

Laboratory for Cognitive Modeling

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RESEARCH ACTIVITIES

Laboratory for Cognitive Modeling (LKM) was officially founded in 2001. LKM carries out research in cognitive modeling, machine learning, neural networks, picture and data mining. Research results concern the modeling of noisy data related to cognitive, medical, biological and other processes. We are developing, testing and applying new approaches and algorithms for modeling from numeric, symbolic and pictorial data, and new approaches to building, evaluation and explanation of models, derived from data. Recent research is related to development of methods for evaluating the utility of ordinal attributes, for evaluating the reliability of single models' predictions in classification and regression, for evaluating the reliability of clustering, for explaining single predictions by arbitrary classification or regression model, for efficient parametrization of images using a subset of possible image resolutions, for text summarization using symbolic graphs, for analysing of sport data, and for user profiling by mining the web-logs. LKM collaborates with psychologists, physicians, biologists, physicists and chemists. A notable aspect of much of this research is its application to problems in image analysis, medical diagnosis, ecological modeling, alternative medicine, and studies of consciousness.

RESEARCH PROJECTS

Artificial Intelligence and Intelligent Systems (P2-0209). Research Programme, Slovenian Research Agency (2009-2014).

Electricity load forecasting supported by prediction explanation and prediction reliability estimates (BI-PT/10-11-007). Bilateral Collaboration Project (Slovenia-Portugal), Slovenian Research Agency (2010-2011).

Integration of data mining and high-performance computer modelling for coronary artery disease, (BI-SR/10-11-020). Bilateral Collaboration Project (Slovenia-Serbia), Slovenian Research Agency (2010-2011).

Machine Learning of Imbalanced Data, (BI-CZ/10-11-008). Bilateral Collaboration Project (Slovenia-Czech Republic), Slovenian Research Agency (2010-2011).

LABORATORY GUESTS

Prof. Dr. Petr Savicky, University of Prague, Czech Republic, 30. 5. 2011 – 10. 6. 2011. Research collaboration on Learning in Imbalanced Data.

Dr. Pedro Pereira Rodrigues, University of Porto. 29. 6. 2011 - 8. 7. 2011. Research collaboration on data streams mining and electricity load forecasting supported by prediction explanation and prediction reliability estimates.

Ercan Canhas, MSc, University of Prizren, Kosovo. 15.1. 2011 - 30. 6. 2011 and 15.9.2011-11.10.2011. PhD scholarship funded by EU, research multidocument summarization based on multilayered graphs.

Prof. Dr. Joao Gama, University of Porto, Portugal, 4. 7. 2011 - 9. 7. 2011. Research collaboration on data streams mining and electricity load forecasting supported by prediction explanation and prediction reliability estimates

Prof. Dr. Nenad Filipović, Miloš Radović and dr. Aleksandar Peulić, University of Kragujevac, Serbia, 20.4.2011 - 22.4. 2011 Research collaboration on the use of machine learning for modeling of coronary artery disease

Prof. Dr. Tatjana Zrimec, University of New South Wales, Australia, 3.3. 2011 - 20.7.2011 Research collaboration on machine learning from medical image data
Miloš Radović, University of Kragujevac, Serbia, 5.12.2011 – 11.12. 2011 Research collaboration on the use of machine learning for modeling of coronary artery disease

RESEARCH VISITS

Zoran Bosnić, University of New South Wales, Australia, 20.6.2011 - 20.9.2011, collaboration on medical imaging projects (Content-based image retrieval, statistical analysis for lung modelling and visualization)

Marko Robnik Šikonja, Institute of Computer Scienc, Academy of Sciences of the Czech Republic. 22. 8. 2011 - 26. 8. 2011. Research collaboration on machine learning of imbalanced data sets with emphasis on feature evaluation

Zoran Bosnić, Petar Vračar, Darko Pevec. University of Porto. 11. 11. 2011 - 16. 11. 2011. Research collaboration on data streams mining and electricity load forecasting supported by prediction explanation and prediction reliability estimates

Zoran Bosnić, Petar Vračar. University of Kragujevac. 20. 10. 2011 – 22. 10. 2011. Research collaboration on project "Integration of data mining and high-performance computer modeling for coronary artery disease"

Matjaž Kukar, Petar Vračar, Darko Pevec. Institute of Computer Science, Academy of Sciences of the Czech Republic, Prague. 26. 9. 2011 - 30. 9. 2011. Research collaboration on machine learning of imbalanced data.

INVITED TALKS AND LECTURES

Darko Pevec: *Input dependent prediction intervals for arbitrary regression models*. Porto: Artificial Intelligence and Decision Support Laboratory, University of Porto, 15th of November 2011.

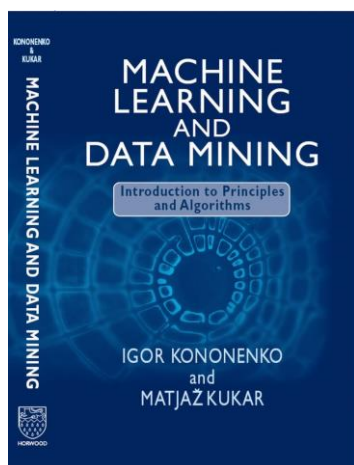
Zoran Bosnić: *Correcting data stream regression predictions using a prediction reliability estimate*. University of Kragujevac: Faculty of Engineering, 21st of October 2011.

Petar Vračar: *Modeling the progression of a basketball match and forecasting the outcome*. University of Kragujevac: Faculty of Engineering, 21st of October 2011.

Zoran Bosnić: *Correcting streaming predictions of an electricity load forecast system using a prediction reliability estimate*. Porto: Artificial Intelligence and Decision Support Laboratory, University of Porto, 15th of November 2011.

SELECTED PUBLICATIONS

- I. Kononenko, M. Kukar: Machine Learning and Data Mining: Introduction to Principles and Algorithms, Horwood publ., 2007 (454 pages).
- E. Štrumbelj, M. Robnik-Šikonja. Online bookmakers' odds as forecasts : the case of European soccer leagues. *Int. j. forecast.*2010, vol. 26, no. 3, str. 482-488.
- E. Štrumbelj, P. Vračar. Simulating a basketball match with a homogeneous Markov model and forecasting the outcome. *Int. j. forecast.*. 2011, str. 1-13.
- E. Štrumbelj, I. Kononenko: An efficient explanation of individual classifications using game theory. *J. Mach. Learn. Res.* 2010, 11[1]:1-18.
- E. Štrumbelj, I. Kononenko, M. Robnik Šikonja. Explaining instance classifications with interactions of subsets of feature values. *Data & Knowledge Engineering*, 68(10):886-904, 2009.
- I. Kononenko. Natural and Machine Learning, Intelligence and Consciousness, In: E. Žerovnik et al. (eds.) *Philosophical Insights about Modern Science*, NY: Nova Science publ., 239-258, 2009.
- M. Robnik-Šikonja, I. Kononenko: Explaining classifications for individual instances. *IEEE Trans. Knowl. Data Eng.*, 2008, 20:589-600.
- I. Kononenko: M. Robnik-Šikonja: Non-myopic feature quality evaluation with (R)ReliefF. In: LIU, H., MOTODA, H. (Eds.). *Computational methods of feature selection*. Boca Raton; London; New York: Chapman & Hall/CRC, 2008, pp. 169-191.
- P. Savicky, M. Robnik Šikonja. Learning random numbers: a MATLAB anomaly, *Applied artificial intelligence*, 22(3):254-265, 2008.
- Z. Bosnić and I. Kononenko. Comparison of approaches for estimating reliability of individual regression predictions. *Data & Knowledge Engineering*, 67 (3)504-516, 2008.
- M. Robnik-Šikonja, K. Vanhoof: Evaluation of ordinal attributes at value level. *Data Mining and Knowledge Discovery*, 14:225-243, 2007.
- Z. Bosnić, I. Kononenko: Estimation of individual prediction reliability using the local sensitivity analysis. *Appl. Intell.*, 2007, 29(3)187-203
- Z. Bosnić, I. Kononenko: Automatic selection of reliability estimates for individual regression predictions. *Knowl. eng. rev.*, 25(1)27-47, 2010.
- E. Štrumbelj, Z. Bosnić, I. Kononenko, B. Zakotnik, C. Grašič-Kuhar: Explanation and reliability of prediction models: the case of breast cancer recurrence. *Knowledge and information systems*, 24(2)305-324, 2010.
- M. Kukar. Quality assessment of individual classifications in machine learning and data mining. *Knowledge and information systems*, 2006, 9(3) 364-384.



The book by two members of LKM was published by Horwood and represents the appreciation of our research work.



We collaborate with several Universities and Institutes from Greece, Portugal, Spain, Czech Republic, Serbia and Belgium.