

# Laboratory for Cognitive Modeling

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## Research Activities

Laboratory for Cognitive Modeling (LKM) was officially founded in December 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. LKM collaborates with psychologists, physicians, biologists, physicists and chemists. A notable aspect of much of this research is its application to problems in picture analysis, medical diagnosis, ecological modeling, alternative medicine, studies of consciousness and manifestation of cognitive processes and consciousness through subtle energies.

## Teaching

The staff of LKM is engaged in teaching the following courses: Programming Languages, Artificial Intelligence Methods, Algorithms and Data Structures 1, Knowledge Engineering, Fundamentals of Algorithms and Data Structures 2, Database Systems 1 and 2, Introduction to Databases, Machine Learning (postgraduate), Data mining (postgraduate).

## Equipment

The computer equipment consists of a network of a dozen Windows NT, Windows 2000 and Linux-based personal computers and servers, and a laser jet printer. Besides we use a Crown-TV camera for Gas Discharge Visualization and a Microscope Olympus BX51 with digital camera.

## Projects and collaboration

*Knowledge synthesis from data and background knowledge:* Basic research project funded by Slovenian Ministry of Education, Science and Sports.

*Cost sensitive intelligent data analysis:* Postdoc research project funded by Slovenian Ministry of Education, Science and Sports.

*Intelligent data analysis in medicine:* Basic research project funded by Slovenian Ministry of Science and Technology.

Several applicative projects concerning intelligent data analysis and data mining.

Several applicative projects concerning the analysis of various subtle influences on human and plant GDV pictures.

### We collaborate with academic institutions:

Technical University SPIFMO, St. Petersburg, Russia,

University of Sydney, Australia,

University of Stuttgart, Germany,

Biotechnical Faculty, University of Ljubljana,

Faculty of Arts, University of Ljubljana,

FRI, Computer Vision Lab and Artificial Intelligence Lab.

We collaborate with research institutions:

Research Institute of Organic Agriculture, Frick, Switzerland,

Research Institute Aco de Paou, Valernes, France,

Institute for Bioelectromagnetics and New Biology BION, Ljubljana,

Jozef Stefan Institute, Ljubljana,

Clinic Center, Ljubljana.

## **Selected References**

I. Kononenko. Bayesian Neural Networks, *Biological Cybernetics Journal*, 61:361–370, 1989.

I. Kononenko. Estimating attributes: Analysis and extensions of RELIEF. In F. Bergadano, L. de Raedt (eds.), *Proc. European conference on machine learning*, Springer Verlag, 171–182, 1994.

I. Kononenko. Inductive and Bayesian learning in medical diagnosis. *Applied Artificial Intelligence*, 7:317–337, 1993.

I. Kononenko (ed.) *Information Society 2000: New Science of Consciousness – Proc. 3rd Int. Conf. on Cognitive science – ISBN 961-6303-27-9* (Ljubljana, 17–19 October 2000), Institut Jožef Stefan.

I. Kononenko: Machine learning for medical diagnosis: History, state of the art and perspective, Invited paper, *Artificial Intelligence in Medicine – ISSN 0933-3657*, 23(1):89–109, 2001.

I. Kononenko, I. Bratko. Information based evaluation criterion for classifier's performance. *Machine Learning Journal*, 6:67–80, 1991.

I. Kononenko, S.J. Hong. Attribute selection for modeling, *Future Generation Computer Systems – ISSN 0167-739X*, 13(2–3):181–195, 1997.

I. Kononenko, E. Šimec, M. Robnik. Overcoming the myopia of inductive learning algorithms, *Applied Intelligence*, 7:39–55, 1997.

I. Kononenko, T. Žrimec. Using machine learning to analyse GDV images: Current research and results, Invited lecture, *Proc. IFOAM-2000: 13th International IFOAM Scientific Conference – ISBN 3-7281-2754-X*, Basel, Switzerland, 28–31 August 2000, pp. 304.

M. Kukar, N. Bešič, I. Kononenko, M. Aursperg, M. Robnik-Šikonja. Prognosing the survival time of patients with the anaplastic thyroid carcinoma using machine learning, In: N. Lavraè et al. (eds) *Intelligent data analysis in medicine and Pharmacology – ISBN 0-7923-8000-2*. Kluwer Academic Publ., 1997.

M. Kukar, I. Kononenko. Cost-sensitive learning with neural networks, *Proc. European conf. on Artificial Intelligence ECAI-98 – ISBN 0-471-98431-0*, Brighton, August 1998, pp. 445–449.

M. Kukar, I. Kononenko, C. Grošelj, K. Kralj, J. Fettich. Analysing and improving the diagnosis of ischaemic heart disease with machine learning, *Artificial Intelligence in Medicine*, 16:25–50, 1999.

M. Kukar, I. Kononenko, T. Silvester. Machine learning in prognostics of the femoral neck fracture recovery, *Artificial intelligence in medicine – ISSN 0933-3657*, 8:431–451, 1996.

N. Lavrac, I. Kononenko, E. Keravnou, M. Kukar, B. Zupan: Intelligent data analysis for medical diagnosis: using machine learning and temporal abstraction, *AI Communications*, 11:191–218, 1999.

M. Robnik-Šikonja, I. Kononenko. An adaptation of Relief for attribute estimation in regression, *Proc. Int. Conf. on Machine Learning ICML-97 – ISBN 1-55860-486-3*, Nashville, July 1997, pp. 296–304.

M. Robnik-Šikonja, I. Kononenko. Attribute dependencies, understandability and split selection in tree based models, *Proc. Int. Conf. on Machine Learning ICML-99 – ISBN 1-55860-612-2*, Bled, 27–29 June 1999, pp. 344–353.

M. Robnik-Šikonja, I. Kononenko. Comprehensible interpretation of Relief's Estimates, *Proc. Int. Conf. on Machine Learning, ICML-01 – ISBN 1-55860-778-1*, Williams College, 28 June – 1 July 2001, pp. 433–440.

M. Robnik-Šikonja, I. Kononenko. Theoretical and Empirical Analysis of ReliefF and RReliefF, *Machine Learning Journal*, in press.

A. Trampuz, I. Kononenko, V. Rus. Experiential and biophysical effects of the Art of Living Programme, *Int. Journal of Psychology* – Abstracts of 27th Int. Congress of Psychology, Stockholm, 23–28 July 2000 – ISSN 0020-7594, 35(3/4)12.

D. Cukjati, M. Robnik-Šikonja, S. Reberšek, I. Kononenko, D. Miklavcic. Prognostic factors, prediction of chronic wound healing and electrical stimulation. *Medical & Biological Engineering & Computing*, 39, 542–550, 2001.