

Bibliography

1. Chiu, L., Gear, T.E.: An Application and Case History of a Dynamic R&D Portfolio Selection Model. IEEE Trans. Eng. Manage. 26, 2-7 (1979).
2. Corner, J.L., Kirkwood, C.W.: Decision Analysis Applications in the Operations Research Literature. 1970-1989. Oper. Res. 39, 206-219 (1991).
3. Covaliu, Z., Oliver, R.M.: Representation and Solution of Decision Problems Using Sequential Decision Diagrams. Manage. Sci. 41, 1860-1881 (1995).
4. Frini, A., Guitouni, A., Martel, J.-M.: A General Decomposition Approach for Multicriteria Decision Trees. Eur. J. Oper. Res. 220, 452-460 (2012).
5. Frohwein, H.I., Haimes, Y.Y., Lambert, J.H.: Risk of Extreme Events in Multiobjective Decision Trees. Part 2: Rare Events. Risk Anal. 20, 125-134 (2000).
6. Frohwein, H.I., Lambert, J.H.: Risk of Extreme Events in Multiobjective Decision Trees. Part 1: Severe Events. Risk Anal. 20, 113-123 (2000).
7. Granot, D., Zuckerman, D.: Optimal Sequencing and Resource Allocation in Research and Development Projects. Manage. Sci. 37, 140-156 (1991).
8. Haimes, Y., Li, D., Tulsiani, V.: Multiobjective Decision Tree Method. Risk Analysis 10, 111-129 (1990).
9. Hess, S.W.: Swinging on the branch of a tree: project selection applications. Interfaces 23, 5-12 (1993).
10. Keeney, R.L., Raiffa, H.: Decisions with Multiple Objectives: Preferences and Value Tradeoffs. Wiley, New York (1976).
11. Kirkwood, C.W.: An Algebraic Approach to Formulating and Solving Large Models for Sequential Decisions Under Uncertainty. Manage. Sci. 39, 900-913 (1993).
12. Li, D.: Multiple Objectives and Non-Separability in Stochastic Dynamic Programming. Int. J. Syst. Sci. 21, 933-950.
13. Lootsma, F.A.: Multicriteria Decision Analysis in a Decision Tree. Eur. J. Oper. Res. 101, 442-451 (1997).
14. Nowak, M.: INSDECM – An interactive procedure for discrete stochastic multicriteria decision making problems. Eur. J. Oper. Res. 175, 1413-1430 (2006).
15. Nowak, B., Nowak, M.: Multicriteria decision aiding in project planning using decision tree and simulation. In: Trzaskalik, T., Wachowicz, T. (eds.) Multiple Criteria Decision Making '10-11, pp. 163-187. University of Economics Press, Katowice (2011).
16. Stonebraker, J.S., Kirkwood, C.W.: Formulating and solving sequential decision analysis models with continuous variables. IEEE Trans. Eng. Manage. 44, 43-53 (1997).
17. Thomas, H.: Decision analysis and strategic management of research and development: a comparison between applications in electronics and ethical pharmaceuticals. R&D Manage. 15, 3-22 (1985).
18. von Winterfeld, D., Edwards, W.: Decision Analysis and Behavioral Research. Cambridge University Press, Cambridge (1986).

A Comparative Study on Single and Dual Space Reduction in Multi-label Classification

Eakasit Pacharawongsakda and Thanaruk Theeramunkong

School of Information, Computer, and Communication Technology
Sirindhorn International Institute of Technology
Thammasat University, Thailand
{eakasit,thanaruk}@siit.tu.ac.th

Abstract. Multi-label classification has been applied to several applications since it can assign multiple class labels to an object. However, its effectiveness might be sacrificed due to high dimensionality problem in both feature space and label space. To address these issues, several dimensionality reduction methods have been proposed to transform the high dimensional spaces to lower-dimensional spaces. This paper aims to provide a comprehensive review on ten dimensionality reduction methods that applied to multi-label classification. These methods can be categorized into two main approaches: single space reduction and dual space reduction. While the former approach aims to reduce the complexity in either feature space or label space, the latter approach transforms both feature and label spaces into two subspaces. Moreover, a comparative study on single space reduction and dual space reduction approaches with five real world datasets are also reported. The experimental results indicated that dual space reduction approach tends to give better performance comparing to the single reduction approach.

Keywords: multi-label classification, dimensionality reduction, dual space reduction

1 Introduction

In the past, traditional classification techniques assumed a single category for each object to be classified by means of minimum distance. However, in some tasks it is natural to assign more than one category to an object. For examples, some news articles can be categorized into both *politic* and *crime*, or some movies can be labeled as *action* and *comedy*, simultaneously. As a special type of task, multi-label classification was initially studied by Schapire and Singer (2000) [9] in text categorization. Later many techniques in multi-label classification have been proposed for various applications such as image classification, music to emotion categorization, automated tag recommendation, Bioinformatics research and sentiment analysis. However, these methods can be grouped into two main approaches: *Algorithm Adaptation* (AA) and *Problem Transformation* (PT) as suggested in [11]. The former approach modifies existing classification

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 473-484

12 Eakasit Pacharawongsakda and Thanaruk Theeramunkong

References

1. Golub, G., Reinsch, C.: Singular value decomposition and least squares solutions. Numerische Mathematik 14, 403–420 (1970)
2. Hsu, D., Kakade, S., Langford, J., Zhang, T.: Multi-label prediction via compressed sensing. In: Proceedings of the Advances in Neural Information Processing Systems 22. pp. 772–780 (2009)
3. Madjarov, G., Kocev, D., Gjorgjevikj, D., Deroski, S.: An extensive experimental comparison of methods for multi-label learning. Pattern Recogn. 45(9), 3084–3104 (Sep 2012)
4. Miettinen, P.: The boolean column and column-row matrix decompositions. Data Mining and Knowledge Discovery 17(1), 39–56 (2008)
5. Pacharawongsakda, E., Theeramunkong, T.: Improving classifier chains for multi-label classification using dual space reduction. In: Proceedings of the 6th International Conference on Knowledge, Information and Creativity Support Systems (KICSS). pp. 104–111. KICSS 2011 (2011)
6. Pacharawongsakda, E., Theeramunkong, T.: Towards more efficient multi-label classification using dependent and independent dual space reduction. In: Proceedings of the 16th Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD). pp. 383–394. PAKDD'12 (2012)
7. Pacharawongsakda, E., Theeramunkong, T.: A two-stage dimensionality reduction framework for multi-label classification. In: Proceedings of the PAKDD Workshop on quality issues, measures of interestingness and evaluation of data mining models (QIMIE). pp. 330–341. QIMIE 2013 (2013)
8. Read, J., Pfahringer, B., Holmes, G., Frank, E.: Classifier chains for multi-label classification. Machine Learning pp. 1–27 (2011)
9. Schapire, R., Singer, Y.: Boostexter: A boosting-based system for text categorization. Machine Learning 39(2/3), 135–168 (2000)
10. Tai, F., Lin, H.T.: Multi-label classification with principle label space transformation. In: Proceedings of the 2nd International Workshop on Learning from Multi-Label Data (MLD'10). pp. 45–52 (2010)
11. Tsoumakas, G., Katakis, I., Vlahavas, I.: Mining Multi-label Data. Data Mining and Knowledge Discovery Handbook. Springer, second edn. (2010)
12. Wang, H., Ding, C., Huang, H.: Multi-label linear discriminant analysis. In: Proceedings of the 11th European conference on Computer vision: Part VI. pp. 126–139. Springer-Verlag, Berlin, Heidelberg (2010)
13. Wicker, J., Pfahringer, B., Kramer, S.: Multi-label classification using boolean matrix decomposition. In: Proceedings of the 27th Annual ACM Symposium on Applied Computing. pp. 179–186. Springer-Verlag, Berlin, Heidelberg (2012)
14. Yu, K., Yu, S., Tresp, V.: Multi-label informed latent semantic indexing. In: Proceedings of the 28th annual international ACM SIGIR conference on Research and development in information retrieval. pp. 258–265 (2005)
15. Zhang, M.L., Zhou, Z.H.: A review on multi-label learning algorithms. IEEE Transactions on Knowledge and Data Engineering 99(PrePrints), 1 (2013)
16. Zhang, Y., Zhou, Z.H.: Multilabel dimensionality reduction via dependence maximization. ACM Transactions on Knowledge Discovery from Data (TKDD) 4(3), 1–21 (2010)

Understanding Context-Aware Business Applications in the Future Internet Environment*

Emilian Pascalau[1] and Grzegorz J. Nalepa[2]

[1]Conservatoire National des Arts et Métiers,
2 rue Conté,75003 Paris, France
emilian.pascalau@cnam.fr
[2]AGH University of Science and Technology
al. A. Mickiewicza 30, 30-059 Krakow, Poland
gjn@agh.edu.pl

Abstract. The obvious move towards a Future Internet environment that is strongly distributed, mobile, cloud-based, semantically rich has raised and emphasized the need for a different type of applications. The focus of this new type of applications can no longer be on the software itself but directly on the relevant needs and goals of end-users. We argue that because these applications are strongly end-user oriented, context and context-awareness play an important role in their design and development. Hence in this paper we discuss context-aware business applications towards a better understanding of their specific features. We emphasize two major directions related to context oriented applications, their importance, and the order in which they should be followed and interlinked.

Keywords: context-aware systems, business applications, user centric approach

1 Introduction

We are witnessing an obvious trend towards the Future Internet environment which is essentially cloud-based and which comes with a new set of characteristics and challenges. In this new environment that is generative and fosters innovation [36] business models and customer relationships are changing, it is about software on demand, simple to use, software that takes into account users' needs, it is mobile, runs everywhere, including web browsers.

A series of new challenges emerge from this new environment. To name just a few:

- how to design software that is highly end-user oriented and social;
- how to involve the end-user in the development process;

* The paper is supported by the AGH UST Grant 11.11.120.859.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 485-496

References

1. Matthias Baldauf, Schahram Dustdar, and Florian Rosenberg. A survey on context-aware systems. *Ad Hoc and Ubiquitous Computing*, 2(4):263–277, 2007.
2. Tim Berners-Lee, James Hendler, and Ora Lassila. The semantic web. *Scientific America*, pages 34–43, 2001.
3. Christian Bizer, Tom Heath, and Tim Berners-Lee. Linked data - the story so far. *International Journal on Semnatic Web and Information Systems*, 2010.
4. Cristiana Bolchini, Carlo A. Curino, Elisa Quintarelli, Fabio A. Schreiber, and Letizia Tanca. A data-oriented survey of context models. *ACM SIGMOD Record*, 36(4):19–26, 2007.
5. Thomas Burkhart, Dirk Werth, and Peter Loos. Context-sensitive business process support based on emails. In *WWW 2012 – EMAIL'12 Workshop*, April 2012.
6. Guanling Chen and David Kotz. A survey of context-aware mobile computing research. Technical report, Dartmouth College Hanover, NH, USA, 2000.
7. Michael Chul, Andy Miller, and Roger P. Roberts. Six ways to make web 2.0 work. *Business Technology, The McKinsey Quaterly*, pages 1–6, 2009.
8. Joëlle Coutaz, James L. Crowley, Simon Dobson, and David Garlan. Context is key. *Communications of the ACM - The disappearing computer*, 48(3):49–53, 2005.
9. J. Davies, M. Potter, M. Richardson, S. Stincic, J. Domingue, C. Pedrinaci, D. Fensel, and R. Gonzalez-Cabero. Towards the open service web. *BT Technology Journal*, 26(2):1694–1719, 2009.
10. J. de Heer, A.J.H. Peddemors, and M.M. Lankhorst. Context-aware mobile business applications. In *CoCoNet workshop*, 2002.
11. Anind K. Dey and Gregory D. Abowd. Towards a better understanding of context and context-awareness. In *In HUC '99: Proceedings of the 1st international symposium on Handheld and Ubiquitous Computing*, pages 304–307. Springer-Verlag, 1999.
12. Adrian Giurca and Gerd Wagner. Rule modeling and interchange. In *Proc of 9th International Symposium on Symbolic and Numeric Algorithms for Scientific Computing, SYNASC2007*, pages 485–491. IEEE, 2007.
13. Hallerbach, Alena, Bauer, Thomas, and Reichert Manfred. Capturing variability in business process models: The provop approach. *Journal of Software Maintenance and Evolution: Research and Practice*, 22(6-7):519–546, 2010.
14. Martin Keen, Amit Acharya, Susan Bishop, Alan Hopkins, Sven Milinski, Chris Nott, Rick Robinson, Jonathan Adams, and Paul Verschueren. *Patterns: Implementing an SOA Using an Enterprise Service Bus*. IBM, 2004.
15. Kristian Ellebaek Kjaer. A survey of context-aware middleware. In *SE'07 Proceedings of the 25th conference on IASTED International Multi-Conference: Software Engineering*, pages 148–155. ACTA Press Anaheim, 2007.
16. Krzysztof Kluza, Krzysztof Kaczor, and Grzegorz J. Nalepa. Enriching business processes with rules using the oryx bpmn editor. In *Artificial Intelligence and Soft Computing, 11th International Conference, ICAISC 2012*, volume 7268 of *LNCS*, pages 573–581. Springer, 2012.
17. James Kobielus, Rob Karel, Boris Evelson, and Charles Coit. Mighty mashups: Do-it-yourself. business intelligence for the new economy. *Information & Knowledge Management Professionals, Forrester*, (47806):1–20, 2009.
18. C. Lovelock, S. Vandermerwe, and B. Lewis. *Services Marketing*. Prentice Hall Europe, 1996.

19. Charles McLellan, Teena Hammond, Larry Dignan, Jason Hiner, Jody Gilbert, Steve Ranger, Patrick Gray, Kevin Kwang, and Spandas Lui. *The Evolution of Enterprise Software*. ZDNet and TechRepublic, 2013.
20. OMG. Business process model and notation (bpmn). Technical Report formal/2011-01-03, OMG, November 2011.
21. Stanislaw Osinski, Jerzy Stefanowski, and Dawid Weiss. Lingo: Search results clustering algorithm based on singular value decomposition. In *Intelligent Information Systems*, pages 359–368, 2004.
22. Emilian Pascalau. Mashups: Behavior in context(s). In *Proceedings of 7th Workshop on Knowledge Engineering and Software Engineering (KESE7) at the 14th Conference of the Spanish Association for Artificial Intelligence (CAEPIA 2011)*, volume 805, pages 29–39. CEUR-WS, 2011.
23. Emilian Pascalau. Towards TomTom like systems for the web: a novel architecture for browser-based mashups. In *Proceedings of the 2nd International Workshop on Business intelligencE and the WEB (BEWEB11)*, pages 44–47. ACM New York, NY, USA, 2011.
24. Emilian Pascalau. Identifying guidelines for designing and engineering human-centered context-aware systems. In *Proceedings of KESE2013 collocated with KI2013*, 2013.
25. Emilian Pascalau, Grzegorz J. Nalepa, and Krzysztof Kluza. Towards a better understanding of context-aware applications. In *Proceedings of FedCSIS2013*. IEEE, 2013. submitted.
26. Daniela Petrelli, Elena Not, Carlo Strapparava, Oliviero Stock, and Massimo Zancanaro. Modeling context is like taking pictures. In *CHI'2000 Workshop on Context Awareness*, 2000.
27. Oumaima Saidani and Selmin Nurcan. Context-awareness for adequate business process modelling. In *Research Challenges in Information Science (RCIS 2009)*, 2009.
28. Ian Sommerville. *Software Engineering 8*. Addison Wesley, 2007.
29. Hong-Linh Truong and Schahram Dustdar. A survey on context-aware web service systems. *International Journal of Web Information Systems*, 5(1):5–31, 2009.
30. The Economist Intelligence Unit. Serious business. web 2.0 goes corporate. *The Economist*, pages 1–20, 2007.
31. W.M.P. van der Aalst, A.J.M.M. Weijters, and L. Maruster. Workflow mining: Discovering process models from event logs. *IEEE Transactions on Knowledge and Data Engineering*, 16(9):1128–1142, 2004.
32. Verizon. Web 3.0: Its promise and implications for consumers and business. White Paper, VerizonBusiness.com, 2010. `http://www.verizonbusiness.com/resources/whitepapers/wp_web-3-0-promise-and-implications_a4_en_xg.pdf`, Retrieved 13-05-2013.
33. Min Wang. Context-aware analytics: from applications to a system framework. http://e-research.csm.vu.edu.au/files/apweb2012/download/APWeb-Keynote-Min.pdf, 2012.
34. Mathias Weske. *Business Process Management: Concepts, Languages, Architectures*. Springer-Verlag New York, Inc., 2007.
35. Jinhua Xiong, Manfred Wojciechowski, Bernhard Holtkamp, Shaohua Yang, and Jianping Fan. A middleware supporting context-aware services based on context business objects. In *The Sixth International Conference on Grid and Cooperative Computing (GCC 2007)*, 2007.
36. Jonathan Zittrain. *The Future of the Internet And How to Stop It*. Yale University Press New Haven and London, 2008.

Symptom -Treatment Relation Extraction from Web-Documents for Construct Know-How Map

Chaveevan Pechsiri[1], Onuma Moolwat[1], and Uraiwan Janviriyasopak[2]

[1] Dept. of Information Technology, DhurakijPundit University, Bangkok, Thailand
[2] Eastern Industrial Co.ltd. , Bangkok, Thailand
{ itdpu@hotmail.com , moolwat@hotmail.com, uraiwanjan@hotmail.com }

Abstract. This paper aims to extract the relation between the disease symptoms and the treatments (called the Symptom-Treatment relation), from hospital-web-board documents to construct the Problem-Solving map which benefits for inexpert-people to solve their health problems in preliminary. Both symptoms and treatments expressed on documents are based on several EDUs (Elementary Discourse Units). Our research contains three problems: first is how to identify a symptom-concept EDU and a treatment-concept EDU. Second is how to determine a symptom-concept-EDU boundary and a treatment-concept-EDU boundary. Third is how to determine the Symptom-Treatment relation from documents. Therefore, we apply a word co-occurrence having a symptom/treatment concept to identify a disease-symptom-concept/treatment-concept EDU, respectively, and also their boundaries. We propose using Naïve Bayes to determine the Symptom-Treatment relation from documents with two feature groups, a symptom-concept-EDU group and a treatment-concept-EDU group. Finally, the result of extraction shows successfully the precision and recall of 84% and 72%, respectively.
Keywords: word order pair, Elementary Discourse Unit, Symptom-Treatment relation

1 Introduction

The objective of this research is to develop a system of automatically extracting relation between the group of disease's symptoms and the treatment/treatment procedure (called the Symptom-Treatment relation) from the medical-care-consulting documents on the hospital's web-board of the Non-Government-Organization (NGO) website edited by patients and professional medical practitioners. The extracted Symptom-Treatment relation is used for constructing the Know-How map which is a map representing how to solve problems, especially disease treatments, called Problem-Solving map (PSM). PSM benefits general people to understand how to solve their health problems in the preliminary stage. Each medical-care-consulting document contains the disease symptoms and the treatments are expressed in the form of

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 497-508

board documents of medical-care-consulting. The evaluation of the Symptom-Treatment relation extraction performance of this research methodology is expressed in terms of the precision and the recall. The results of precision and recall are evaluated by three expert judgments with max win voting. The precision of the extracted Symptom-Treatment relation is 84% and 72% recall. These research results, especially the low recall, can be increased if the interrupt occurrences on either a symptom boundary or a treatment boundary, as shown in the following, are solved.

EDU1: *หนูมีอาการท้องผูกค่ะ* **(I have a constipation symptom.)**

EDU2: [*หนู*]*พยายามฝึกถ่ายทุกวัน* **([I] try to train excretion every day.)**

EDU3: *ได้ผล* **(It can work)**

EDU4: *แต่หนูต้องกินโยเกิร์ตด้วย*: **(But I must have yogurt too)**

where EDU3 is an interrupt to the treatment-concept-EDU boundary (EDU2 and EDU4). Moreover, our extracted Symptom-Treatment relation can be represented by PSM (Fig. 2) which is very beneficial for patients to understand the disease symptoms and their treatment. However, the extracted symptoms and the extracted treatments are various to the patient characteristics, environment, time, and etc. Therefore, the generalized symptoms and the generalized treatments have to be solved before constructing PSM.

References

1. Abacha, A.B. and Zweigenbaum, P. : Automatic extraction of semantic relations between medical entities: a rule based approach. Journal of Biomedical Semantics, 2 (Suppl 5):S4 (2011) (http://www.jbiomedsem .com/content/2/S5/S4)
2. Carlson, L., Marcu, D., Okurowski, M. E.: Building a Discourse-Tagged Corpus in the Framework of Rhetorical Structure Theory. In Current Directions in Discourse and Dialogue. pp.85-112 (2003)
3. Chanlekha, H., Kawtrakul, A.: Thai Named Entity Extraction by incorporating Maximum Entropy Model with Simple Heuristic Information. IJCNLP' 2004 proceedings (2004)
4. Chareonsuk, J ., Sukvakree, T., Kawtrakul, A.: Elementary Discourse unit Segmentation for Thai using Discourse Cue and Syntactic Information. NCSEC 2005 proceedings (2005)
5. Guthrie, J. A., Guthrie, L., Wilks, Y., Aidinejad, H.: Subject-dependent co-occurrence and word sense disambiguation. Proceedings of the 29th annual meeting on Association for Computational Linguistics (1991)
6. Mitchell, T.M.: Machine Learning. The McGraw-Hill Companies Inc. and MIT Press, Singapore (1997)
7. Rosario, B.: Extraction of semantic relations from bioscience text. A dissertation submitted in partial satisfaction of the requirements for the degree of Doctor of Philosophy in Information Management and Systems. University of California, Berkeley. (2005)
8. Song, S-K., Oh, H-S. , Myaeng, S.H., Choi, S-P., Chun, H-W., Choi, Y-S., and Jeong, C-H.: Procedural Knowledge Extraction on MEDLINE. AMT 2011, LNCS 6890, pp. 345–354 (2011).
9. Sudprasert, S., Kawtrakul, A. Thai Word Segmentation based on Global and Local Unsupervised Learning. NCSEC'2003 Proceedings (2003)

Range Reverse Nearest Neighbor Queries

Reuben Pereira, Abhinav Agshikar, Gaurav Agarwal, Pranav Keni
{reubpereira, abhi2chat, grvmast, pranvprk}@gmail.com

Abstract: Reverse nearest neighbor (RNN) queries have a broad application base such as decision support, profile-based marketing, resource allocation, data mining, etc. Previous work on RNN, visible nearest neighbor and visible RNN has been done considering only point queries. Such point queries are highly unlikely in the real world. In this paper we introduce a novel variant of RNN queries - Range Reverse Nearest Neighbor queries which consider queries over a region rather than a point.

Keywords: Data Mining, Query processing, Spatial Databases, Nearest Neighbor Queries.

1 Introduction

Data Mining is a relatively young and interdisciplinary field of computer science that discovers new patterns from large data sets involving methods at the intersection of artificial intelligence, machine learning, statistics and database systems.

While the Reverse Nearest Neighbor (RNN) search problem, i.e. finding all objects in a database that have a given query q among their corresponding k-nearest neighbors, has been studied extensively in the past years, considerably less work has been done so far to support RNN queries on a region that may not be indexed by a point access method. Also less research is done for handling obstacles in case of Range queries. This paper proposes a novel approach to handle queries like "Finding an apartment in a set of buildings which is closest to a park."

2 Range Reverse Nearest Neighbor Queries

2.1 Preliminaries

Suppose that we are interested in a particular region and want to check for its reverse nearest data points. In order to expand the query point defined in R′NN to an area, we can stress on using a Range Nearest Neighbor Query.

Now suppose we are out to buy an apartment for ourselves but a requirement is that it must be near a particular monument or a recreational area or even say a road. We can consider this region of interest as a query region and this will have to be a

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 509-518

queries. Research enthusiasts can dwell more into techniques developed in this paper and move ahead in the exciting field of data mining.

Acknowledgement

We would like to thank Prof. Gajanan Gawde, Prof. Manisha Naik Gaonkar and Prof. Sebastian Mesquita for their invaluable guidance throughout our research. We are also grateful to the Head of Department and Faculty of Computer Engineering Department at Goa College of Engineering, Farmagudi, Goa-India.

References

1. Beckmann, N., Kriegel, H., Shneider, R., Seeger, B.: The R*-tree: An Efficient and Robust Access Method for Points and Rectangles. ACM **19.2** (1990) 322-331
2. Gao, Y., Zheng, B., Chen, G., Lee, W., Lee, K. C. K., Li, Q.-Visible Reverse k-Nearest Neighbor Queries. ICDE'09 Data Engineering, IEEE 25th International Conference on (2009) 1203-1206
3. Goldstein, J.,Ramakrishnan, R., Shaft, U., Yu, J.: Processing queries by linear constraint Knowledge and Data Engineering, IEEE Transactions on **18.1** (2006): 78-91
4. Hu, H., Lee, D. L.: Range Nearest Neighbor Query. Knowledge and Data Engineering, IEEE Transactions on **18.1** (2006) 78-91
5. Korn, F., Muthukrishnan, S.:Influence sets based on reverse nearest neighbor queries.ACM SIGMOD Record **29.2** (2000) 201-212
6. Roussopoulos N., Kelley, S., Vincent, F.: Nearest Neighbor Queries. ACM SIGMOD record **24.2** (1995) 71-79
7. Singh, A., Ferhatosmanoglu, H.,Tosun, A.:High Dimensional Reverse Nearest Neighbor queries. Proceedings of the twelfth international conference on Information and Knowledge management, ACM, (2003) 91-98
8. Stanoi, I., Agrawal, D., El Abbadi, A.:Reverse nearest neighbor queries for dynamic databases. ACM SIGMOD Workshop on Research Issues in Data Mining and Knowledge Discovery(2000) 44-53
9. Tao, Y., Papadias, D., Lian,X.: Reverse kNN search in arbitrary Dimensionality. Proceedings of the Thirtieth international conference on Very large data bases VLDB Endowment **30** (2004) 744-755

Intelligent Auto-adaptive Web E-content Presentation Mechanism

Wiesław Pietruszkiewicz[1] and Dorota Dżega[2]

[1] West Pomeranian University of Technology,
Faculty of Computer Science and Information Technology
ul. Zolnierska 49, 71-210 Szczecin, Poland
wpietruszkiewicz@wi.zut.edu.pl
[2] West Pomeranian Business School,
Faculty of Economics and Computers Science
ul. Zolnierska 53, 71-210 Szczecin, Poland
ddzega@zpsb.szczecin.pl

Abstract. Herein, we present an intelligent auto-adaptive web e-content presentation mechanisms, responsible for the presentation of learning materials and being a technological core of e-learning software. As the e-learning is based on various pieces of software it is possible to efficiently gather data and extract meaningful information about learner's needs. Together with the delivered knowledge about course, we can use them in the reasoning mechanism, deployed to select proper pieces of content - called as the learning pills - according to the learner's requirements. In the first part of this article, we analyse the organisation of learning process and basic pieces of knowledge delivered in it. Later, we introduce the framework for an intelligent auto-adaptive content presentation mechanism. Finally, we discuss its abilities, future research and summarise the presented material.

Keywords: E-learning, content adaptation, intelligent methods, knowledge engineering

1 Introduction

The development of Internet technology had a positive impact on the growing popularity of distance learning. The last decade was period of huge increase of e-learning, blended-learning and m-learning offers deployed not only by universities and schools, but also by various companies.

Together with the technological advancement, and accessibility to the vast amount of information stored in the distributed (Web) environment, it became necessary to provide requested information, additionally selected according to its relevancy. This also applies to the process of e-learning, where information provided by its mechanisms must be tailored to the users' requirements and expectations, concerning the expected outcome of learning process, i.e. the new gained skills.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 519-528

Therefore, the traditional one-size-fits-all courses will be replaced by one-to-one. However, to introduce such functionality content adaptation methods must by feasible in the business terms.

Acknowledgments. The research was founded by the research grant N115 413240 from the National Science Centre in Poland.

References

1. Beldaglia, B., Adiguzela, T.: Illustrating an ideal adaptive e-learning: A conceptual framework. Procedia Social and Behavioral Sciences **2** (2010) 5755–5761
2. Brusilovsky, P.: Adaptive and intelligent technologies for web-based education. Special Issue on Intelligent Systems and Teleteaching **4** (1999) 19–25
3. dall'Acqua, L.: A model for an adaptive e-learning environment. In: Proceedings of the World Congress on Engineering and Computer Science, WCECS 2009. Volume 1. (2009) 604–609
4. Dunlap, J., Dobrovolny, J., Young, D.: Preparing e-learning designers using kolb's model of experiential learning. Innovate: Journal of Online Education (2008)
5. Dżega, D., Pietruszkiewicz, W. In: Intelligent Decision-Making Support within the E-Learning Process. Springer Verlag (2012) 497–521
6. Kolb, A., A., K.D.: Experiential learning theory bibliography 1971-2001 (2001)
7. Moebs, S.: A learner, is a learner, is a user, is a customer: Qos-based experience-aware adaptation. In: Proceedings of the 16th ACM international conference on Multimedia. (2008) 1035–1038
8. Paramythis, A., Loidl-Reisinger, S.: Adaptive learning environments and e-learning standards. In: 2nd European Conference on e-Learning (ECEL 2003). (November)
9. Pushpa, M.: Aco in e-learning: Towards an adaptive learning path. International Journal on Computer Science and Engineering **4**(3) (2012) 458–462
10. Stoyanov, S., Kirschner, P.: Expert concept mapping method for defining the characteristics of adaptive e-learning: Alfanet project case. Educational Technology, Research and Development **52**(2) (2004) 41–56
11. Vasilyeva, E., Pechenizkiy, M., Bra, P.: Adaptation of feedback in e-learning system at individual and group level. In: Proceedings of the 5th international conference on Adaptive Hypermedia and Adaptive Web-Based Systems. (2008) 235–244
12. Wiggins, G., Trewin, S.: A system for concerned teaching of musical aural skills. In Gauthier, G., Frasson, C., VanLehn, K., eds.: Intelligent Tutoring Systems. Volume 1839 of Lecture Notes in Computer Science. Springer Berlin Heidelberg (2000) 494–503
13. Woźniak, P.: Algorithm used in supermemo 8 for windows. `http://www.supermemo.com/english/algsm8.htm` (September 2013)
14. Woźniak, P.: Repetition spacing algorithm used in supermemo 2002 through supermemo 2006. `http://www.supermemo.com/english/algsm11.htm` (September 2013)

Combination of Interpretable Fuzzy Models and Probabilistic Inference in Medical DSSs

Marco Pota – Massimo Esposito – Giuseppe De Pietro

Institute for High Performance Computing and Networking (ICAR)
National Research Council of Italy
Via P. Castellino 111, 80131, Naples, Italy

{marco.pota – massimo.esposito – giuseppe.depietro}@na.icar.cnr.it

Abstract. Fuzzy logic have gained increasing importance in Decision Support Systems (DSSs), in particular in medical field, since it allows to build a transparent and interpretable knowledge base. However, in order to obtain a general description of a system, probabilistic approaches undoubtedly offer the most significant information. Moreover, a good system should be useful also to classify data items which are lacking of some input features. In this work, an approach is proposed to construct an interpretable fuzzy system, which furnishes probabilistic information as a result. The resulting fuzzy sets can be interpreted as the terms of the involved linguistic variables, while the resulting weighted rules model probabilistic information. Rules are presented in two forms: the first is a set of one-dimensional models, which can be used if only one input feature is known; the second is a multi-dimensional combination of them, which can be used if more input features are known. As a proof of concept, the method has been applied for the detection of Multiple Sclerosis Lesions from brain images. The results show that this method is able to construct, for each one of the variables influencing the classification, an interpretable fuzzy partition, and very simple *if-then* rules. Moreover, a multi-dimensional rule base is presented, by means of which improved results are obtained, also with respect to naive Bayes classifier.

Keywords: probability; statistical learning; fuzzy partition; rule extraction; classification; linguistic variable; clinical DSS.

1 Introduction

Decision Support Systems (DSSs) are gaining increasing importance in recent research. In particular, in some fields of application like medicine, DSSs are often required to manage data affected by uncertainty and vagueness, and to offer a transparent and comprehensible knowledge base. These issues can be accomplished by using fuzzy logic [17]: on the one hand, fuzzy sets can model terms of linguistic variables; on the other hand, fuzzy rules show a clear and logic justification for each conclusion.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 529-540

Table 4. Classification power

Method	CR	SCE
Proposed method	84 %	0.176
Naive Bayes classifier	81 %	0.189

References

1. Abonyi, J., Szeifert, F.: Supervised fuzzy clustering for the identification of fuzzy classifiers. Pattern Recogn. Lett. 24, 2195-2207 (2003)
2. Bezdek, J.C.: Pattern Recognition with Fuzzy Objective Function Algorithms. Kluwer Academic Publishers Norwell, MA, USA, (1981)
3. Box, G.E.P., Tiao, G.C.: Bayesian Inference in Statistical Analysis. Wiley (1973)
4. D'Acierno, A., De Pietro, G., Esposito, M.: Data driven generation of fuzzy systems: An application to breast cancer detection. In: Rizzo, R., Lisboa, P.J.G. (eds) CIBB 2010. LNCS, Computational Intelligence Methods for Bioinformatics and Biostatistics, vol. 6685, pp. 203-214. Springer, Heidelberg (2011)
5. Eick, C.F., Zeidat, N., Zhao, Z.: Supervised clustering – Algorithms and benefits. Technical Report Number UH-CS-05-10 (2005)
6. Ghazavi, S.N., Liao, T.W.: Medical data mining by fuzzy modeling with selected features. Artificial Intelligence in Medicine 43, 195-206 (2008)
7. Glorennec, P.Y.: Algorithmes d'apprentissage pour systèmes d'inférence floue. Editions Hermès, Paris (1999)
8. Guillaume, S.: Designing fuzzy inference systems from data: an interpretability-oriented review. IEEE Trans. Fuzzy Syst. 9, 426-443 (2001)
9. Guillaume, S., Charnomordic, B.: Learning interpretable fuzzy inference systems with FisPro. Information Sciences 181, 4409-4427 (2011)
10. MacQueen, J.B.: Some methods for classification and analysis of multivariate observations. Proc. 5-th Symposium on Mathematical Statistics and Probability, Berkeley, University of California Press 1, 281-297 (1967)
11. Pedrycz, W.: Fuzzy equalization in the construction of fuzzy sets. Fuzzy Sets and Systems, 64, 21-30 (1994)
12. Pota, M., Esposito, M., De Pietro, G.: Transformation of probability distribution into a fuzzy set interpretable with likelihood view. In: IEEE 11th International Conference on Hybrid Intelligent Systems (HIS 2011), Malacca, Malaysia, pp. 91-96. IEEE Press, New York (2011)
13. Pota, M., Esposito, M., De Pietro, G.: From likelihood uncertainty to fuzzyness: a possibility-based approach for building clinical DSSs. The 7th International Conference on Hybrid Artificial Intelligence Systems (HAIS '12), Salamanca, Spain, part II, pp. 369-380. IEEE Press, New York (2012)
14. Quinlan, J.R.: Induction on decision trees. Machine Learning 1, pp. 81-106 (1986)
15. Wang, L.X., Mendel, J.M.: Generating fuzzy rules by learning from examples. IEEE Trans. Syst. Man Cybern. 22, 1414-1427 (1992)
16. Yuan, Y., Shaw, M.J.: Induction of fuzzy decision trees. Fuzzy Sets and Systems 65, 125-139 (1995)
17. Zadeh, L.: Fuzzy sets. Inform. Control. 8, 338-353 (1965)

Dynamic data discovery

Michal R. Przybylek

Faculty of Mathematics, Informatics and Mechanics
University of Warsaw, Poland

Abstract. This paper[1] presents a new approach to mine dynamic data. We propose generalised tree languages together with their finite models and show how they can represent systematic series of sequential and parallel actions organised into a process. Then we develop an evolutionary heuristic based on skeletal algorithms to learn tree automata. We present two major applications of our techniques: one in process mining and another in discovering a mathematical theory.

Keywords: data mining, process mining, skeletal algorithms, theory discovery, tree automata

1 Introduction

In order to survive in today's global economy more and more enterprises have to redesign their business processes. The competitive market creates the demand for high quality services at lower costs and with shorter cycle times. In such an environment business processes must be identified, described, understood and analysed to find inefficiencies which cause financial losses.

One way to achieve this is by modelling. Business modelling is the first step towards defining a software system. It enables the company to look afresh at how to improve organization and to discover the processes that can be solved automatically by software that will support the business [9]. However, as it often happens, such a developed model corresponds more to how people think of the processes and how they wish the processes would look like, then to the real processes as they take place.

Another way is by extracting information from a set of events gathered during executions of a process. Process mining [16], [14], [22] [5], [20], [19], [21], [24], [17], [18], [15], [23], [13] is a growing technology in the context of business process analysis. It aims at extracting this information and using it to build a model. Process mining is also useful to check if the "a priori model" reflects the actual situation of executions of the processes. In either case, the extracted knowledge about business processes may be used to reorganize the processes to reduce they time and cost for the enterprise.

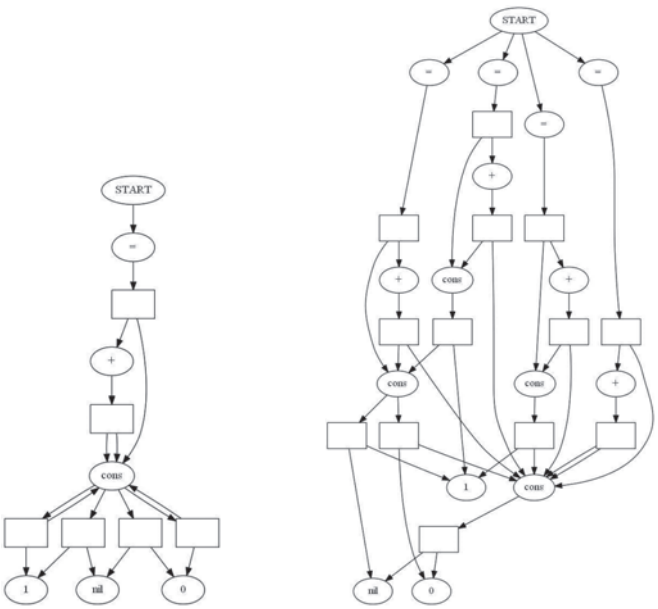
Skeletal algorithms [10], [11] are a new branch of evolutionary metaheuristics [3], [6], [7], [12], [8] focused on data and process mining. The basic idea behind

[1] This work has been partially supported by Polish National Science Center, project DEC-2011/01/N/ST6/02752.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 541-552

www.mimuw.edu.pl/~mrp/Skeletal_algorithms/finite.html

In future works we will be mostly interested in validating the presented algorithms in industrial environment and apply them to real data.



(a) Syntax for natural numbers. (b) Automaton mined from 16 samples.

Fig. 3: Natural numbers.

References

1. Barr, M. and Wells, C. (1983). Toposes, Triples and Theories. *Springer-Verlag*. Available on: http://www.cwru.edu/artsci/math/wells/pub/ttt.html
2. Bergman, G. M. (1998). An Invitation to General Algebra and Universal Constructions.
3. Bremermann, H. J. (1962). Optimization through evolution and recombination. In *Self-Organizing systems 1962, edited M.C. Yovitts et al.*, page 93106, Washington. Spartan Books.
4. Comon H. and Dauchet M. and Gilleron R. and Loding C. and Jacquemard F. and Lugiez D. and Tison S. and Tommasi M. (2007). Tree Automata Techniques and Applications. Available on: http://www.grappa.univ-lille3.fr/tata

5. de Medeiros, A., van Dongen, B., van der Aalst, W., and Weijters, A. (2004). Process mining: Extending the alpha-algorithm to mine short loops. In *BETA Working Paper Series*, Eindhoven. Eindhoven University of Technology.
6. Friedberg, R. M. (1956). A learning machines part i. In *IBM Journal of Research and Development*, volume 2.
7. Friedberg, R. M., Dunham, B., and North, J. H. (1959). A learning machines part ii. In *IBM Journal of Research and Development*, volume 3.
8. Holland, J. H. (1975). Adaption in natural and artificial systems. Ann Arbor. The University of Michigan Press.
9. Przybylek, A. (2007). The Integration of Functional Decomposition with UML Notation in Business Process Modelling. In *Advances in Information Systems Development*, volume 1.
10. Przybylek, M. R. (2013 I). Skeletal Algorithms in Process Mining. In *Studies in Computational Intelligence*, volume 465.
11. Przybylek, M. R. (2013 II) Process mining through tree automata Accepted
12. Rechenberg, I. (1971). Evolutions strategie – optimierung technischer systeme nach prinzipien der biologischen evolution. In *PhD thesis*. Reprinted by Fromman-Holzboog (1973).
13. Ren, C., Wen, L., Dong, J., Ding, H., Wang, W., and Qiu, M. (2007). A novel approach for process mining based on event types. In *IEEE SCC 2007*, pages 721–722.
14. Valiant, L. (1984). A theory of the learnable. In *Communications of The ACM*, volume 27.
15. van der Aalst, W. and van Dongen, B. (2002). Discovering workflow performance models from timed logs. In *Engineering and Deployment of Cooperative Information Systems*, pages 107–110.
16. van der Aalst, W. (2011). Process mining: Discovery, conformance and enhancement of business processes. Springer Verlag.
17. van der Aalst, W., de Medeiros, A. A., and Weijters, A. (2006a). Process equivalence in the context of genetic mining. In *BPM Center Report BPM-06-15*, BPMcenter.org.
18. van der Aalst, W. and M. Pesic, M. S. (2009). Beyond process mining: From the past to present and future. In *BPM Center Report BPM-09-18*, BPMcenter.org.
19. van der Aalst, W. and ter Hofstede, A. (2002). Workflow patterns: On the expressive power of (petri-net-based) workflow languages. In *BPM Center Report BPM-02-02*, BPMcenter.org.
20. van der Aalst, W., ter Hofstede, A., Kiepuszewski, B., and Barros, A. (2000). Workflow patterns. In *BPM Center Report BPM-00-02*, BPMcenter.org.
21. van der Aalst, W., Weijters, A., and Maruster, L. (2006b). Workflow mining: Discovering process models from event logs. In *BPM Center Report BPM-04-06*, BPMcenter.org.
22. Weijters, A. and van der Aalst, W. (2001). Process mining: Discovering workflow models from event-based data. In *Proceedings of the 13th Belgium-Netherlands Conference on Artificial Intelligence*, pages 283–290, Maastricht. Springer Verlag.
23. Wen, L., Wang, J., and Sun, J. (2006). Detecting implicit dependencies between tasks from event logs. In *Lecture Notes in Computer Science*, volume 3841, pages 591–603.
24. Wynn, M., Edmond, D., van der Aalst, W., and ter Hofstede, A. (2004). Achieving a general, formal and decidable approach to the or-join in workflow using reset nets. In *BPM Center Report BPM-04-05*, BPMcenter.org.

On a Constrained Regression Problem and its Convex Optimisation Formulation

Michał Przyłuski

Warsaw University of Technology
Institute of Control & Computation Engineering
ul. Nowowiejska 15/19, 00-665 Warsaw, Poland
M.Przyluski@elka.pw.edu.pl

Abstract. We shall consider a constrained regression problem. A shape constraint is applied to a third-degree polynomial regression. We show that some of those problems might be formulated as a problem of finding a proper metric projection. They belong to a class of convex optimisation problems for which efficient solvers exist. A numerical example for a related problem arising in econometrics is given.

Keywords: Convex optimisation, constrained regression, econometrics, total cost function.

1 Introduction

Numerous statistics-related models, especially in econometrics, require the user to find approximate values of several unknown parameters (the process of so called *estimation*), usually by employing the least squares method.

The model is frequently a carefully chosen family of functions that depends on some finite (and often small) number of parameters. It could be a family of affine functions of one variable, namely $\eta = a\xi + b$, that depends on two parameters a and b, both of them being arbitrary real numbers. The process of finding a and b is then usually called *linear regression* (see [14, 17]).

All information that we have about the model is that independently chosen values of $\xi_1, \xi_2, \ldots, \xi_K$ have led to making observations of $\eta_1, \eta_2, \ldots, \eta_K$ results, respectively. Those pairs do not have to, and usually do not, satisfy the postulated equality $\eta_k = a\xi_k + b$, for a given a and b, for all $k = 1, 2, \ldots, K$. The difference $\eta_k - a\xi_k - b$ is often considered a random variable that represents *all the errors in the model*.

First of all, the error is caused by *observational error* (sometimes called a *measurement error*) of the variable η, which reflects the difference between the actual value of a quantity and the measured value. Secondly, the error due to actual *variation of the variable* η itself. It might be caused by influences of some external randomness, that can not be explained by the model alone, but affects the measured quantity.

Linear regression problem could be then formulated as a problem of finding real numbers a and b that minimise the following function

$$f_0(a, b) = \sum_{k=1}^{K} \big(\eta_k - a\xi_k - b\big)^2. \tag{1}$$

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 553-562

regression. We have also proven that the solution of the constrained optimisation problem (which is convex, after all) exists and is uniquely defined without the analysis of constraints' Hessian matrix.

Acknowledgements. Research was partially supported by the National Science Centre (Poland) under the grant DEC-2012/07/B/HS4/03076.

References

1. Adhikari, S., Marshall, S. J.: Glacier Volume-Area Relation for High-Order Mechanics and Transient Glacier States. Geophys. Res. Lett. 39, L16505 (2012)
2. Balakrishnan, A. V.: Applied Functional Analysis. Springer, New York (1976)
3. Céa, J.: Optimisation theorie et algorithmes (in french). Dunod, Paris (1971)
4. Chiang, A. C.: Fundamental Methods of Mathematical Economics. McGraw-Hill, New York (1974)
5. Clarke, K. A.: Testing Nonnested Models of International Relations: Reevaluating Realism. Am. J. Polit. Sci. 45, 724–744 (2001)
6. Grasmair, M., Scherzer, O., Vanhems, A.: Nonparametric Instrumental Regression with Non-convex Constraints. Inverse Problems 29, 035006 (2013)
7. Hazelton, M. L., Turlach, B. A.: Semiparametric Regression with Shape-Constrained Penalized Splines. Comput. Stat. Data Anal. 55, 2871–2879 (2011)
8. Hildreth, C.: Point Estimates of Ordinates of Concave Functions. J. Amer. Statist. Assoc. 49, 598–619 (1954)
9. Jones, M. C., Davies, S. J., Park, B. U.: Versions of Kernel-Type Regression Estimators. J. Amer. Statist. Assoc. 89, 825–832 (1994)
10. Löfberg, J.: YALMIP: a Toolbox for Modeling and Optimization in MATLAB. In: Proceedings of the CACSD Conference, pp. 284–289, Taiwan (2004)
11. Mańczak, K.: Metody identyfikacji wielowymiarowych obiektów sterowania (in polish). WNT, Warsaw (1971)
12. Matzkin, R. L.: Semiparametric Estimation of Monotone and Concave Utility Functions for Polychotomous Choice Models. Econometrica 59, 1315–1327 (1991)
13. McAleer, M.: The Significance of Testing Empirical Non-nested Models. J. Econometr. 67, 149–171 (1995)
14. Samuelson, W. F., Marks, S. G.: Managerial Economics. Wiley, Hoboken, NJ (1998)
15. Söderström, T., Stoica, P.: System Identification. Prentice Hall, Cambridge (1989)
16. Vuong, Q.: Likelihood Ratio Tests for Model Selection and Nonnested Hypothesis. Econometrica 57, 307–333 (1989)
17. van der Waerden, B. L.: Mathematical Statistics. Allen & Unwin, London (1969)

A Fuzzy-Genetic System for ConFLP Problem

Krzysztof Pytel[1] and Tadeusz Nawarycz[2]

[1] Department of Theoretical Physics and Computer Science
University of Lodz, Poland
[2] Department of Biophysics, Medical University of Lodz, Poland
kpytel@uni.lodz.pl
tadeusz.nawarycz@umed.lodz.pl

Abstract. The article presents the idea of the fuzzy-genetic system, that support making decisions in multi-objective optimization problems. The Genetic Algorithm realizes the process of multi-objective optimization and search Pareto-optimal solutions in a given area of the search space. The Fuzzy Logic Controller (FLC) is used for making decisions, which solution from the Pareto-optimal set will be used. The FLC uses additional fuzzy logic criteria obtained from experts. The article presents the results of solving the Connected Facility Location Problem (ConFLP). The ConFLP is a theoretical model used in telecommunication network design. ConFLP is a NP-hard problem, based on the graph theory. The Genetic Algorithm optimizes three different objective functions: looking for a tree with the minimal edge length that connects each clients' terminals, optimizing the number of network nodes which interlink the terminals and designing their distribution in the given network area. All objective functions are mutually dependent, which additionally makes problem solving very difficult. The experiments show, that the proposed algorithm is an efficient tool for solving the Connected Facility Location Problem. The algorithm can be also used for solving similar optimization problems.

Key words: genetic algorithms, multi-objective optimization, connected facility location problem

1 Introduction

In many practical problems of optimization, it's often expected that several objectives reach the optimal value at the same time, which is called the multi-objective optimization problem [14][17]. These multiple objectives, often conflicting each other, can accept the maximum or minimum in different points of the search space. The multi-objective optimization problems is a type of multiple attribute decision problems with infinite number of potential alternative solutions. In the given task of the multi-objective optimization, instead of one optimal solution we receive a set of solutions, with a similar value. These multiple solutions are called Pareto-optimal solutions. The decision which solution from the Pareto-optimal set will be used, is made by the decision-maker, based on separate criteria.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 563-574

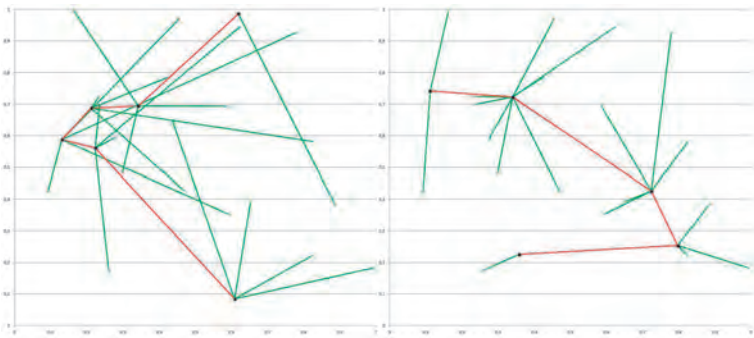


Fig. 5. The distribution of network nodes in estein20 task: a) before the optimization, b) after the optimization

The Genetic Algorithm permits to find a solution with the smaller number of nodes than in the optimum Steiner tree problem. For example, in estein100 task, the number of nodes was diminished from 44 to 8. The value of the total length of links is greater than the optimum, but such a solution is better from the point of view of the computer network designer.

In the example of the optimization of estein20 task, we can notice that the Genetic Algorithm is able to diminish the number of nodes with relation to the initial value during the process of evolution. In such a case, no terminal is assigned to the node.

The operating time of the algorithm on the class PC computer did not exceed 5 minutes for the task of optimization 100 terminals. This permits the use of the program for solving tasks typical for a designer of small computer networks. In the case of large networks, the time of calculations can be considerably longer. The parameters of the algorithm, eg. the number of generations, can be changed by adapting the algorithm to the needs of the user and the required accuracy of calculations.

The proposed algorithm is an efficient tool for solving optimization problems for criteria of the tree length, the number of nodes and for assigning terminals to network nodes. The proposed algorithm can be used for solving similar problems of multiobjective optimization.

References

[1] Beasley J.E., OR-library. URL http://people.brunel.ac.uk/˜mastjjb/jeb/orlib/steininfo.html.

[2] Gollowitzer S., Ljubic I., MIP Models for Connected Facility Location: A Theoretical and Computational Study, Computers & OR, vol. 38, no. 2, pp. 435-449, 2011.

[3] Gupta A., Kleinberg J., Kumar A., Rastogi R., and Yener B., Provisioning a virtual private network: A network design problem for multicommodity flow. In In Proceedings of the 33rd Annual ACM Symposium on Theory of Computing, pages 389-398, 2001.

[4] Hwang F. K., Richards D. S., Winter P., The Steiner Tree Problem, ser. ADM. Amsterdam, Netherlands: North-Holland, 1992, vol. 53.

[5] Karger D. R., and Minkoff M., Building Steiner trees with incomplete global knowledge. In FOCS '00: Proceedings of the 41st Annual Symposium on Foundations of Computer Science, pages 613-623, 2000

[6] Krick C., Racke H., and Westermann M., Approximation algorithms for data management in networks. In SPAA '01: Proceedings of the thirteenth annual ACM symposium on Parallel algorithms and architectures, pages 237-246. ACM, 2001.

[7] Kwasnicka H., Evolutionary Computation in Artificial Intelligence, Publishing house of Wrocaw University of Technology, Wroclaw, 1999 (in Polish).

[8] Ljubic I., A hybrid VNS for connected facility location. In T. Bartz-Beielstein, M. J. B. Aguilera, C. Blum, B. Naujoks, A. Roli, G. Rudolph, and M. Sampels, editors, Hybrid Metaheuristics, volume 4771 of Lecture Notes in Computer Science, pages 157-169. Springer, 2007.

[9] Michalewicz Z., Genetic Algorithms + Data Structures = Evolution Programs, - Springer Verlag, Berlin (1992).

[10] Polzin T., S. Daneshmand S., Practical Partitioning-Based Methods for the Steiner Problem, in WEA, ser. Lecture Notes in Computer Science, C. Alvarez and M. J. Serna, Eds., vol. 4007. Springer, 2006, pp. 241- 252.

[11] Pytel K., Nawarycz T., Analysis of the Distribution of Individuals in Modified Genetic Algorithms [in] Rutkowski L., Scherer R., Tadeusiewicz R., Zadeh L., Zurada J., Artificial Intelligence and Soft Computing, Springer-Verlag Berlin Heidelberg (2010).

[12] Pytel K., The Fuzzy Genetic Strategy for Multiobjective Optimization, Proceedings of the Federated Conference on Computer Science and Information Systems, Szczecin, (2011).

[13] Rutkowska D., Pilinski M., Rutkowski L., Neural networks, genetic algorithms and fuzzy systems, PWN, Warsaw, 1996, (in Polish).

[14] Sakawa M, Genetic Algorithms and fuzzy Multiobjective optimization, Kluwer Academic Publications, Boston (2002).

[15] Tomazic A., Ljubic I., A GRASP Algorithm for the Connected Facility Location Problem, in SAINT. IEEE Computer Society, 2008, pp. 257-260.

[16] Tomazic A., Novel Presolving Techniques for the Connected Facility Location Problem. in Federated Conference on Computer Science and Information Systems pp. 495-500, IEEE-Explore Digital Library, 2012.

[17] Zitzler E., Evolutionary Algorithms for Multiobjective Optimization: Methods and Applications, Zurich (1999).

Knowcations - Conceptualizing a Meme and Cloud-based Personal 2nd Generation Knowledge Management System

Ulrich Schmitt

University of Stellenbosch Business School
PO Box 802, Gaborone, Botswana

schmitt@knowcations.org

Abstract. The first generation of Organizational Knowledge Management (OKM) focused on the capturing, storing, and reusing of existing knowledge. To be classed as second generation, systems need to facilitate the creation of new knowledge and innovation which requires creativity and the awareness that old knowledge becomes obsolete.
Recent suggestions also urged to advance Personal Knowledge Management (PKM) as an overdue support tool for knowledge workers in the rising Creative Class and Knowledge Societies. Based on the assumption of creative conversations between many individuals' PKM devices, the autonomous systems are supposed to enable the emergence of the distributed processes of collective extelligence and intelligence, which in turn feed them.
With a PKM prototype system pursuing these qualities, the paper illustrates the interaction between a user and external information-bearing hosts and vehicles. The resulting feedback loop incorporates Boisot's I-Space Model, Dawkins' Memes, Probst's KM Building Blocks and Pirolli's Sensemaking Model for Intelligence Analysis.

Keywords: Personal Knowledge Management Systems. Information Space. Extelligence. Memes. Memetics. Business Genes. Sensemaking. Creative Class. Knowledge Worker.

1 First versus Second Generation Knowledge Management

In the "Complete Guide to Knowledge Management", Pasher and Ronen describe the focus of the first generation of Knowledge Management (KM) as the capturing, storing, and reusing of existing knowledge including "systems of managing knowledge like company yellow pages, experts outlining processes they are involved in, creating learning communities where employees/customers share their knowledge, creating information systems for documenting and storing knowledge, and so on. These first-generation KM initiatives were about viewing knowledge as the foremost strategic asset, measuring it, capturing it, storing it, and protecting it. They were about treating

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 575-586

6 The Road ahead

In "Creative Environments" [34], Wierzbicki and Nakamori affirm: "In the new knowledge civilisation era, given the systemic methods and tools of intercultural and interdisciplinary integration of knowledge, we shall also need computerised creativity support", but they also maintain: "Before we think of constructing systems of tools to support creativity, we should reflect upon what prescriptive conclusions can be derived from descriptive theoretical considerations". The system-in-progress introduced agrees with this notion; it provides a pragmatic novel solution based on established concepts and theories, some of which have already been alluded to.

In follow-up papers-to-be-submitted the prescriptive character of the system is further verified against the notion of the 'Ideosphere' [Sandberg, Kimura], Nonaka's concept of 'ba' as well as the integrated JAIST Nanatsudaki Model of knowledge creation. After reflecting on the potent co-evolutions which shaped human innovativeness, the more recent organizational, commercial, and social changes with their profound impacts on the way we work and live are explored together with the diverse shortcomings experienced by societal stakeholders. With Gurteen's interpretation of the knowledge worker and Florida's concept of the rising creative class gaining currency, the paper further looks at Vannevar Bush's still unfulfilled vision of the 'Memex' and the wider role of PKM in the context of ICT for Development (ICT4D) and a new era of networked open science.

It is planned to transform the prototype to a commercially viable PKM software application within two years. In parallel, a system training seminar will be set up as well as a curriculum and study guide for the wider multi-disciplinary Personal Knowledge Management contexts and methodologies. Further papers in progress or planned will feature the meta-entities of the system-in-progress (Sources, Actors, Profiles, Uses, and Projects) and their interdependencies as well as a case study. The latter will integrate the papers published with all their memes and references to demonstrate the knowledge management and authoring capabilities of the system.

References

1. Andrews, K. R.: The Concept of Corporate Strategy. Irwin, University of Michigan (1987)
2. Armour, P. G.: The Five Orders of Ignorance. Communications of the ACM 2000, Vol. 43, No. 10. pp. 17-20. (2000)
3. Bjarneskans, H., Grønnevik, B., Sandberg, A.: The lifecycle of memes. http://www.aleph.se/Trans/Cultural/Memetics/memecycle.html (1999)
4. Boisot, M.: Exploring the information space. University of Pennsylvania. pp. 5, 8. (2004)
5. Cheong, R.K., Tsui, E.: From Skills and Competencies to Outcome-based Collaborative Work. Knowledge and Process Management, 18(3), pp. 175-193 (2011)
6. Collis, J.: Introducing Memetics. http://meme.sourceforge.net/docs/memetics.php (2003)
7. Davenport, T. H.: Personal Knowledge Management and Knowledge Worker Capabilities. In: Pauleen, D. J., Gorman, G.E. (eds) Personal Knowledge Mgmt. pp. 167-188 (2011)
8. Dawkins, R.: The Selfish Gene. Paw Prints (1976)
9. Distin, K.: The Selfish Meme. Cambridge University Press (2005) pp. 40, 185

10. Frost, A.: Two reasons why knowledge management fails. YouTubeVideo. http://www.youtube.com/watch?v=pF9M5ezkxQs (2011)
11. Grant, G.: Memetic Lexicon. www.aleph.se/Trans/Cultural/Memetics/meme_lex.html (1990)
12. Gratton, L.: The Shift - The Future of Work is Already Here. HarperCollins UK (2011)
13. Koch, R.: The Power Laws of Business. Nicholas Brealey. pp. 50, 51, 53 (2001)
14. Levy, P.: The Semantic Sphere 1. Wiley. pp. 115-116 (2011)
15. Nonaka, I., Takeuchi, H.: The Knowledge-Creating Company. Oxford University Press. pp. 71-2, 89 (1995)
16. Pasher, E., Ronen, T.: The Complete Guide to Knowledge Management. Wiley. pp. 166-167 (2011)
17. Pauleen, D.J., Gorman, G.E.: The Nature and Value of Personal Knowledge Management. In: Pauleen, D.J., Gorman, G.E. (eds) Personal Knowledge Management. pp. 1-16 (2011)
18. Pirolli, P., Russell, D. M.: Introduction to this special issue on sensemaking. Human-Computer Interaction, 26:1-2, 1-8 (2011)
19. Pirolli, P. & Card, S.: The Sensemaking Process and Leverage Points for Analyst Technology. Proceedings of International Conference on Intelligence Analysis. (2005)
20. Probst, G.J.B.: Practical Knowledge Management. Prism, A.D. Little. pp. 17-29 (1998)
21. Rosenstein, B.: Living in More Than One World. Berrett-Koehler Publishers. p. 53 (2009)
22. Rumsfeld, D. H.: Knowns & Unknowns. www.youtube.com/watch?v=QaxqUDd4fiw (2002)
23. Schamanek, A.: Taxonomies of the Unknown. http://andreas.schamanek.net/w/phi/not-knowing/taxonomies_of_the_unknown (2012)
24. SAQA: Level Descriptors for the South African National Qualification Framework (NQF). South African Qualification Authority (2012)
25. Schmitt, U.: Leveraging Personal KM Systems for Business and Development. 2nd Biennial Conference of the Africa Academy of Management (AFAM), Jan 9-11, 2014, Gaborone, Botswana. (2014)
26. Schmitt, U.: Managing Personal Knowledge to make a Difference. BAM 2013 Conference, Liverpool, Sep 10-12, 2013. British Academy of Management. 978-0-9549608-6-5 (2013)
27. Schmitt, U.: Making Personal Knowledge Management Part and Parcel of HE Programme and Services Portfolios. 6th World Universities Forum. Jan 10-11, 2013, Vancouver, Canada. Conference Presentation (2013)
28. Schmitt, U.: Innovating Personal Knowledge Creation and Exploitation. In: 2nd Global Innovation and Knowledge Academy Conference (GIKA), Jul 9-11, 2013, Valencia, Spain. ISBN 978-84-616-0275-9. (2013)
29. Schmitt, U.: Knowcations - A Meme-based PKM System-in-Progress. 8th International Conference on E-Learning (ICEL), Jun 27-28, 2013, Cape Town, South Africa. ISBN 978-1-909507-26-5 (2013)
30. Schmitt, U.: Knowcations - The Quest for a Personal Knowledge Management Solution. In: i-Know, 12th International Conference on Knowledge Management and Knowledge Technologies, Sep 05-07 2012, Graz, Austria. Copyright 2012 ACM 978-1-4503-1242-4/12/09. Graz: ACM. http://dl.acm.org/citation.cfm?id=2362469. (2012)
31. Stewart, I., Cohen, J.: Figments of Reality - The Evolution of the Curious Mind. Cambridge University Press. pp. 243-245, 288-289 (1999)
32. University of Arizona Health Sciences Center. Q-cubed Programs - What Is Ignorance. http://www.ignorance.medicine.arizona.edu (2012)
33. Wiig, K.M.: The Importance of Personal Knowledge Management in the Knowledge Society. In: Pauleen, D.J., Gorman, G.E. (eds) Personal Knowledge Mgmt. pp. 229-262 (2011)
34. Wierzbicki, A. P. & Nakamori, Y.: Creative Environments: Issues of Creativity Support for the Knowledge Civilization Age. Springer Publishing Company. p. 11. (2007)

A New Insight into the Evolution of Information Society and Emerging Intelligent Technologies

Andrzej M.J. Skulimowski [1,2]

[1]AGH University of Science and Technology,
Department of Automatic Control and Biomedical Engineering, Decision Science Laboratory,
Al. Mickiewicza 30, 30-050 Krakow, Poland
[2]International Centre for Decision Sciences and Forecasting, Progress & Business Foundation, Lea 12B, 30-048 Kraków, Poland
e-mail: ams (at) agh.edu.pl

Abstract. This paper presents the methodological background to a foresight of selected artificial intelligence technologies carried out within the research project SCETIST [12] as well as a review of its results. Unlike the usual approaches to foresight exercises, the technological trends and scenarios have been generated via a simulation of a hybrid system consisting of discrete-time control and discrete-event components. The first is a complex information society model, which describes the evolution of social, economic and scientific factors relevant to the production and adsorption of intelligent technologies, while the discrete-event component is tailored to model the legislative and science and technology (S&T) development processes in each technological area under consideration. In the project SCETIST, we specifically investigate the development of intelligent Internet technologies, including e-health, e-government and expert systems. Special attention is paid to decision support systems and recommenders. Other project work packages encompass neurocognitive and computer vision systems, as well as quantum and molecular computing. Finally, we will present the first foresight results related to the evolution of creativity and decision-support systems in the context of overall progress in information technology (IT) and computer science (CS), as well as global economic trends and social behaviour.

Keywords: Information Society Foresight, Scenario Analysis, Collaborative Foresight Tools, Intelligent Systems, Complex System Modelling

1. Introduction

The foundations of the research described in this paper go back to a report [7] prepared for the FISTERA (Foresight of the Information Society in the European Research Era), an EU 5th Framework Programme Thematic Network by the International Centre for Decision Sciences and Forecasting, P&B Foundation, Cracow. The aim of the report was to identify new trends, processes, and phenomena regarding the current state of the information society , as well as technological, social and economic trends in the ten EU New Member States that acceded in 2004. The candidate countries Bulgaria and Romania that acceded later in 2007 and Turkey were

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 587-598

also included in the report. The project team made a number of unique political, social, technological, and economical observations, related to the evolution of the information society. The research has continued within the foresight research project SCETIST [10] resulting in new general complex system modelling rules.

This paper provides an overview of the methodological background and selected results of the foresight project SCETIST (Scenarios and Development Trends of Selected Information Society Technologies until 2025) [14]. The project examined the future of selected artificial intelligence technologies such as intelligent decision support, computer vision, global expert systems [12] as well as neurocognitive and autonomous systems until the year 2025. We have also investigated the development of intelligent internet technologies, including e-health, e-learning [13], and e-government. Moreover, the project included a work package devoted to quantum and molecular computing. The overall research focussed on the evolution of decision-support systems and recommenders in the context of global trends in information technology (IT), computer science (CS), the economy and social behaviour.

Unlike the usual approaches to foresight exercises, technological trends and scenarios were generated by combining an expert Delphi with a simulation of a hybrid system consisting of discrete-time control and discrete-event components. Several customized applications were integrated together to form a Foresight Support System (FSS) capable of modelling the information society [10,11,13]. The latter system is also able to manage information on the evolution of social, economic and scientific factors relevant to the production and absorption of intelligent technologies. Its discrete-event component [5] models the impact of legislative, research and development (R&D) and science and technology (S&T) policies on each technological area under examination. This is described in more detail in the next section.

While conducting the above research, it became necessary to elaborate new methodological approaches, as the methods commonly used to model information society phenomena turned out to be insufficient [1,2,16,17]. Consequently, this paper also aims to present how the general rules and principles that govern the evolution of the information society and information technology were retrieved. Then they were formulated in a mathematically strict manner, analysed and applied to model the development of advanced intelligent technologies. We will show how this model interacts with other social modelling approaches and discuss the scope of its general applicability beyond the above areas of research. Furthermore, we will provide a collection of new methods to analyse the role of global information society technology (IST) development trends in an IST foresight.

The results obtained should be constructively applied to developing technological policies and strategies at different levels, from corporate to multinational. Modern modelling methods such as discrete-event-systems, multicriteria analysis, and discrete-time control have been used to better understand the role of global IST development trends and to develop information society and IT policies in an optimal control framework. A number of partial goals have been defined, which might help to achieve the ultimate objectives. These include:

- The construction of an innovative information society model that uses technological, social, economic and behavioral trends as a background for subsequent technological forecasts.

- Devising a novel methodology in creating development scenarios of information and telecommunication technologies as well as conditional forecasts of the technologies based on discrete-event system control theory [5].
- An ontological knowledge base which stores raw data together with IST models, trends and scenarios in the form of so-called proceedings containing data together with records of their step-by-step analyses and results.
- A detailed analysis of technological trends and scenarios in selected areas such as expert systems, decision support systems, recommenders, m-health, autonomous robots, neurocognitive technologies, as well as development prospects of quantum and molecular computing.
- Devising multicriteria outranking methods suitable for IT management and capable of generating constructive recommendations for decision makers concerning investment in information technologies for the development of a company, region or brand,
- A penetrative analysis of several real-life industrial applications in selected technological areas submitted by industrial partners cooperating on the implementation of the project results.

Any of the above partial objectives should provide useful solutions to the technology management problems presented by the companies involved in the foresight exercise, allowing them to apply the knowledge gained to set strategic technological priorities as well as formulate IT and R&D investment strategies. This is discussed further in Section 4.

2. The information society model

The development model for each of the technological areas under consideration indicates the demand for technologies and their end-products, the ability to create innovations, as well as the legal and economic conditions of technology creation, development and use. These factors are common for all the technological areas mentioned in Section 1, although each factor has a different degree of influence. Thus, the general foresight methodology is to elaborate a common information society model that will serve all technological areas, then to merge it with specific R&D and technological models for each area under consideration. Both types of model components differ in a few fundamental features: the information society model describes a given country, or group of countries, while the research and technological development trends are globally relevant due to the rapid diffusion of IT innovations. Furthermore, the data input to the information society model will originate mainly from publicly-available statistical sources, while the S&T trends will be derived from bibliographic and patent data [1,17] as well as from an expert Delphi [3].

This section examines the main research issue related to the information society foresight [7], namely how the development of the information society in a country, or a group of countries, depends on the global processes of IT development and on the integration of information societies around the world, driven by the global trends. Global IT trends under consideration include falling telecommunication prices, the exchange of information through the internet, rapid diffusion of information innova-

tions and technologies, and access to web information sources worldwide. Social phenomena, such as IT consumption patterns, preference dynamics, and civil society evolution, driven by the growing availability of e-government services and related web content, have also been taken into consideration.

The different aspects of the information society make it difficult to provide a description that is clear, unambiguous and concise. One of the FISTERA [7] findings was that the sole analysis of composite indicators based on statistical data does not sufficiently explain future social and economic behaviour. Therefore, we have introduced a new class of input-output models with state variables that fit well into the information society specificity. In particular, we have defined eight major subsystems of an information society, such as population and demographics, the legal system and IS policies, IT for personal and industrial use, etc. (see Fig.1). Their interaction properly characterises the evolution of the overall system.

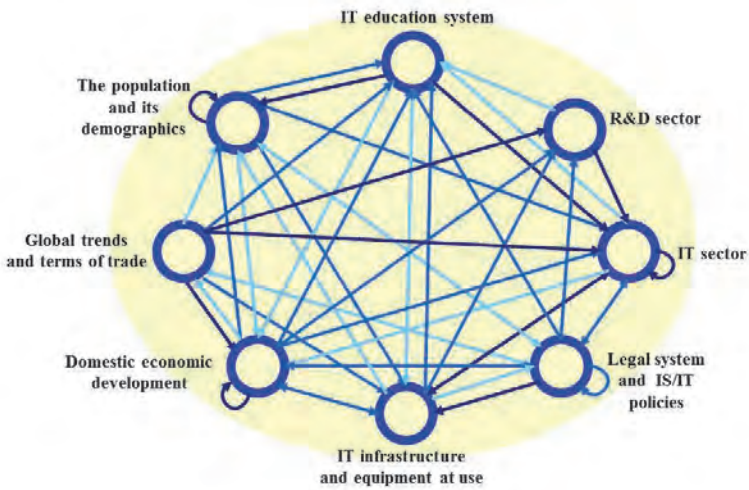


Fig.1. An example of a causal graph linking the major groups of data used in the IS/IT evolution model: dark blue arrows denote strong direct dependence (both positive or negative), medium blue indicates average relevance of causal dependence, and light blue denotes weak dependence between subsystems [10,11]. The feedback directions are averaged based on multiple expert assessment. They may vary for different subsystem variables.

During analysis, each of the factors appears as a bundle of discrete events, continuous trends and continuous or discretised state variables. The evolution of the information society is then modelled as a discrete-continuous-discrete-event system, where the mutual impacts of each of the elements are represented either in symbolic form, as generalised influence diagrams, or within state-space models. External

controls, such as legal regulations and policies, are modelled as discrete-event controls. Technological trends form inputs, while the feedback loops allow us to model the influence of technological demand on IT, R&D, production and supply.

A causal graph of the underlying dynamical model that was derived from a time series analysis and from participatory group model building and an expert Delphi [10] has been presented in Fig.1 above. Only direct impacts, i.e. those which show immediately or within one modelling step are marked. The indirect impact may be obtained by multiplying the coincidence matrix associated with the directed direct impact graph by itself.

Let us recall that a *discrete-event system* can be described as a 5-tuple [5]*:*

$$P=(Q,V,\delta,Q_0,Q_m) \tag{1}$$

where Q – is the set of system states, V – the set of admissible operations, $\delta: V\times Q \rightarrow Q$ – the transition function governing the results of operations over states, Q_0 - the set of (potential) initial states of the process, Q_m – the set of final reference states. A pair of states $e:=(q_1,q_2)$, such that $q_2=\delta(v,q_1)$ will be termed *an event.* The set of all the admissible events in the system (1) will be denoted by E. Following the above assumptions concerning the controlled discrete-event variables, the operations from V may be either controls, i.e. the decision maker's actions over Q, or may occur spontaneously as the results of random processes. Furthermore, we assume that there exists a set $X(Q)$ of quantitative or ordinal characteristics of states from Q, which can be deterministic, interval, stochastic, fuzzy etc. One of the coordinates of G can be (but does not need to be) identified with time. *An elementary scenario s* is a sequence of events $(e_1,...,e_p)$, such that if $e_i=(q_i,q_{i+1})$ then $e_{i+1}=(q_{i+1},q_{i+1+2})$. In order to conform with the usual definition of scenarios, we define a *foresight scenario* as a cluster of elementary scenarios, where clustering is based on a set of similarity rules applied to events.

After scaling the dynamics based on past observations, key technological, economic or social characteristic trends can be described quantitatively as solutions to discrete-time dynamical systems of the form

$$x_{t+1}=f(x_t,\ldots,x_{t-k},u_1,\ldots,u_m,\eta_1,\ldots,\eta_n) \tag{2}$$

where $x_t,\ldots x_{t-k}$, are state variables, $x_j=(x_{j1},\ldots x_{jN}) \in IR^N$, $u_1,\ldots u_m$ are controls, and $\eta_1,\ldots \eta_n$ are external non-controllable or random variables. In the socio-econometric models tailored to the information society in Poland that were analysed in [10], f has been linear non-stationary with respect to x, and stationary with respect to u and η.

Discrete-event and discrete-time control systems may jointly govern the evolution of causal systems, thus providing a tool to elicit trends and construct elementary scenarios, which appear as trajectories to (1)-(2). Consequently, when using (1)-(2) to generate optimal technological strategies or investment policies, the goals should be quantified and associated with events and elementary scenarios. A generalisation of the multicriteria shortest-path algorithm for variable-structure networks can then be applied to the optimal control of discrete-events [5] and discrete dynamical systems.

To generate the appropriate technological recommendations, a new method for the IST assessment has been developed as well, namely the dynamic generalisation of the SWOTC analysis (SWOT with "Challenges" an additional element). Used as TOWSC (TOWS with "Challenges" as above), it allows us to properly characterise the intelligent information technologies under consideration and their development

trends. The combination of the dynamic evolution model and SWOTC yields a dynamic benchmarking scheme, which enables us to compare different IST, identify their dynamics and provide aggregate group characteristics.

The model presented above should be coupled with a knowledge base that includes ontology management functionality, specifically ontology merging and splitting, time evolution, operations on metadata as well as data updating protocols. The usual data warehousing functionality has been implemented as well, including automatic updating.

3. The topics covered by the foresight project

An instance of the above-presented knowledge base serves to gather and process the information related to one of the technological focus areas of the project. These are listed below:

- Basic internet and software technologies,
- Key information society application areas (e-government, e-health, e-learning, e-commerce),
- Expert systems, decision support systems and recommenders,
- Machine vision and neurocognitive systems,
- Molecular and quantum computing.

In addition to the above, the industrial partners of the project could propose additional subject areas for technological development forecasts. The thematic databases store the above area-specific information, while a common data block contains interdisciplinary information to be used during thematic analyses, such as macroeconomic data, social characteristics (employment, education, demographics), geographic information and other data potentially useful in providing decision-making support.

A number of specialized foresight data management and data analytics algorithms that have been implemented to process the data gathered include:

- Enhanced trend-impact and cross-impact analysis,
- IT consumption and consumer preference models,
- Specific sector and market models concerning information society technologies and applications such as e-commerce, e-education, e-health and care services, electronic media, internet advertising, quantitative information markets, etc.,
- Time series forecasting with autoregression, filtering and adaptive trend algorithms.

Recommendations for the project stakeholders have been generated making use of technological forecasts and multicriteria outranking methods [6,9] tailored to IT prioritization problems.

The knowledge gathered in the system is continuously updated and processed with Bayes networks and other types of causal models, automatic rule generation techniques and anticipatory feedback models [14]. The latter models have been defined and investigated within SCETIST, as a tailored technique to build conditional scenarios.

3.1. Foresight as a participatory cooperative process

The success of the foresight research depends on the knowledge and diversity of the expert opinions. Therefore, we invited all interested scientists, specialist-practitioners and ICT users in other industries to participate in various expert surveys and collaborative research online. The most common of these is the Delphi analysis, in which selected leading experts (in various fields from industry, academia and government) complete questionnaires. The online flexible multi-round or real-time online Delphi that was used in SCETIST is outlined in the next subsection.

The other collaborative techniques include a group model building tool [11] and the quantified SWOTC analysis, both outlined in Section 2 and in [13], where experts assess the values of several predefined features but are still able to define their own.

Once the online forms are completed, their analysis is not limited to the statistic processing of gathered data. Instead, we apply modern artificial intelligence techniques to build models of technological, economic and social development as well as create forecasts and scenarios.

3.2 Multi-round online expert Delphi

The Delphi survey technique is most frequently used method in foresight studies (cf. e.g. Linstone and Turoff [3]). The method consists in conducting a questionnaire survey among a pre-selected expert group. The survey is conducted several times, during which the experts involved cannot contact each other to discuss the subject matter. Each expert is asked to justify the presented results in terms of related rules, trends and events. The process is usually repeated until a consensus or a 'well-justified dissensus' (also called a 'dissent' [17]) among the experts is reached. The latter may be justified by different views of future external political decisions and scientific discoveries. In the case of a dissensus, several future variants of the trend or phenomenon under investigation may emerge.

The Delphi may elicit expert opinions on the probability and timing of specific future events, and the results obtained may be used to construct future trends and scenarios, rank key technologies and provide recommendations for decision makers. This information is frequently used as the initial material for panel workshops, where it is discussed by experts and stakeholders. After collecting and analyzing the Delphi results, the project manager can develop more narrowly-focused questionnaires, to be completed and discussed at panel workshops. The variants derived from the Delphi survey serve to build future scenarios. Firstly, the variants are embedded in an anticipatory network [13], which allows us to identify non-rational decisions responsible for the occurrence of some variants and to filter them out. They are then clustered to form 3-6 descriptive scenarios for each group of technologies.

The online multi-round Delphi applied in SCETIST comprises a unique tool allowing us to permanently update foresight results and to build a model of the evolution of expert views. The survey has been conducted online with questionnaires of diversified degrees of interaction and complexity. Experts can enter the exercise at any time, and after completing the online forms they can view the results of the analysis. In addition, the experts participating in a Delphi exercise can provide information

about their expertise concerning each part of the questionnaire, which makes it possible to include the opinions of people who are not specialists within all the research areas but who possess unique knowledge in a specific area. Progressing to the next round is possible immediately after collecting a specified minimum number of responses to the previous round. Thus, Delphi can be regarded as a persistent anytime process. Furthermore, computer-assisted Delphi enables us to manage the credibility of experts in a convenient way [13]. This is essential when addressing a large group of experts of diverse educational backgrounds and professional experience.

Fig. 2. The topics of the Delphi survey on "Decision support and expert systems" available at www.ict.foresight.pl

The topics of the Delphi questionnaires on expert and decision support systems are shown in Fig.2. The other Delphi areas relate to future development of basic IT, socio-economic trends, fundamental issues concerning neurocognitive and vision systems as well as quantum and molecular computing. All members of the scientific community interested in the above topics are invited to contribute to the research. The questionnaires are available at www.ict.foresight.pl as a permanent outcome of SCETIST. A screenshot of questions 13.1-13.4 in the survey section on creativity in the context of expert systems is shown in Fig.3.

13. Problems of creativity in designing experts systems, DSS and decision making

The problem of creativity in the context of implementation of creativity support systems and creativity displayed by

No.	In the timeframe until 2025, further development of creativity support systems will occur pertaining to different areas of creativity. Please estimate the value of given quantitative parameters of creativity support systems and autonomous creative systems	2015	2020	2025	Further development until 2030	Notes, explanations, sources and forecast justifications	Degree of certainty
13.1	Adequate and universal creativity indices and creativity measuring methods based of the effect of creative activities and psychophysiological parameters (eye movements, pulse, blood pressure, etc.) will be created, allowing for real time feedback in creativity support systems. Please provide the probability of the creation of such indices in the given timeframe	%	%	%	%		only expressing my subjective opinion
13.2	Cognitive research will allow for the formulation and implementation of active methods supporting the effectiveness of the learning process, fitted to different disciplines. Please provide the probability of implementation of widely available system with the following features:						
	a) system uses sensors determining user perception capabilities based on his/her physiological parameters	%	%	%	%		only expressing my subjective opinion
	b) system is able to determine the level of concentration of an online user	%	%	%	%		only expressing my subjective opinion
	c) system measures learning efficiency in a given timeframe	%	%	%	%		only expressing my subjective opinion
	d) system measures overall user creativity (creativity tests)	%	%	%	%		only expressing my subjective opinion
	e) system measures creativity in terms of the applications of acquired knowledge	%	%	%	%		only expressing my subjective opinion
	f) based on (c) and (d) systems recommends factors increasing creativity in learning and applying acquired knowledge	%	%	%	%		only expressing my subjective opinion
	g) system stimulates the development of general creativity	%	%	%	%		only expressing my subjective opinion
13.3	Please specify the expected number of disciplines for which specialist systems of learning creativity support will be created. In the column Notes please specify what, in your opinion, these disciplines will be and which disciplines could present a problem and why						only expressing my subjective opinion
13.4	Cognitive systems supporting creative processes (scientific work, literature, poetry, musical composition, industrial design, painting etc.) will be created. Please provide the probability of the creation of a widely available system with the following features:						
	a) system uses sensors determining online user creative capabilities based on his/her physiological parameters	%	%	%	%		only expressing my subjective opinion
	b) system measures user satisfaction with the work done	%	%	%	%		only expressing my subjective opinion
	c) system measures overall user creativity (creativity tests fitted to particular area)	%	%	%	%		only expressing my subjective opinion
	d) based on (b) and (c) system recommends activities increasing creativity	%	%	%	%		only expressing my subjective opinion
	e) system stimulates the development of general creativity	%	%	%	%		only expressing my subjective opinion

Fig. 3. An excerpt from the Delphi survey topics devoted to creativity (questions 13.1-13.4) available at http://www.ict.foresight.pl.

The conclusions of the Delphi study have been formulated in the expert panels, consisting of the most active experts taking part in both rounds of questionnaire research. All those interested in joining the ICT foresight research team can complete the expert application forms at http://www.ict.foresight.pl. The participants of KICSS conference series are particularly encouraged to take part in this survey.

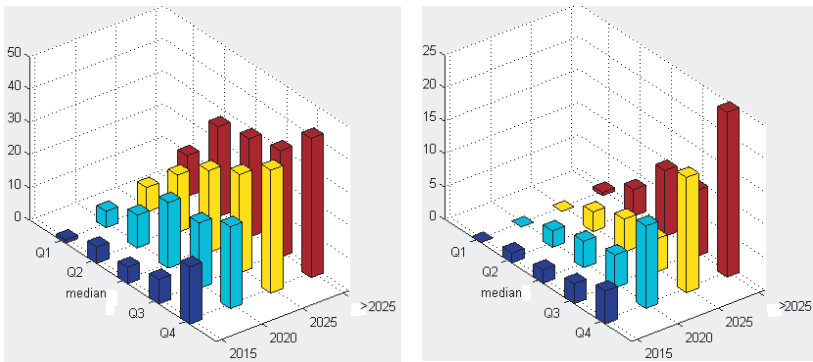
4. Results and conclusions

It is beyond the scope of this paper to present the complete results of SCETIST, or even the full expert Delphi survey. However, we include a sample of the results of the second round of the survey, specifically addressing the following question concerning creativity (see also Fig.3 and [13]):

"*Autonomous systems capable of creative action will be created, so that 95% of recipients are unable to tell the difference between application output and a human creator output in the following areas:*

a) Construction and architecture
b) Industry
c) Literature…" (question No. 13.10).

The results are visualised in Fig 4 (a) and (b), where we selected the replies to the specific questions a) and c) above (the results for (b) turned out to be very similar to those of (a)). The survey was conducted in February and March 2013 using the Polish version of Delphi. 43 replies were taken into account for the above question.



(a) (b)

Fig. 4. The results of the Delphi survey on creativity: (a)- question 13.10a, (b) - question 13.10c available at www.ict.foresight.pl. The results are given as the probability of occurrence of a particular event, in % on the vertical axis. Q1,Q2,Q3 and Q4 denote the corresponding quintiles (corresponding to 20%, 40%,60% and 80% of responses). The symbol *">2025*" reads "*after 2025 but before 2030*".

The new methodology and innovative foresight approach outlined above and in [2,7-12] make it possible to create more reliable estimates of future development trends and scenarios, as well as visualise their dynamics. The scenarios can again be used to re-examine information society and IT evolution principles, constituting a consistent interactive and adaptive control model. The approach allows us to characterise the technological and socio-economical evolution in quantitative terms. It also enables us to rank and benchmark the countries or regions under consideration in terms of information society and IT development. More objective and quantifiable future characteristics have made it possible to define and recommend to decision

makers appropriate policy goals and measures to be implemented. The technological characteristics indicate future demand for IT, which is of benefit to developers of Content Management Systems (CMS), recommenders and decision support systems (DSS) [13]. The outcomes of the project can also serve to inform R&D and educational institutions on the most likely in-demand areas of development as well as the demand for IT professionals. The main user group of the future trends and scenarios are still innovative IT companies seeking technological recommendations, advice concerning R&D priorities, as well as corporations from different sectors that invest in IT. A generic way to elaborate on such recommendations concerning strategic planning in corporations is the technological roadmapping process (cf. e.g. [4,15]). An online roadmapping methodology, tailored to the needs of Polish IT companies and to the scope of foresight research, has been elaborated by the project team [15].

By comparing quantitative vs. descriptive approaches to building scenarios, we can observe that extracting evolution rules prior to scenario analysis proves especially useful in the case of converging information societies as exemplified by the case of Poland. The first ex-post assessments of the foresight results confirm the efficacy of the modelling methods developed and applied, as well as a good coherence of forecasts and real-life data gathered ex-post.

To learn more about these findings, the reader is referred to further reports and publications that can be downloaded from the SCETIST project website www.ict.foresight.pl.

Acknowledgement. The research results presented in this paper have been obtained during the foresight project "Scenarios and Development Trends of Selected Information Society Technologies until 2025" co-financed by the ERDF within the Innovative Economy Operational Programme 2006-2013, Contract No. WND-POIG.01.01.01-00-021/09.

References

1. Daim, T.U., Rueda, G., Martin, H., Gerdsri, P.: Forecasting emerging technologies: Use of bibliometrics and patent analysis. Technological Forecasting and Social Change, 73, 981-1012 (2006)
2. Lane, D. Pumain D., van der Leeuw S.E., G. West (Eds.). Complexity Perspectives in Innovation and Social Change, Springer Science+Business Media B.V. (2009).
3. Linstone, H.A., Turoff, M. (Eds.): The Delphi Method. Techniques and Applications. p. 616 (1975). Electronic version © Harold A. Linstone, Murray Turoff, 2002, available at www.foresight.pl
4. Petrick, I.J., Echols, A.E.: Technology roadmapping in review: A tool for making sustainable new product development decisions. Technological Forecasting and Social Change 71, 81-100 (2004)
5. Skulimowski, A.M.J.: Optimal Control of a Class of Asynchronous Discrete-Event Systems. In: Automatic Control in the Service of Mankind. Proceedings of the 11th IFAC World Congress, Tallinn (Estonia), 1990, Pergamon Press, London, Vol.3, pp. 489-495 (1991)

6. Skulimowski, A.M.J.: Decision Support Systems Based on Reference Sets. AGH University Scientific Publishers, Series: Monographs, No. 40, p.165 (1996)
7. Skulimowski A.M.J.: Framing New Member States and Candidate Countries Information Society Insights. In: Ramon Compaño and Corina Pascu (Eds.), Prospects for a Knowledge-Based Society in the New Members States and Candidate Countries**,** Publishing House of the Romanian Academy, Bucharest, pp. 9-51 (2006)
8. Skulimowski, A. M. J.: Methods of technological roadmapping and foresight (in Polish). Chemik: Nauka-Technika-Rynek 42(5), 197–204 (2009)
9. Skulimowski, A.M.J.: Freedom of Choice and Creativity in Multicriteria Decision Making. In: Thanaruk Theeramunkong, Susumu Kunifuji, Cholwich Nattee, Virach Sornlertlamvanich (Eds.), Knowledge, Information, and Creativity Support Systems: KICSS 2010, Revised Selected Papers, Springer, Lecture Notes in Artificial Intelligence, Vol. 6746, pp. 190-203 (2011)
10. Skulimowski, A.M.J.: Fusion of Expert Information on Future Technological Trends and Scenarios. In: Kunifuji, S., Tang, X.J., Theeramunkong, T. (Eds.), Proc. the 6th International Conference on Knowledge, Information and Creativity Support Systems, Beijing, China, Oct. 22-24, 2011 (KICSS 2011), JAIST Press, Beijing, pp. 10-20 (2011)
11. Skulimowski, A.M.J.: Discovering Complex System Dynamics with Intelligent Data Retrieval Tools. In: Zhang, Y. et al. (Eds.), Sino-foreign-interchange workshop on Intelligent Science and Intelligent Data Engineering IScIDE 2011, Xi'an, China, Oct. 23-26, 2011, Lecture Notes in Computer Science, Vol. 7202, Springer, Berlin–Heidelberg, pp. 614-626 (2012)
12. Skulimowski, A.M.J.: Universal Intelligence, Creativity, and Trust in Emerging Global Expert Systems. In: Rutkowski L. et al. (Eds.). Artificial Intelligence and Soft Computing. 12th International Conference, ICAISC 2013, Zakopane, Poland, 9-13 June, 2013, Proceedings, Part II. Lecture Notes in Artificial Intelligence, Vol. 7895, Springer, Berlin–Heidelberg, pp. 582-592 (2013)
13. Skulimowski, A.M.J.: Web-Based Learning in Remote Areas: Evaluation of Learning Goals, Scenarios and Bidirectional Satellite Internet Implementation. In: Jhing-Fa Wang, Rynson Lau (Eds.) Advances in Web-Based Learning – ICWL 2013, 12th International Conference, Kenting, Taiwan, October 6-9, 2013. Proceedings, Lecture Notes in Computer Science, Vol. 8167, Springer, Berlin–Heidelberg, pp. 50-60 (2013)
14. Skulimowski, A.M.J. (Ed.): Scenarios and Development Trends of Selected Information Society Technologies until 2025 (SCETIST). Final Report, Progress & Business Foundation, Kraków, www.ict.foresight.pl (2013) [accessed: October 1, 2013]
15. Skulimowski, A.M.J., Pukocz, P.: Enhancing creativity of strategic decision processes by technological roadmapping and foresight. In: Lee, V.C.S., Ong, K.L. (Eds.), KICSS 2012: seventh international conference on Knowledge, Information and Creativity Support Systems: Melbourne, Victoria, Australia, 8–10 Nov. 2012; IEEE Computer Society. CPS Conference Publishing Services, pp. 223–230 (2012)
16. Tadeusiewicz, R.: A need of scientific reflection on the information society development. In: G. Bliźniuk, J.S. Nowak (Eds.), Information Society 2005 (in Polish). Katowice, PTI, pp. 11–38 (2005)
17. von der Gracht, H.A.: Consensus measurement in Delphi studies: Review and implications for future quality assurance, Technological Forecasting and Social Change, 79(8), 1525-1536 (2012)
18. Wong, Chan-Yuan, Goh, Kim-Leng: Modeling the behaviour of science and technology: self-propagating growth in the diffusion process. Scientometrics 84(3), 669-686 (2010)

Modeling and recognition of video events with Fuzzy Semantic Petri Nets *

Piotr Szwed

AGH University of Science and Technology
pszwed@agh.edu.pl

Abstract. This paper addresses the problem of modeling and automated recognition of complex behavior patterns in video sequences. We introduce a new concept of Fuzzy Semantic Petri Nets (FSPN) and discuss their application to recognition of video events. FSPN are Petri nets coupled with an underlying fuzzy ontology. The ontology stores assertions (facts) concerning classification of objects and detected relations. Fuzzy predicates querying the ontology content are used as guards of transitions in FSPN. Tokens carry information on objects participating in a scenario and are equipped with weights indicating likelihood of their assignment to places. In turn, the places correspond to scenario steps. The Petri net structure is obtained by translating a Linear Temporal Logic formula specifying a scenario in a human-readable form. We describe a prototype detection system consisting of an FSPN interpreter, the fuzzy ontology and a set of predicate evaluators. Initial tests yielding promising results are reported.

Keywords: Petri nets, fuzzy ontology, event recognition, temporal logic

1 Introduction

Automatic recognition of complex behavior patterns in analyzed video sequences is a challenging area in computer vision. Such patterns, commonly referred as scenarios or events, can be perceived as combinations of simpler events describing interactions between objects that are either detected and tracked, or predefined as components of a scene configuration. Practical implementations of event recognition systems face two problems [13]. The first is related to methods used for extraction of features, which are further used to recognize and discriminate events. The methods are often delivering uncertain or noisy data. The second problem is an approach to scenario modeling. Definitions of scenarios, to be meaningful and manageable, should preferably be decoupled from a software implementation and use semantic description of objects and their relations. In particular, such semantic information should be communicated to system operators in case of intelligent video surveillance systems or used as a video metadata when applied in automated video indexing engines.

* This work is supported from AGH University of Science and Technology under Grant No. 11.11.120.859

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 599-610

In the further development, it was replaced by a new corrected implementation: *movesTowardsVerticalObject*.

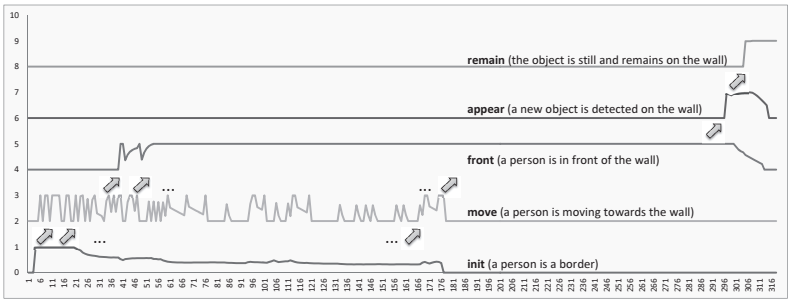


Fig. 8: Weights of tokens assigned to places at consecutive frames

Analogous experiments were conducted for several event recognition tasks including abandoned luggage and detecting violation of a surveillance zone. Tests for the abandoned luggage and graffiti painting events yielded 100% correct results (true positives). For a zone violation the recognition ratio was about 76%. Detailed analysis revealed that in this case the lower performance was caused by tracking problems (lost of identity in case of occlusion and in some cases invalid segmentation).

7 Conclusions

In this paper we address the problem of modeling and recognition of video events. To summarize our contribution: firstly, we propose to apply a temporal logic formalism to specify event scenarios and further to translate them to Petri net structures; secondly, we introduce Fuzzy Semantic Petri Nets; finally, we describe a proof of concept prototype system that interprets a data resulting from a tracking algorithm, represents it as a content of a fuzzy ontology and detects event occurrences with a FSPN interpreter. An advantage of FSPN is their capability of detecting concurrently occurring events, in which participate various combinations of objects, analyze scenario alternatives and their likelihoods.

References

1. Aggarwal, J., Park, S.: Human motion: modeling and recognition of actions and interactions. In: 3D Data Processing, Visualization and Transmission, 2004. 3DPVT 2004. Proceedings. 2nd International Symposium on. pp. 640–647 (Sept 2004)
2. Aggarwal, J., Ryoo, M.S.: Human activity analysis: A review. ACM Computing Surveys (CSUR) 43(3), 16 (2011)

3. Akdemir, U., Turaga, P., Chellappa, R.: An ontology based approach for activity recognition from video. In: Proceedings of the 16th ACM international conference on Multimedia. pp. 709–712. ACM (2008)
4. Albanese, M., Chellappa, R., Moscato, V., Picariello, A., Subrahmanian, V.S., Turaga, P., Udrea, O.: A constrained probabilistic Petri net framework for human activity detection in video. Multimedia, IEEE Transactions on 10(8), 1429–1443 (Dec 2008)
5. Barnard, M., Odobez, J.M., Bengio, S.: Multi-modal audio-visual event recognition for football analysis. In: Neural Networks for Signal Processing, 2003. NNSP'03. 2003 IEEE 13th Workshop on. pp. 469–478 (Sept 2003)
6. Borzin, A., Rivlin, E., Rudzsky, M.: Surveillance event interpretation using generalized stochastic Petri nets. In: Image Analysis for Multimedia Interactive Services, 2007. WIAMIS'07. Eighth International Workshop on. pp. 4–4. IEEE (2007)
7. Bremond, F., Maillot, N., Thonnat, M., Vu, V.T., et al.: Ontologies for video events. Research report number 51895. Tech. rep., INRIA Sophia-Antipolis (2004)
8. Brémond, F., Thonnat, M., Zúniga, M.: Video-understanding framework for automatic behavior recognition. Behavior Research Methods 38(3), 416–426 (2006)
9. Büchi, J.R.: On a Decision Method in Restricted Second-Order Arithmetic. In: International Congress on Logic, Methodology, and Philosophy of Science. pp. 1–11. Stanford University Press (1962)
10. Ghanem, N., DeMenthon, D., Doermann, D., Davis, L.: Representation and recognition of events in surveillance video using Petri nets. In: Computer Vision and Pattern Recognition Workshop, 2004. CVPRW '04. Conference on. pp. 112–112 (June 2004)
11. Joo, S.W., Chellappa, R.: Attribute grammar-based event recognition and anomaly detection. In: Computer Vision and Pattern Recognition Workshop, 2006. CVPRW '06. Conference on. pp. 107–107 (June 2006)
12. Kripke, S.: Semantical considerations on modal logic. Acta philosophica fennica 16(1963), 83–94 (1963)
13. Lavee, G., Rivlin, E., Rudzsky, M.: Understanding video events: A survey of methods for automatic interpretation of semantic occurrences in video. Systems, Man, and Cybernetics, Part C: Applications and Reviews, IEEE Transactions on 39(5), 489–504 (Sept 2009)
14. Lavee, G., Rudzsky, M., Rivlin, E., Borzin, A.: Video event modeling and recognition in generalized stochastic Petri nets. Circuits and Systems for Video Technology, IEEE Transactions on 20(1), 102–118 (Jan 2010)
15. Lukasiewicz, T., Straccia, U.: Managing uncertainty and vagueness in description logics for the Semantic Web. Web Semantics Science Services and Agents on the World Wide Web 6(4), 291–308 (2008)
16. Manna, Z., Pnueli, A.: Temporal logic. In: The Temporal Logic of Reactive and Concurrent Systems, pp. 179–273. Springer New York (1992)
17. Munch, D., Jsselmuiden, J., Arens, M., Stiefelhagen, R.: High-level situation recognition using fuzzy metric temporal logic, case studies in surveillance and smart environments. In: Computer Vision Workshops (ICCV Workshops), 2011 IEEE International Conference on. pp. 882–889 (Nov 2011)
18. Nagel, H.H.: Steps toward a cognitive vision system. AI Magazine 25(2), 31 (2004)
19. Vu, V.T., Bremond, F., Thonnat, M.: Automatic video interpretation: A novel algorithm for temporal scenario recognition. In: International Joint Conference on Artificial Intelligence. vol. 18, pp. 1295–1302. Lawrence Erlbaum Associates Ltd (2003)

A system using n-grams for visualizing the human tendency to repeat the same patterns and the difficulty of divergent thinking

Taro Tezuka[1], Shun Yasumasa[2], Fatemeh Azadi Naghsh[2]

[1] Faculty of Library, Information and Media Science
University of Tsukuba
Ibaraki, Japan 305-8550
tezuka@slis.tsukuba.ac.jp
[2] Graduate School of Library, Information and Media Studies
University of Tsukuba
Ibaraki, Japan 305-8550
{yasumasa,atena}@slis.tsukuba.ac.jp

Abstract. One of the factors that inhibits creative thinking is that humans tend to think in the same patterns repetitively and cannot easily come up with a totally new combination of concepts. In other words, humans are not talented at evenly exploring combinatorial space. In order to visualize how strong this tendency is, we implemented a system that asks users to type a long sequence of numbers and then evaluates the frequency of the appearance of the same subsequences, or n-grams. This system can also be used to train oneself to avoid such tendency. We call it "the Creativity Test". The reason for the name is because we believe that efficiency in exploring a wider part of a combinatorial space without being caught in few patterns is important for divergent thinking, which constitutes an integral part of creativity. When we tested the system on a group of participants, we discovered that, for most of them, surprisingly long subsequences appeared repeatedly, making the participants realize how inefficient they were at coming up with new combinations.

Keywords: Creativity, divergent thinking, heuristics, visualization, n-gram

1 Introduction

Creativity, or the ability to create new ideas, is a fundamental mechanism that drives the advancement of human society. It is not easy to actually define creativity, and many theories have been proposed. If we could concisely define what it is to make an idea new, it would be easier to implement a computer program that comes up with new ideas. In an abstract sense, however, a new idea is nothing but a new combination of existing concepts. This is because unless it can be expressed using existing concepts, it cannot be communicated to others. Therefore, we put forth that creative thinking is the process of searching through combinations to find ones that are useful but have not been utilized. We can formalize this mathematically as follows.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 611-622

We have not shown that training by this system can raise the level of practical creativity. It is still unclear if unevenness in the appearance of number sequences is related to the unevenness of searching through combinatorial space in terms of practical creative behavior. To make the system more connected to the actual process of creative thinking, we would like to build a system that presents the sequence of objects or concepts belonging to a certain category, rather than using numbers. For example, we are considering building a system that asks chemists to list the names of reactions or molecules in random order, which may make them realize that they are likely to fall into a certain pattern, therefore restricting the generation of new combinations and potential inventions.

We would also like to explore the differences among individuals and if the ability to generate random patterns is actually relevant to the level of creativity the individual has. We plan to compare our system with existing tests that are said to measure creativity and see if there is any correlation. We want to see what factors affect scores in our system: for example, if the time of day would affect the level of creativity. Are individuals more likely to fall into the same pattern in the morning, or late at night? Also, we would like to compare scores when the subject is in different mental states: for example, when the subject is either elated or depressed, would the result be different?

Acknowledgments

This work was supported in part by JSPS KAKENHI Grant Numbers 21700121, 25280110, and 25540159.

References

1. Altshuller, Genrich. Creativity as an exact science: The Theory of the Solution of Inventive Problems, Gordon and Breach Science Publishing, 1984.
2. Amabile, Teresa M. Creativity in context: Update to “the social psychology of creativity”, Westview Press, 1996.
3. Bostrom, Robert P., and Murli Nagasundaram. ”Research in Creativity and GSS”, Proceedings of the 31st Hawaii International Conference on System Sciences, pp. 391-405, 1998.
4. Durand, Douglas E., and Susie H. VanHuss. ”Creativity software and DSS: Cautionary findings.” Information and management 23, pp. 1-6, 1992.
5. Duran-Novoa, Roberto, Noel Leon-Rovira, Humberto Aguayo-Tellez, and David Said. ”Inventive problem solving based on dialectical negation, using evolutionary algorithms and TRIZ heuristics”, Computers in Industry 62, pp. 437-445, 2011.
6. Guilford, Joy Paul. The Nature of Human Intelligence, McGraw-Hill Education, 1967.
7. Mednick, Sarnoff. ”The associative basis of the creative process”, Psychological Review 69, No. 3, pp. 220, 1962.
8. Lopez-Ortega, Omar. ”Computer-assisted creativity: Emulation of cognitive processes on a multi-agent system”, Expert Systems with Applications 40, pp. 3459-3470, 2013.
9. Malaga, Ross A. ”The effect of stimulus modes and associative distance in individual creativity support systems”, Decision Support Systems 29, pp. 125-141, 2000.
10. Manning, Christopher D., and Hinrich Schutze. Foundations of statistical natural language processing, The MIT Press, 1999.

11. Massetti, Brenda. ”An Empirical Examination of the Value of Creativity Support Systems on Idea Generation”, MIS Quartery 20, pp. 83-97, 1996.
12. Muller-Wienbergen, Felix, Oliver Muller, Stefan Seidel, and Jorg Becker. ”Leaving the Beaten Tracks in Creative Work -A Design Theory for Systems that Support Convergent and Divergent Thinking”, Journal of the Association for Information Systems 12, pp. 714-740, 2011.
13. Rhodes, Mel. ”An analysis of creativity.” The Phi Delta Kappan 42, pp. 305-310, 1961.
14. Russ, Sandra W., and Julia A. Fiorelli. ”Developmental approaches to creativity”, in J.C. Kaufman and R.B. Sternberg (Eds.), The Cambridge Handbook of Creativity, pp. 233-249, 2010.
15. Suchamn, Lucy. Plans and Situated Actions: The Problem of Human-machine Communication, Cambridge Press, 1987.
16. Seidel, Stefan, Felix Muller-Wienbergen, and Jorg Becker. ”The concept of creativity in the information systems discipline: Past, present, and prospects”, Communications of the Association for Information Systems 27, pp. 14, 2010.
17. Storm, Benjamin C.and Genna Angello. ”Overcoming fixation: Creative problem solving and retrieval-induced forgetting”, Psychological Science 21(9), pp. 1263-1265, 2010.
18. Torrance, E. Paul. ”The nature of creativity as manifest in its testing”, The Nature of Creativity, pp. 43-75, 1988.

Evoking Emotion through Stories in Creative Dementia Care

Clare Thompson, Neil Maiden, Mobina Nouri & Konstantinos Zachos

Centre for Creativity in Professional Practice, City University London
Clare.Thompson.1@city.ac.uk, N.A.M.Maiden@city.ac.uk,
Mobina.Nouri.1@city.ac.uk, kzachos@soi.city.ac.uk

Abstract. This paper reports research to refine the design of a mobile creativity support app to improve person-centred care for older people with dementia. One barrier to previous app use during creative thinking appeared to be the negative activation emotions associated with problem avoidance and prevention exhibited by care staff when resolving challenging behaviours. Therefore we investigated the redesign of the app's content so that care staff were more likely to positive activation associated with creative thinking through storytelling through a first formative evaluation.

Keywords: Dementia care, case-based reasoning, creativity, emotions, moods.

1. Dementia Care and Creativity

Dementia is a condition related to ageing. After the age of 65 the proportion of people with dementia doubles for every 5 years of age so that one fifth of people over the age of 85 are affected. This equates to a current total of 750,000 people in the UK with dementia, a figure projected to double by 2051 when it is predicted to affect a third of the population either as a sufferer, relative or carer [14]. Dementia care is often delivered in residential homes. In the UK, 4 in 5 of all home residents have some form of dementia [13], and delivering the required care to them poses complex and diverse problems that new software technologies have the potential to overcome.

The prevailing paradigm in the care of older people with dementia is person-centered. This paradigm seeks an individualized approach that recognizes the uniqueness of each resident and understanding the world from the perspective of the person with dementia [5]. It can offer an important role for creative problem solving that produces novel and useful outcomes [12], i.e. care activities that both recognize a sense of uniqueness and are new to the care of the resident and/or care staff. However, there is little explicit use of creative problem solving in dementia care with and without technical support, in spite of its potential benefits to both improve care and reduce the stress associated with caring for people with dementia [7].

During design studies, care staff demonstrated the greatest potential and appetite for the Other Worlds technique [1] that exploits similarities between domains. There-

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 623-634

References

1. Allan, D., Kingdon, M., Murrin, K., and Rudkin D.: Innovation Company, Capstone Publishing Company Limited, Chichester, UK (2002).
2. Alm C.O. & Sproat R.: Perceptions of emotions in expressive storytelling, Illinois, University of Illinois (2005).
3. Baas, M.,De Dreu, C.K.W., & Nijstad, B.A.: A meta-analysis of 25 years of mood-creativity research: Hedonic tone, activation, or regulatory focus? Psychological Bulletin, 134, 779-806 (2008).
4. Blom K. & Beckhaus S.: Emotional storytelling, IEEE Virtual Reality 2005 Conference, Work-shop on Virtuality Structure, March 2005, Bonn: IEEE Computer Society Press, 23-27 (2005).
5. Brooker D.: Person-centred dementia care: Making Services Better, Bradford Dementia Group Good Practice Guides. Jessica Kingsley Publishers London and Philadephia (2007).
6. Campbell J.: The hero with a thousand faces 3rd Edition, California: New World Library (2008).
7. Help The Aged: My Home Life: Quality of Life In Care Homes; A Review of the Literature London. http://myhomelifemovement.org/downloads/mhl_review.pdf (2007).
8. Higgins, E. T.: Beyond pleasure and pain. American Psychologist, 52, 1280–1300 (1997).
9. Kipper K., Dang H.T. & Palmer M.: Class-based Construction of a Verb Lexicon, Proceedings AAAI/IAAI Conference 2000, 691–696 (2000).
10. Maiden N.A.M., D'Souza S., Jones S., Muller L., Panesse L., Pitts K., Prilla M., Pudney K., Rose M., Turner I. & Zachos K.: Computing Technologies for Reflective and Creative Care for People with Dementia, in press, Communications of the ACM (2013).
11. Owen T. & Meyer J.: Minimizing the use of 'restraint' in care homes: Challenges, dilemmas and positive approaches, Adult Services Report 25, Social Care Institute of Excellence, http://www.scie.org.uk/ publications/reports/report25.pdf (2009).
12. Sternberg, R. J. (Ed.): Handbook of creativity, New York, Cambridge University Press (1999).
13. Triggle N.: Dementia 'affects 80% of care home residents', http://www.bbc.co.uk/ news/health-21579394 (2013).
14. Wimo A. & Prince M.: World Alzheimer Re-port 2010: The Global Economic impact of Demen-tia, http://www.alz.co.uk/research/worldreport/ (2010).
15. Zachos K., Maiden N.A.M., Pitts K., Jones S., Turner I., Rose M., Pudney K. & MacManus J.: A Software App to Support Creativity in Dementia Care, Proceedings 9th ACM Creativity and Cognition Conference, 124-131 (2013).

Intuitionistic Fuzzy Dependent OWA Operator and Its Application

Cuiping Wei[1,2] , Xijin Tang[3] and Yanzhao Bi[1]

[1] College of Mathematical Sciences, Yangzhou University,
Yangzhou 225002, China
[2] Management School, Qufu Normal University,
Rizhao 276826, China
[3] Academy of Mathematics and Systems Science,
Chinese Academy of Sciences, Beijing 100190, China

Abstract. In this paper, we propose a novel approach, based on entropy and similarity measure of intuitionistic fuzzy sets, to determine weights of the IFOWA operator. Then we define a new intuitionistic fuzzy dependent OWA (IFDOWA) operator which is applied to handling multi-attribute group decision making problem with intuitionistic fuzzy information. Finally, an example is given to demonstrate the rationality and validity of the proposed approach.
Keywords: Multi-attribute group decision making, intuitionistic fuzzy values, intuitionistic fuzzy dependent OWA operator, entropy, similarity.

1 Introduction

The ordered weighted aggregating (OWA) operator [26], as an important tool for aggregating information, has been investigated and applied in many documents [1, 11, 20, 27]. One critical issue of the OWA operator is to determine its associated weights. Up to now, a lot of methods have been proposed to determine the OWA weights. Xu [19] classified all those weight-determining approaches into two categories: argument-independent approaches [6, 11, 14, 20, 23, 26] and argument-dependent approaches [1, 7, 19, 21, 24, 25]. For the 1st category, Yager [26] suggested an approach to compute the OWA weights based on linguistic quantifiers provided by Zadeh [28, 29]. O'Hagan [11] defined degree of orness and constructed a nonlinear programming to obtain the weights of OWA operator. Xu [20] made an overview of methods for obtaining OWA weights and developed a novel weight-determining method using the idea of normal distribution. For the 2nd category, Filev and Yager [7] developed two procedures to determine the weights of OWA operator. Xu and Da [21] established a linear objective-programming model to obtain the OWA weights. Xu [19] proposed a new dependent OWA operator which can relieve the influence of unfair arguments on the aggregated results. In [24, 25], Yager and Filev developed an argument-dependent method to generate the OWA weights with power function of the input arguments.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 635-646

5 Concluding

In this paper, we propose a new argument-dependent approach, based on entropy and similarity measure, to determine the OWA weights. we apply the IFDOWA operator to a multi-attribute group decision making problem and illustrate the effectiveness of the approach. It is worth noting that the results in this paper can be further extended to interval-valued intuitionistic fuzzy environment.

Acknowledgements. The work is supported by the National Natural Science Foundation of China (71171187, 71371107), the National Basic Research Program of China (2010CB731405), Ministry of Education Foundation of Humanities and Social Sciences (10YJC630269).

References

1. Ahn B.S.: Preference relation approach for obtain OWA operators weights. International Journal of Approximate Reasoning 47, 166-178 (2008)
2. Atanassov K.: Intuitionistic fuzzy sets. Fuzzy Sets and System 20(1), 87-96 (1986)
3. Atanassov K.: Intuitionistic fuzzy sets: Theory and Applications. Heidelberg: Physica-Verlag (1999)
4. Burillo P., Bustince H.: Entropy on intuitionistic fuzzy sets and on interval-valued fuzzy sets. Fuzzy Sets and Systems 78, 305-316 (1996)
5. Chen S.M., Tan J.M.: Handling multi-criteria fuzzy decision making problems based on vague set theory. Fuzzy Sets and Systems 67(2), 163-172 (1994)
6. Emrouznejad A., Amin G.: Improving minimax disparity model to determine the OWA operator weights. Information Sciences 180, 1477-1485 (2010)
7. Filev D.P., Yager R.R.: On the issue of obtaining OWA operator weights. Fuzzy Sets and Systems 94, 157-169 (1998)
8. Hong D.H., Choi C.H.: Multicriteria fuzzy decision-making problems based on vague set theory. Fuzzy Sets and Systems 114, 103-113 (2000)
9. Li D.F., Cheng C.T.: New similarity measure of intuitionistic fuzzy sets and application to pattern recongnitions. Pattern Recognition Letters 23, 221-225 (2002)
10. Ngwenyama O., Bryson N.: Eliciting and mapping qualitative preferences to numeric rankings in group decision making. European Journal of Operational Research 116, 487-497 (1999)
11. O'Hagan M.: Aggregating template rule antecedents in real-time expert systems with fuzzy set. Proc. 22nd Ann. IEEE Asilomar Conf. on Signals, Systems and Computers Pacific Grove, pp. 681-689, CA(1988)
12. Szmidt E., Kacprzyk J.: Entropy for intuitionistic fuzzy sets, Fuzzy Sets and Systems 118(3), 467-477 (2001)
13. Wang Y., Lei Y.J.: A technique for constructing intuitionistic fuzzy entropy. Control and Decision 22(12), 1390-1394 (2007)
14. Wang Y.M., Parkan C.: A minimax disparity approach for obtain OWA operator weights. Information Sciences 175, 20-29 (2005)
15. Wei C.P.,Tang X.J.: An intuitionistic fuzzy group decision making approach based on entropy and similarity measures. International Journal of Information Technology and Decision Making 10(6), 1111-1130 (2011)
16. Wei C.P., Wang P.: Entropy, Similarity Measure of Interval-valued Intuitionistic Fuzzy Sets and Their Applications. Information Science 181(19), 4273-4286 (2011)

12 C.P.Wei, X.J. Tang and Y.Z.Bi

17. Xia M.M., Xu Z.S.: Some new similarity measures for intuitionistic fuzzy values and their application in group decision making. Journal of Systems Science and Systems Engineering 19(4), 430-452 (2011)
18. Xu Z.S.: Intuitionistic fuzzy aggregation operators. IEEE Transactions on Fuzzy Systems 15, 1179-1187 (2007)
19. Xu Z.S.: Dependent OWA operator. In: Torra, V., Narukawa, Y., Valls, A., DomingoFerrer, J.(eds.) MDAI 2006, LNCS (LNAI), 3885, pp. 172-178. Springer, Heidelberg (2006)
20. Xu Z.S.: An overview of methods for determining OWA weights. International Journal of Intelligent Systems 20(8), 843-865 (2005)
21. Xu Z.S., Da Q.L.: The uncertain OWA operator. International Journal of Intelligent Systems 17, 569-575 (2002)
22. Xu Z.S., Yager R.R.: Some geometric aggregation operators based on intuitionistic fuzzy sets. International Journal of General System 35(4), 417-433 (2006)
23. Yager R.R.: Quantifer guided aggregation using OWA operators. International Journal of Intelligent Systems 11(1), 49-73 (1996)
24. Yager R.R.: Families of OWA operators. Fuzzy Sets and Systems 59 125-148 (1993)
25. Yager R.R., Filev D.P.: Parameterized and-like and or-like OWA operators. International Journal of General Systems 22(3), 297-316 (1994)
26. Yager R.R.: On ordered weighted averaging aggregation operators in multicriteria decision making. IEEE Transactions on Systems, Man and Cybernetics 18, 183-190 (1988)
27. Yager R.R., Kacprczyk K.: The ordered weighted averaging operators: thery and applications. MA, USA: Kluwer Academic Publishers Norwell 275-294 (1997)
28. Zadeh A.: A computational approach to fuzzy quantifiers in natural languages. Computers and Mathematics with Applications 9, 149-184 (1983)
29. Zadeh A.: A computational theory of dispositions. International Journal of Intelligent Systems 2, 39-64 (1987)

On quick sort algorithm performance for large data sets

Marcin Woźniak[1], Zbigniew Marszałek[1], Marcin Gabryel[2], Robert K. Nowicki[2].

[1] Institute of Mathematics, Silesian University of Technology,
ul. Kaszubska 23, 44-100 Gliwice, Poland,
[2] Institute of Computational Intelligence, Czestochowa University of Technology,
Al. Armii Krajowej 36, 42-200 Czestochowa, Poland
Marcin.Wozniak@polsl.pl, Zbigniew.Marszalek@polsl.pl,
Marcin.Gabryel@iisi.pcz.pl, Robert.Nowicki@iisi.pcz.pl

Abstract. Sorting algorithms help to organize data. However sometimes it is not easy to determine the correct order in large data sets, especially if they present special poses of the input series. It often complicates sorting, results in time prolongation or even unable sorting. In such situations, the most commonly used method is to perform sorting process to reshuffled input data or change the algorithm. In this paper, the authors examined quick sort algorithm in two versions for large scale data sets. The algorithms have been examined in performance tests and the results helped to compare them.
Keywords: computer algorithm, data sorting, data mining, analysis of computer algorithms

1 Introduction

Quick sort algorithm is known from [1, 7]. In classic method, described also in [3, 17–19, 21], we sort elements idexed i_{left}, i_{left-1}, ..., $i_{right-1}$, i_{right}. All the elements are placed according to the order on both sides of the one reference element, chosen to divide them. A reference element index is an arithmetic average of indexes in the form of lower minimum total value, for more details see [1, 7, 17, 21]. Unfortunately, the cost of calculating this element index is determined by the number of elements in the sequence. This slows down the sorting of large data sets. An additional complication is the fact, that in practice there are often sequences mearly sortable for the classic version. Therefore we may often face some complications. These difficulties encourage looking for an optimal solution. Authors of [4, 13, 16, 19] describe the specific features of quick sort. Moreover, the authors of [5, 8, 10, 12, 18, 19, 22] pay attention to the impact on memory management or practical application of sorting algorithms. At the same time the authors of [16, 18–20] present the results of research on increasing efficiency. In Section 2 we have examined the quick sort to make it faster and more stable for large data sets. The results, presented in Section 2.2, suggest that there are some aspects of this method that may help to make it more stable and faster.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 647-656

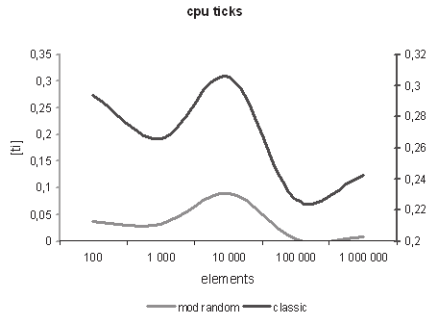


Fig. 6. Comparing the values of expected variability of CPU clock cycles

be appropriate for large data sets, even those described in Section 1.1. The authors consider increasing the efficiency of sorting algorithm for large data sets in further research and development.

References

1. I.A. Aho, J. Hopcroft, J. Ullman: The design and analysis of computer algorithms. Addison-Wesley Publishing Company, USA 1975.
2. H. Bing-Chao, D.E. Knuth.: A one-way, stack less Quick sort algorithm. BIT. vol.26, 1986, pp. 127–130.
3. T.H. Cormen, C.E. Leiserson, R.L. Rivest, C. Stein.: Introduction to algorithms. The MIT Press and McGraw-Hill Book Company, Cambridge, 2001.
4. R.S. Francis, L.J.H. Pannan.: A parallel partition for enhanced parallel quick sort. Parallel Computing, 18(5):543–550, 1992.
5. G. Gedigaa, I. Duntschb.: Approximation quality for sorting rules. Computational Statistics & Data Analysis 40, 2002, pp. 499–526.
6. P. Raghaven.: Lecture Notes on Randomized Algorithms. tech. report, IBM Research Division, Yorktown Heights, New York, 1990.
7. D.E. Knuth.: The Art of Computer Programming, vol.3, 2nd ed. Addison-Wesley, USA, 1998.
8. A. LaMarca, R.E. Ladner.: The influence of caches on the performance of sorting. Proceedings of the 8th Annual ACM-SIAM Symposium on Discrete Algorithms, New Orleans, Louisiana, 1997, pp. 370–379.
9. P. Larson.: External Sorting: Run Formation Revisited. IEEE Transactions on Knowledge and Data Engineering, vol.15, no.4, 2003, pp. 961–972.
10. P.A. Larson, G. Graefe.: Memory Management during Run Generation in External Sorting. Proceedings of SIGMOD, 1998, pp. 472–483.
11. C. Martynez, S. Roura.: Optimal sampling strategies in quick sort and quick select. SIAM Journal on Computing, vol.31, no.3, 2002, pp. 683–705.
12. Z. Marszałek, M. Woźniak.: On possible organizing NoSql database systems. International Journal of Information Science and Intelligent System, Martin Science Publishing, vol.2, no.2, 2013, pp 51–59.

13. M. MacIlroy.: A killer adversary for quick sort. Software Practice and Experience, vol.29, 1999, pp. 1–4.
14. Y. Pan, M. Hamdi.: Quick sort on a linear array with a reconfigurable pipelined bus system. Working Paper 94-03, The Center for Bussiness and Economics Research, The University of Dayton, 1994.
15. A. Rauh, G.R. Arce.: A Fast Weighted Median Algorithm Based on Quick select. Proceedings of IEEE 17th International Conference on Image Processing, Hong Kong, 2010, pp. 105–108.
16. L. Rashid, W.M. Hassanein, M.A. Hammad.: Analyzing and Enhancing the Parallel Sort Operation on Multithreaded Architectures. Journal Supercomputer, Springer-Verlag, 2009.
17. R. Sedgewick.: Implementing Quick sort programs. Communications of the ACM, 21(10):847–857, 1978, pp. 847–857.
18. P. Tsigas, Y. Zhang.: Parallel quick sort seems to outperform sample sort on cache coherent shared memory multiprocessors: An evaluation on sun enterprise 10000. Technical report, Department of Computing Science, Chalmers University of Technology, 2002.
19. P. Tsigas and Y. Zhang.: A simple, fast parallel implementation of quick sort and its performance evaluation on SUN enterprise 10000. Proceedings of 11th Euromicro Workshop on Parallel, Distributed and Network-Based Processing (PDP 2003), 2003, pp. 372–381.
20. R. Trimananda, C.Y. Haryanto.: A Parallel Implementation of Hybridized Merge-Quick sort Algorithm on MPICH. Proceedings of International Conference on Distributed Framework for Multimedia Applications, 2010.
21. M.A. Weiss.: Data Structure & Algorithm Analysis in C++, 2nd ed. Addison Wesley Longman, 1999.
22. M. Woźniak, Z. Marszałek, M. Gabryel, R.K. Nowicki.: Modified merge sort algorithm for large scale data sets. Lecture Notes in Artificial Intelligence, no.7895 Part II, Springer-Verlag Berlin Heidelberg, 2013, pp. 612–622.

Triple heap sort algorithm for large data sets

Marcin Woźniak[1], Zbigniew Marszałek[1], Marcin Gabryel[2], Robert K. Nowicki[2].

[1]Institute of Mathematics, Silesian University of Technology,
ul. Kaszubska 23, 44-100 Gliwice, Poland
[2]Institute of Computational Intelligence, Czestochowa University of Technology,
Al. Armii Krajowej 36, 42-200 Czestochowa, Poland
Marcin.Wozniak@polsl.pl, Zbigniew.Marszalek@polsl.pl,
Marcin.Gabryel@iisi.pcz.pl, Robert.Nowicki@iisi.pcz.pl

Abstract. Sorting algorithms are important procedures to facilitate the order of data. Classic versions of algorithms often can not efficiently determine the correct order in large scale data sets. In this article, authors describe and examine an extended heap sort algorithm performance for large data sets. Extension of the heap structure was subject to performance tests, that showed validity. With the extension, algorithm is able to sort incoming strings faster, regardless to the arrangement of incoming data.
Keywords: computer algorithm, data sorting, data mining, analysis of computer algorithms

1 Introduction

In the heap, we make levels to place in them sorted elements. Since the levels are stacked one on the other, we obtain a multi-level structure. With this arrangement, we can propagate inheritance and relationship among the elements in successive levels of the heap. In [2] the heap is also called a tree. The tree is a custom graph that is coherent and acyclic. Coherence means that all the nodes of the graph are combined into a single structure. Acyclic means that from each node we can move to another node in one and the only one way. This structure allows to introduce the inheritance and relationship between the nodes. Relationships are determined for the child nodes, which are in the next level of the heap and are connected to the node of the previous level. Discussing the examined heap sort algorithm we assume the following:

1. In the next levels of the heap, all the nodes have the same number of descendants.
2. In the middle levels (layers), there are no nodes without children.
3. The only level that may have an incomplete structure of the descendants is second to last. Having children in this level depends on the number of items in the string that we are deploying in the created heap.
4. In the level, elements are placed in the nodes from the left to the right side of the heap.

Andrzej M.J. Skulimowski (ed.): Proceedings of KICSS'2013, pp. 657-665

3 Final Remarks

In conclusion, examined triple heap structure has a positive effect on increasing the efficiency and reducing the time costs. Triple heap sort algorithm has a good stability and sorts large data sets about 15% faster than classic version. Thus, the proposed algorithm is proper for sorting large scale data sets regardless of input elements. We therefore conclude that replacing classic structure of the heap by the triple heap allows to increase the efficiency of sorting. The authors of this paper intend to focus on the research conducted to examine the impact of increasing the number of divisions of the heap structure on sorting large scale data sets and implementing parallel sorting.

References

1. K. Abrahamson, N. Dadoun, D.G. Kirkpatrick, T. Przytycka.: A simple parallel tree construction algorithm. Journal Algorithms, no.10, 1987, pp. 287–302.
2. I.A. Aho, J. Hopcroft, J. Ullman: The design and analysis of computer algorithms. Addison-Wesley Publishing Company, USA, 1975.
3. T.O. Alanko, H.H.A. Erkio, I.J. Haikala.: Virtual memory behavior of some sorting algorithm. IEEE Transactions on Software Engineering, vol.10, no.4, 1984, pp. 422–431.
4. M. Ben-Or.: Lower Bounds for Algebraic Computation Trees. Proceedings of 15th ACM Symp. Theory of Computing, ACM Press, 1983, pp. 80–86.
5. P. Crescenzi, R. Grossi, G.F. Italiano.: Search data structures for skewed strings. Experimental and Efficient Algorithms, Lecture Notes in Computer Science, no.2647, Springer-Verlag Berlin Heidelberg, 2003, pp. 81–96.
6. E.E. Doberkat.: Inserting a new element into a heap. BIT Numerical Mathematics, vol.21, 1983, pp. 255–269.
7. V. Estivill-Castro, D. Wood.: A Survey of Adaptive Sorting Algorithms. Computing Surveys, vol.24, no.4, 1992, pp. 441–476.
8. D.E. Knuth.: The Art of Computer Programming Vol.3: Sorting and Searching. Addison-Wesley, USA, 1998.
9. P.A. Larson, G. Graefe.: Memory Management during Run Generation. External Sorting. Proceedings of SIGMOD, 1998, pp. 472–483.
10. Z. Marszałek, M. Woźniak.: On possible organizing NoSql database systems. International Journal of Information Science and Intelligent System, Martin Science Publishing, vol.2, no.2, 2013, pp 51–59.
11. A. Rauh, G.R. Arce.: A Fast Weighted Median Algorithm Based on Quick select. Proceedings of IEEE 17th International Conference on Image Processing, 2010, pp. 105–108.
12. S. Roura.: Digital access to comparison-based tree data structures and algorithms. Journal Algorithms, vol.40, no.1, 2001, pp. 123–133.
13. L. Wegner, J.I. Teuhola.: The External Heap sort. IEEE Transactions on Software Engineering, vol.15, no.7, 1989, pp. 917–925.
14. M.A. Weiss.: Data Structure & Algorithm Analysis in C++, 2nd ed. Addison Wesley Longman, 1999.
15. M. Woźniak, Z. Marszałek, M. Gabryel, R.K. Nowicki.: Modified merge sort algorithm for large scale data sets, Lecture Notes in Artificial Intelligence, no.7895 Part II, Springer-Verlag Berlin Heidelberg, 2013, pp. 612–622.

Committees and Reviewers

Conference Chairs:

Andrzej M.J. Skulimowski, Progress & Business Foundation and AGH University of Science and Technology, Poland, General Chair
Susumu Kunifuji, Vice President of Japan Advanced Institute of Science and Technology, Japan, Program Co-Chair
Thanaruk Theeramunkong, Thammasat University, Thailand, PhD Award Chair

Program Committee Members:

Catherine G. August, Stevens Institute of Technology, Hoboken, NJ, USA
Stephanie Buisine, École Nationale Supérieure d'Arts et Métiers, Paris, France
Amilcar Cardoso, Department of Informatics Engineering, University of Coimbra, Portugal
João Clímaco, INESCC, University of Coimbra, Portugal
Simon Colton, Department of Computing, Goldsmiths, University of London, UK
József Dombi, University of Szeged, Hungary
Włodzisław Duch,Toruń University, Poland
Petr Fiala, University of Economics in Prague, Czech Republic
John Garofalakis, Computer Engineering & Informatics Department, University of Patras, Greece
Mordecai Henig, Tel Aviv University, Israel
Takeo Higuchi, Japan Creativity Society, Onitaka, Ichikawa City, Japan
Josef Jablonsky, University of Economics in Prague, Czech Republic
Janusz Kacprzyk, Systems Research Institute, PAS, Warsaw, Poland
Ignacy Kaliszewski, Systems Research Institute, PAS, Warsaw, Poland
Hideaki Kanai, Japan Advanced Institute of Science and Technology, Japan
Thomas Köhler, Technical University of Dresden, Germany
Antoni Ligęza, AGH University of Science and Technology, Kraków, Poland
Kazunori Miyata, Japan Advanced Institute of Science and Technology, Japan
David C. Moffat, Glasgow Caledonian University, UK
Anna Mura, Universitat Pompeu Fabra, Barcelona, Spain
Grzegorz J. Nalepa, AGH University of Science and Technology, Kraków, Poland
Kazushi Nishimoto, Japan Advanced Institute of Science and Technology, Japan
Maciej Nowak, Katowice University of Economics, Poland

Kok-Leong Ong, Deakin University, Melbourne, Australia
François Pachet, Sony CSL, Paris, France
Paweł Rotter, AGH University of Science and Technology and Progress & Business Foundation, Kraków, Poland
Jose L. Salmeron, Universidad Pablo da Olavide, Seville, Spain
Jagannathan Sarangapani, Missouri University of Science and Technology, Rolla, MO,USA
Hsu-Shih Shih, Tamkang University, Taipei, Taiwan
Roman Słowiński, Poznań University of Technology, Poland
Janusz Starzyk, Ohio University, Athens, OH, USA
Ralph Steuer, University of Georgia at Athens, GA, USA
Ryszard Tadeusiewicz, AGH University of Science and Technology, Kraków, Poland
Xijin Tang, Institute of Systems Science, Chinese Academy of Sciences, Beijing, P.R.China
Tadeusz Trzaskalik, Katowice University of Economics, Poland
Geraint A. Wiggins, University of London, UK
Takashi Yoshino, Wakayama University, Japan
Atsuo Yoshitaka, Japan Advanced Institute of Science and Technology, Japan
Po-Lung Yu, National Chiao Tung University, Taipei, Taiwan
Takaya Yuizono, Japan Advanced Institute of Science and Technology, Japan
Songmao Zhang, Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing, P.R. China
Constantin Zopounidis, Technical University of Crete, Chania, Greece

Organizing Committee:

Marek Czerni, Progress & Business Foundation and Pedagogical University, Kraków, Poland
Dariusz Kluz, Progress & Business Foundation, Kraków, Poland - Webmaster
Magdalena Krzyszkowska-Pytel, Progress & Business Foundation, Kraków, Poland
Alicja Madura, Progress & Business Foundation, Kraków, Poland - Conference Secretary
Witold Majdak, Progress & Business Foundation and AGH University of Science and Technology, Kraków, Poland
Urszula Markowicz, Progress & Business Foundation, Kraków, Poland
Przemysław Pukocz, Progress & Business Foundation and AGH University of Science and Technology, Kraków, Poland

Paweł Rotter, Progress & Business Foundation and AGH University of Science and Technology, Kraków, Poland
Andrzej M.J. Skulimowski, Progress & Business Foundation and AGH University of Science and Technology, Kraków, Poland – Chair

Reviewers:

Catherine G. August, Stevens Institute of Technology, Hoboken, NJ, USA
Stephanie Buisine, École Nationale Supérieure d'Arts et Métiers, Paris, France
João Clímaco, INESCC, University of Coimbra, Portugal
Simon Colton, Department of Computing, Goldsmiths, University of London, UK
Włodzisław Duch, Toruń University, Poland
Lidia Dutkiewicz, AGH University of Science and Technology, Kraków, Poland
John Garofalakis, University of Patras, Greece
Tessai Hayama, Kanazawa Insitute of Technology, Japan
Takeo Higuchi, Japan Creativity Society, Onitaka, Ichikawa City, Japan
Adrian Horzyk, AGH University of Science and Technology, Kraków, Poland
Josef Jablonsky, University of Economics in Prague, Czech Republic
Janusz Kacprzyk, Systems Research Institute, Polish Academy of Sciences, Warsaw, Poland
Ignacy Kaliszewski, Systems Research Institute, Polish Academy of Sciences, Warsaw, Poland
Hideaki Kanai, Japan Advanced Institute of Science and Technology, Japan
Piotr Kleczkowski, AGH University of Science and Technology, Kraków, Poland
Thomas Köhler, Technical University of Dresden, Germany
Susumu Kunifuji, Japan Advanced Institute of Science and Technology, Japan
Antoni Ligęza, AGH University of Science and Technology, Kraków, Poland
Witold Majdak, AGH University of Science and Technology, Kraków, Poland
Kazunori Miyata, Japan Advanced Institute of Science and Technology, Japan
David C. Moffat, Glasgow Caledonian University, UK
Anna Mura, Universitat Pompeu Fabra, Barcelona, Spain
Grzegorz J. Nalepa, AGH University of Science and Technology, Kraków, Poland
Kazushi Nishimoto, Japan Advanced Institute of Science and Technology, Japan
Maciej Nowak, Katowice University of Economics, Poland
Kok-Leong Ong, Deakin University, Melbourne, Australia
François Pachet, Sony CSL, Paris, France
Paweł Rotter, AGH University of Science and Technology and Progress & Business Foundation, Kraków, Poland
Jose L. Salmeron, Universidad Pablo da Olavide, Seville, Spain

Jagannathan Sarangapani, Missouri University of Science and Technology, Rolla, MO, USA
Hsu-Shih Shih, Tamkang University, Taipei, Taiwan
Marcin Skowron, Austrian Research Institute for Artificial Intelligence, Austria
Andrzej M.J. Skulimowski, Progress & Business Foundation and AGH University of Science and Technology, Kraków, Poland (as an editor)
Janusz Starzyk, Ohio University, Athens, OH, USA
Ralph Steuer, University of Georgia, Athens, GA, USA
Marcin Szpyrka, AGH University of Science and Technology, Kraków, Poland
Ryszard Tadeusiewicz, AGH University of Science and Technology, Kraków, Poland
Xijin Tang, Institute of Systems Science, Chinese Academy of Sciences, Beijing, P.R.China
Thanaruk Theeramunkong, Thammasat University, Thailand
Tadeusz Trzaskalik (Volume Reviewer), Katowice University of Economics, Poland
Konrad Wala (Volume Reviewer), AGH University of Science and Technology, Kraków, Poland
Geraint A. Wiggins, Queen Mary University of London, UK
Takashi Yoshino, Wakayama University, Japan
Atsuo Yoshitaka, Japan Advanced Institute of Science and Technology, Japan
Takaya Yuizono, Japan Advanced Institute of Science and Technology, Japan
Songmao Zhang, Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing, P.R. China
Constantin Zopounidis, Technical University of Crete, Chania, Greece

Author Index

List of Participants

Weronika Teresa Adrian, AGH University of Science and Technology, Poland
João Miguel Pereira Alves, University of Minho, Portugal
Renato Cordeiro de Amorim, Glyndwr University, United Kingdom
Dimitrios Assimakopoulos, University of Patras, Greece
Pimnapa Atsawintarangkun, Japan Advanced Institute of Science and Technology, Japan
Katherine G. August, Stevens Institute of Technology, USA
Reza Basseda, Stony Brook University, USA
Marta Bondyra, AGH University of Science and Technology, Poland
Wojciech Tadeusz Chmiel, AGH University of Science and Technology, Poland
Grazia Concilio, Politecnico di Milano, Italy
Lidia Dutkiewicz, AGH University of Science and Technology, Poland
Dorota Dżega, West Pomeranian Business School, Poland
Shounak Gore, University of Buffalo, USA
Andrés Gómez de Silva Garza, Mexico Autonomous Institute of Technology, Mexico
Ryo Hatano, Japan Advanced Institute of Science and Technology, Japan
Takeo Higuchi, Japan Advanced Institute of Science and Technology, Japan
Furukawa Hiroaki, Japan Advanced Institute of Science and Technology, Japan
Władysław Homenda, Polish Academy of Science, Poland
Petr Homola, Codesign, s.r.o., Czech Republic
Adrian Horzyk, AGH University of Science and Technology, Poland
Won Kyung Hwam, Ajou University, South Korea
Marco Iannaccone, National Research Council of Italy, Italy
Bipin Indurkya, AGH University of Science and Technology, Poland
Agnieszka Jastrzębska, Polish Academy of Science, Poland
Marek Jaszuk, University of Information Technology and Management in Rzeszow, Poland
Tomoko Kajiyama, Aoyama Gakuin University, Japan
Eric Kenis, Voka-Vlaams Economisch Verbond, Belgium
Dariusz Kluz, Progress & Business Foundation, Poland
Thomas Köhler, Dresden University of Technology, Germany
Edyta Kucharska, AGH University of Science and Technology, Poland
Susumu Kunifuji, Japan Advanced Institute of Science and Technology, Japan
Wojciech Lesiński, Polish Academy of Science, Poland
Antoni Ligęza, AGH University of Science and Technology, Poland
Ewa Łukasik, Poznan University of Technology, Poland

Alicja Madura, Progress & Business Foundation, Poland
Neil Maiden, City University London, United Kingdom
Urszula Małgorzata Markowicz, Progress & Business Foundation, Poland
Zbigniew Marszałek, Silesian University of Technology, Poland
Jerzy Stanisław Michnik, University of Economics in Katowice, Poland
Aniello Minutolo, Institute for High Performance Computing and Networking, ICAR-CNR, Italy
Taizo Miyachi, Tokai University, Japan
Grzegorz Jacek Nalepa, AGH University of Science and Technology, Poland
Hai-Minh Nguyen, Japan Advanced Institute of Science and Technology, Japan
Michał Lech Niedźwiecki, AGH University of Science and Technology, Poland
Mobina Nouri, City University London, United Kingdom
Maciej Nowak, University of Economics in Katowice, Poland
Chaveevan Pechsiri, Dhurakij Pundit University, Thailand
Reuben Pereira, Goa College of Engineering, India
Wiesław Pietruszkiewicz, West Pomeranian University of Technology, Poland
Jakob Polcwiartek, Aalborg University, Denmark
Marco Pota, Institute for High Performance Computing and Networking, ICAR-CNR, Italy
Michał Roman Przybyłek, University of Warsaw, Poland
Michał Przyłuski, Warsaw University of Technology, Poland
Edyta Przymus, AGH University of Science and Technology, Poland
Przemysław Pukocz, AGH University of Science and Technology, Poland
Krzysztof Pytel, University of Lodz, Poland
Paweł Rotter, AGH University of Science and Technology, Poland
Ratana Rujiravanit, Chulalongkorn University, Thailand
Magdalena Scherer, Czestochowa University of Technology, Poland
Rafał Scherer, Czestochowa University of Technology, Poland
Heinz-Ulrich Schmitt, Stellenbosch University, Republic of South Africa
Ewelina Skulimowska, AGH University of Science and Technology, Poland
Andrzej M.J. Skulimowski, Progress & Business Foundation, Poland
Paweł Kazimierz Szeliga, AGH University of Science and Technology, Poland
Piotr Szwed, AGH University of Science and Technology, Poland
Xijin Tang, CAS Academy of Mathematics and Systems Science, China
Taro Tezuka, University of Tsukuba, Japan
Thanaruk Theeramunkong, Thammasat University, Thailand
Tadeusz Trzaskalik, University of Economics in Katowice, Poland
Marcin Woźniak, Silesian University of Technology, Poland
Takaya Yuizono, Japan Advanced Institute of Science and Technology, Japan

P AND B INCUBATOR Ltd., Cracow

www.pbincubator.eu

A creative IT company that offers creativity support tools based on the latest research achievements and practice tests

multiround and real-time Delphi

online surveys for a diversified spectrum of applications

corporate foresight support systems

exploring over 20 years of foresight experience

in-company innovation management

efficient web architectures

tailored decision support systems

strategic planning with roadmapping support tools

P&B Incubator offers **a great opportunity for organizations** seeking expert decision making support in the following areas:

- technology acquisition and in-house development strategies,
- mergers and acquisitions, market expansion and HR planning,
- long-term financing and development plans.

P&BI uses an efficient and universal web-based software system to designing and conducting **practice-oriented** multi-round or real-time **Delphi surveys.** Responses can be quantitative as well as qualitative. They can focus on market factors and technological parameters either directly, or to the probability or expected future period of achieving them. Surveys can also use Likert scales and binary decision trees as options. Responses are analyzed with advanced statistical methods that make it possible to:

- identify scenarios and clusters of technological trends,
- perform correlation analysis and causality tests,
- generate reliable forecasts.

The design, performance, monitoring and statistical analysis of surveys is implemented as an expert system offered within the 'software as a service' (SaaS) framework. Customers may order full-service surveys, including the design of questionnaires and recruitment of experts, or use different collaborative options to work together with the P&BI team.

Increase your competiveness using Corporate Innovation Support Systems (CISS). CISS deployment ensures a strategic alignment between corporate innovation strategies and market demand. Implementing a CISS in a company results in the increased ability to generate new products and services. It can also boost competitiveness by involving more staff in discovering market niches and consumer preferences.

This new class of enterprise software developed by the P&BI evolved from a system of innovation and patent databases in the 90's into a sophisticated idea management system. It is endowed with the following features:

- multicriteria expert evaluation capabilities that make it possible to judge whether an idea submitted to the system is worth further development,
- a financial assessment tool for aiding investment decisions,
- project ranking using financial and originality-based venture criteria,
- real options detection and valuation in future cash-flow analysis.

The efficient web architecture of our CISS is based on best practices in decision support and ERP systems. It is offered either as SaaS or as an intranet software system tailored to the customer's individual needs.

Our experts will advise you in selecting the best tool for your needs and scope of use. They will also provide customers with online or blended training and support as well as ensure that our software is compatible with recent network programming environments

For inquiries please use the contact form on the web page www.pbincubator.eu, email: office@pbincubator.eu, phone: +48126360100 ext.27, fax: +48126368787

ISBN 978-83-939344-1-6 (print)
ISBN 978-83-912831-8-9 (CD)
ISBN 978-83-939344-6-1 (eBook)

International Conferences on
Knowledge, Information and Creativity Support Systems

1st KICSS'2006, Ayutthaya, Thailand, August 1-4, 2006
2nd KICSS'2007, Nomi, Japan, November 5-7, 2007
3rd KICSS'2008, Hanoi, Vietnam, December 22-23, 2008
4th KICSS'2009, Seoul, Korea, November 25-27, 2009
5th KICSS'2010, Chiang Mai, Thailand, November 25-27, 2010
6th KICSS'2011, Beijing, China, October 22-24, 2011
7th KICSS'2012, Melbourne, Australia, November 8-9, 2012
8th KICSS'2013, Krakow, Poland, November 7-9, 2013
9th KICSS'2014, Limassol, Cyprus, November 6-8, 2014
10th KICSS'2015, Phuket, Thailand, November 12-14, 2015

International Center for Decision Science and Forecasting
of the Progress & Business Foundation
www.pbf.pl, www.foresight.pl

PROGRESS & BUSINESS PUBLISHERS