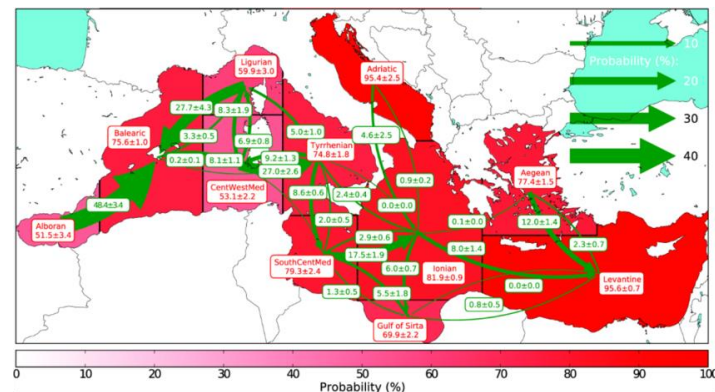
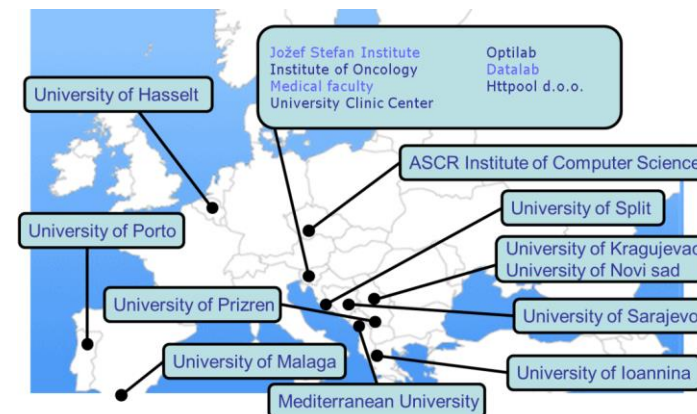


# Laboratory for Cognitive Modelling

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We developed the methodology for analysing the movement of water masses in the Mediterranean Sea



We collaborate with several Universities and Institutes from Belgium, BiH, Croatia, Czech Republic, Greece, Kosovo, Portugal, Serbia, Monte negro, and Spain

## RESEARCH ACTIVITIES

Laboratory for Cognitive Modelling (LKM) was officially founded in 2001. LKM carries out research in cognitive modelling, machine learning, neural networks, statistics, picture and data mining. Research results concern the modelling of noisy data related to cognitive, medical, biological and other processes. We are developing, testing and applying new approaches and algorithms for modelling from numeric, symbolic and pictorial data, and new approaches to building, evaluation and explanation of models, derived from data. Recent research is related to evaluating the utility of ordinal attributes, generation of semi-artificial data, analysis of big data with map-reduce approach, analysis of graphs, evaluating the reliability of single models' predictions in classification and regression, evaluating the reliability of clustering, explaining single predictions by arbitrary classification and regression model, text summarization using archetypal analysis, analysing and modelling of sport data, user profiling by mining the web-logs, recommendation systems, learning of imbalanced classification problems, applying evolutionary computation to data mining focused on using ant colony optimization, prediction intervals which represent the distribution of individual future points in a more informative manner, spatial data mining with multi-level directed graphs, employing background knowledge analysis for search space reduction in inductive logic programming, detection of (non)-ischemic episodes in ECG signals, heuristic search methods in clickstream mining and mining of data streams. A notable aspect of much of this research is its application to problems in image analysis, medical diagnosis, ecological modelling, marketing and financial modelling.

## RESEARCH PROJECTS

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

AGROIT - Increasing the efficiency of farming through on open standards based AgrolT platform, European Project (Framework Programmes) (2014-2016)

Development of new e-learning models for game-based learning using mobile technologies, Bilateral Collaboration Project BI-ME/14-15-009, (2014-2015)

A component for intelligent analysis of data streams. Industry-Funded Project, Optilab (2012-2014).

Supervised and unsupervised learning from imbalanced datasets for assistance in movement of persons with low vision, Bilateral Collaboration Project (BI-HR/14-15-024), 2014-2015

Computer based modeling in bioinformatics for gene based cancer classification focused on reliability and machine learning, Bilateral Collaboration Project (BI-BA/14-15-008), 2014-2015

## LABORATORY GUESTS

Dr. Josip Musić, University of Split. 9.12.2014 - 13.12.2014. Research collaboration on Supervised and unsupervised learning from imbalanced datasets for assistance in movement of persons with low vision.

Ante Panjkota, MSc, University of Split. 9.12.2014 - 13.12.2014. Research collaboration on Supervised and unsupervised learning from imbalanced datasets for assistance in movement of persons with low vision.

Dr. Ivo Stančić, University of Split. 9.12.2014 - 13.12.2014. Research collaboration on Supervised and unsupervised learning from imbalanced datasets for assistance in movement of persons with low vision.

Tripo Matijević, Univerzitet »Mediteran«, Fakultet za informacione tehnologije, 15. 12. - 18. 12. 2014, Research collaboration on bilateral project BI-ME/14-15-009

Tijana Vujičić, Univerzitet »Mediteran«, Fakultet za informacione tehnologije, 15. 12. - 18. 12. 2014, Research collaboration on bilateral project BI-ME/14-15-009

Nađa Žarić, Univerzitet »Mediteran«, Fakultet za informacione tehnologije, 15. 12. - 18. 12. 2014, Research collaboration on bilateral project BI-ME/14-15-009

## RESEARCH VISITS

Zoran Bosnić. Awarded by CEEPUS and OeAD (Austrian Agency for International Cooperation in Education and Research) to visit Johannes Kepler University, Institute for System Software, Linz, Austria (9. 11. - 15. 11. 2014)

Zoran Bosnić. Awarded CEEPUS Scholarship for Staff mobility to visit Reykjavik University, School of Computer Science, Iceland (25. 8. - 30. 8. 2014)

Igor Kononenko, Matjaž Kukar, Petar Vračar, Darko Pevec: Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Split, Croatia, 26. 8. - 29. 8. 2014. Collaboration on research project »Supervised and unsupervised learning from imbalanced datasets for assistance in movement of persons with low vision«.

Matjaž Kukar, Domen Košir, Kaja Zupanc: Faculty of Information Technologies, Mediterranean University, Podgorica, Montenegro, 17. 11. - 19. 11. 2014. Collaboration on research project »Development of new e-learning models for game-based learning using mobile technologies«.

Igor Kononenko, Zoran Bosnić, Marko Robnik Šikonja, Miha Drole: University of Sarajevo, BiH, 3.7.-5.7.2014. Collaboration on research project: »Computer based modeling in bioinformatics for gene based cancer classification focused on reliability and machine learning«

## INVITED TALKS AND LECTURES

Zoran Bosnić. Incremental learning and very fast decision trees: Reykjavik University, School of Computer Science, Iceland, August 26th, 2014.

Darko Pevec: Reliability estimation of individual predictions in supervised learning, 27.8.2014, an invited lecture at Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split, Croatia.

Matjaž Kukar: Data mining and databases, 27. 8. 2014, an invited talk at the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Split, Croatia

Igor Kononenko: Recent research in the Laboratory for Cognitive Modelling, 27. 8. 2014, an invited talk at the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Split, Croatia

Petar Vračar: Modelling dynamic processes and applications in sport, 27. 8. 2014, an invited talk at the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Split, Croatia

## SELECTED PUBLICATIONS

- Z. Bosnić, J. Demšar, G. Kešpret, P.P. Rodrigues, J. Gama, I. Kononenko. Enhancing data stream predictions with reliability estimators and explanation. *Eng. appl. artif. intell.*, vol. 34, p.p. 178-192, 2014.
- E. Canhasi, I. Kononenko. Weighted archetypal analysis of the multi-element graph for query-focused multi-document summarization. *Expert systems with applications*, Feb. 2014, vol. 41, no. 2, pp. 535-543.
- E. Canhasi, I. Kononenko. Multi-document summarization via archetypal analysis of the content-graph joint model. *Knowledge and information systems*, 2014, vol. 41, no. 3, str. 821-842
- D. Košir, I. Kononenko, Z. Bosnić. Web user profiles with time-decay and prototyping. *Appl. intell.*, vol. 41, no. 4, p.p. 1081-1096, Dec. 2014.
- U. Ocepek, Z. Bosnić, I. Nančovska Šerbec, J. Rugelj. Exploring the relation between learning style models and preferred multimedia types. *Computers & Education*, Nov. 2013, vol. 69, pp. 343-355.
- B. Petelin, I. Kononenko, V. Malačič, M. Kukar. Multi-level association rules and directed graphs for spatial data analysis. *Expert systems with applications*, 2013, vol. 40, issue 12, pp. 4957-4970
- B. Petelin, I. Kononenko, V. Malačič, M. Kukar, Dynamic fuzzy paths and cycles in multi-level directed graphs. *Engineering applications of artificial intelligence*, 2014, vol. 37, p. 194-206.
- D. Pevac, I. Kononenko. Input dependent prediction intervals for supervised regression. *Intelligent data analysis*, 18(5):873-887, 2014.
- Pičulin, Matej, Robnik Šikonja, Marko. Handling numeric attributes with ant colony based classifier for medical decision making. *Expert systems with applications*, 2014, 41(16):7524-7535
- M. Robnik Šikonja, E. Štrumbelj, I. Kononenko. Efficiently explaining the predictions of a probabilistic radial basis function classification network. *Intelligent data analysis*, 2013, vol. 17, no. 5, pp. 791-802.
- E. Štrumbelj. On determining probability forecasts from betting odds. *International journal of forecasting*, 2014, vol. 30, no. 4, 934-943.
- E. Štrumbelj., F. Erčulj. Analysis of experts` quantitative assessment of adolescent basketball players and the role of anthropometric and physiological attributes. *Journal of Human Kinetics*, 2014, vol. 42, 267-276.
- E. Štrumbelj.. A comment on the bias of probabilities derived from betting odds and their use in measuring outcome uncertainty. *Journal of sports economics*, 2014, (in print, available online)
- E. Štrumbelj., I. Kononenko. Explaining prediction models and individual predictions with feature contributions. *Knowledge and information systems*, 2014, vol. 41, no. 3, 647-665.
- M. Toplak, R. Močnik, M. Polajnar, Z. Bosnić, L. Carlsson, C. Hasselgren, J. Demšar, S. Boyer, B. Zupan, J. Stalring. Assessment of machine learning reliability methods for quantifying the applicability domain of QSAR regression models. *J. chem. inf. mod.*, vol. 54, no. 2, p.p. 431-441, Feb. 2014.