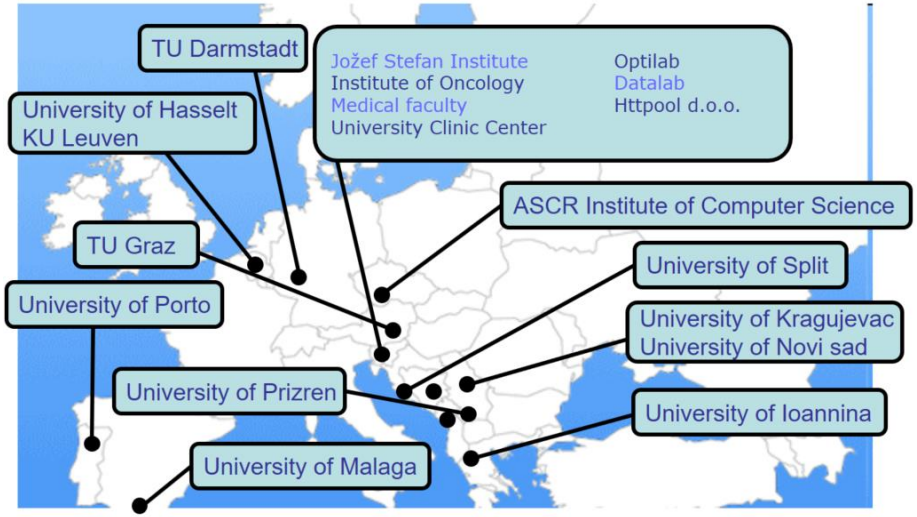
Who are we?

Laboratory for cognitive modeling (LKM) has 11 permanent members and several collaborators, and at any time also several students engaged in student research projects. LKM members are:

- **Igor Kononenko**, Ph. D., professor and head of the laboratory (machine learning and data mining, artificial intelligence methods, explanation and reliability of individual predictions, matrix factorization and deep neural networks, user profiling, recommender systems, applications),
- **Marko Robnik Šikonja**, Ph. D., professor (machine learning, data mining, data analytics, cognitive modeling, artificial intelligence, natural language processing),
- **Zoran Bosnić**, Ph. D., professor (learning from data streams , user profiling, e-learning, reliability estimation),
- **Matjaž Kukar**, Ph. D., associate professor (spatial data analysis, data stream mining, data mining in databases, reliability estimation, data mining applications in medicine),
- **Erik Štrumbelj**, Ph. D., associate professor (statistics , machine learning),
- **Petar Vračar**, Ph. D., teaching assistant, researcher (sports modeling in team sports),
- **Matej Pičulin**, Ph. D., teaching assistant (swarm intelligence, fuzzy rules),
- **Jana Faganeli Pucer**, Ph.D., researcher (analysis of ECG signals, modelling of air pollution),
- **Martin Jakomin**, junior researcher (matrix factorization, mining of data streams),
- **Gregor Pirš**, junior researcher (Bayesian statistics),
- **Tadej Škvorc**, researcher (natural language processing).

International Cooperation



University of *Ljubljana*
Faculty *of Computer and Information Science*

Laboratory for Cognitive Modeling

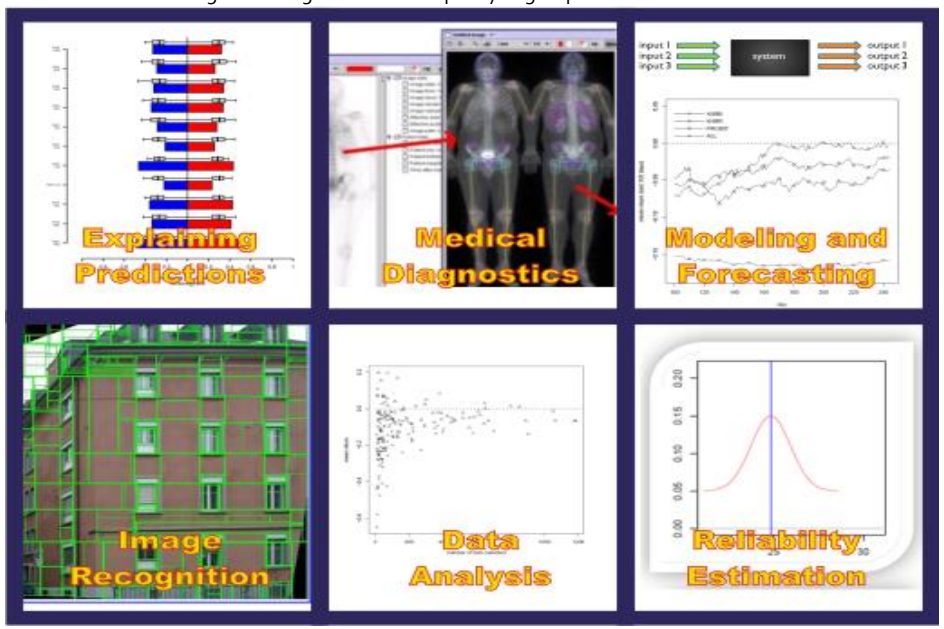
http://lkm.fri.uni-lj.si
lkm@fri.uni-lj.si

Večna pot 113
SI-1000 Ljubljana, Slovenia

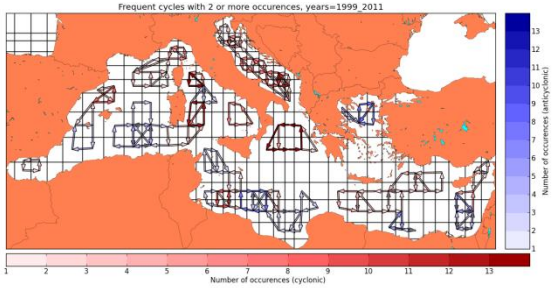
Phone: +386-1-4798-226

Laboratory for Cognitive Modeling (LKM)

LKM was established in 2001. As one of five laboratories constituting the Artificial intelligence department at the Faculty of computer and information science, we develop and apply state-of-the-art methods for data mining, data analytics, and big data. LKM members are (co)authors of over 360 scientific papers and 12 books. According to SCI database LKM members' research papers were cited over 2000 times which gives strong credits to the quality of group's work.



Research Interests



- machine learning and data mining,
- modeling of numerical, symbolic, spatial, graph, image and text data,
- big data analytics,
- estimation of data quality and data importance,
- statistical data analysis,
- interactions of various parameters,
- medical diagnostics, recommendation systems, e-learning, web user profiling, modeling of sport games, analysis of oceanographic data, modeling od air pollution, text summarization.

What can we do for you?

- **improve** your business by implementing business intelligence into your ERP and CRM systems,
- help **recognize behavior** of your clients and suit your services to them,
- **reduce costs** of your business by optimizing business processes,
- **consult and educate** in data storage, intelligent data analysis, and big data
- enable planning and **forecasting** of business success in the future,
- **explore factors** that influence your business success,
- ensure your advantage over business competitors by using **modern forecasting tools**.
- together with you, we develop a **recommender system,** a **model** of your processes with explanation and reliability of predictions.

Reference projects

Marketing data analysis

In cooperation with University of Hasselt, Belgium, we have developed a new approach to customer (dis)satisfaction analysis. The new method reaches beyond statistical analysis and correlations between product/service features and satisfaction. It allows introspection into feature dependencies and significance of individual scores as well as their visualization. We have successfully tested the method on customer satisfaction problems in electrical distribution, entertainment industry, and hi-tech product development. Application of the method is not limited to customer satisfaction problem, but can be used on any survey with graded answers.

Analysis of insurance portfolio

We have analyzed a portfolio of automobile insurance portfolio of a Slovene subsidiary of an international insurance company. We have detected shortcomings in their system of data collection and analysis as well as market opportunities and portfolio weaknesses. Similar analyses are possible for other insurance, stock-market or bank portfolios. Applications are possible in fraud detection, market opportunities search and improvement of business practices.

CRM for a major local mobile phone operator

Within the CRM portal, developed for a major local mobile phone operator, we developed and implemented various programmer- and user-friendly subsystems for data mining, building upon the Oracle Data Mining platform and Java object-oriented programming paradigm. Developed subsystems significantly shortened the development time, as they could be effectively used without extensive knowledge of data mining methods. Data analysts and end-users were able to easily build, apply, visualize, and validate models for subscriber behavior (especially churn).

Production process analysis

In a Swedish paper mill, they were trying to solve the problem of large amounts of crumpled (wrinkled) paper. The process outcome (percentage of wrinkled paper) was used as a guideline for building decision trees from the collected data. It became immediately obvious that a single parameter consistently occupied the root node of the decision tree. This parameter had the heaviest influence on the amount of wrinkled paper. If the value of the parameter was held within a certain interval, the amount of wrinkled paper was significantly lower than before. In the production process, the engineers started to observe the critical parameter and maintain its values in the pre-defined interval. This resulted in significantly reduced amounts of wrinkled paper and substantial savings in the production process.

Steel plants

In steel plants, measurements of the liquid steel are used to assess the steel quality and its future uses. The correct assessment is very important, as it influences the steel plant's income. Steel quality assessment is usually carried out by seasoned experts. Because experts are not always readily available (weekends, vacations, illnesses), and the production process must not stop, suboptimal decisions have been made in the past. From the past expert's assessments, a decision tree was constructed and evaluated. It turned out that on the independent data set it performed even better than experts. An expert system was developed and put to routine production use.

Medical diagnostics and prognostics

In contemporary medicine, diagnosis is the foundation of a successful treatment. The diagnosis is made by the physician, according to the patient's signs, symptoms and diagnostic test results (lab tests, x-ray, ultrasound, other image modalities). A similar problem is prognostics, where the physician forecasts the course of the disease. Based on the records of the patients treated in the same hospital for the same (or similar) disease, machine learning methods can be used to induce knowledge (trees, rules) useful for diagnosing (or prognosing) new patients. The induced knowledge may be used as an explanation for diagnoses, and provide insight into the diagnostic problem. Tools based on induced knowledge are also used to assist medical students and inexperienced physicians.

Classification of images

We developed two expert systems for supporting medical decisions from scintigraphic images (myocardial perfusion scintigraphy and whole-body scintigrams - for University Medical Centre in Ljubljana) and an expert system for classification of corona types (for the University of St. Petersburg).

Analysis of sport betting markets

For one of the main players in technical betting we have analyzed the organized sport betting market. As a result, we developed some new predictive models for specific bet types and found market niches based on market efficiency. Since sport betting market is a twin brother of stock-market, similar analyses are possible for stock-markets, in particular currency exchange rates and other derivative financial instruments.