

Lucian Blaga University of Sibiu, Romania
Faculty of Sciences
Department of Mathematics and Informatics

MDIS 2013 - SIBIU

**Third International Conference on
Modelling and Development of Intelligent Systems**

October 10 –12, 2013
Sibiu, Romania

**Third International Conference on
Modelling and Development of Intelligent Systems**
October 10 - 12, 2013, Sibiu, Romania

Editor: Lecturer Cristina Răulea

PREFACE

The aim of the conference is to bring together computer scientists, mathematicians, researchers and students working in fields which can be connected with modeling and development of intelligent systems.

The topic of the conference includes but is not limited to the following subjects:

- Evolutionary computing
- Grid computing and clustering
- Data mining
- Ontology engineering
- Intelligent systems for decision support
- Knowledge based systems
- Pattern recognition and model checking
- Motion recognition
- Hybrid computation for artificial vision
- Knowledge reasoning for artificial vision
- Geometric modelling and spatial reasoning
- Modelling and optimization of dynamic systems
- Large scale optimization techniques
- Adaptive systems
- Multiagent systems
- Swarm intelligence
- Metaheuristics and applications
- Machine Learning
- Mathematical models for development of intelligent systems

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Specialists from Bulgaria, Germany, Greece, Romania, Republic of Moldova, Serbia, Syria, United States, Ukraine joint together to this third edition of the conference to present and to discuss recent problems on mathematical models, design, development and applications of intelligent systems.

The conference's papers were reviewed by two independent reviewers and will be published in a proceedings volume edited by Lucian Blaga University Press. The proceedings will be indexed by Mathematical Review and Zentralblatt.

Conference Chair
Prof. PhD. Dana Simian

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- Assist. Laura Stoica, "Lucian Blaga" University, Sibiu, Romania
- Assist. Cristina Cismas, "Lucian Blaga" University, Sibiu, Romania

OFFICIAL LANGUAGE

The official language of the Conference is English.

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OUTLINE CONFERENCE PROGRAM

Thursday, 10 October 2013	
$8^{30} - 9^{00}$	Registration (Room A18 [*])
$9^{00} - 9^{15}$	Opening ceremony (Room A18)
$9^{15} - 9^{45}$	Plenary lecture George Elefterakis
$9^{45} - 10^{15}$	Plenary lecture Milan Tuba
$10^{15} - 10^{40}$	Presentation from Company Ropardo by Gabriela Cîndea
$10^{40} - 11^{00}$	Coffee break
$11^{00} - 12^{40}$	Session 1, Room A18 chairman Dana Simian
$12^{40} - 15^{00}$	Lunch (University Canteen)
$15^{00} - 16^{40}$	Session 2, Room A18 chairman Kiril Alexiev
$16^{40} - 17^{00}$	Coffee break
$18^{00} - 23^{00}$	Official dinner (Restaurant <i>Gallant</i> , Victoriei Bd., No.55, Sibiu)
Friday, 11 October 2013	
$9^{00} - 9^{30}$	Plenary lecture Ioana Moisil, Room A18
$9^{30} - 11^{10}$	Session 3, Room A18 chairman Milan Tuba
$11^{10} - 11^{20}$	Coffee break
$11^{20} - 13^{40}$	Session 4, Room A18 chairman Florin Stoica
$14^{30} - 18^{00}$	Trip to Astra Museum and Dumbrava (departure from the Faculty of Sciences)

^{*} Room A18 is situated in the building of Faculty of Sciences, I. Ratiu Str, No. 5-7.

PAPERS PRESENTATION

(ROOM A18)

THURSDAY, October 10, 2013

9¹⁵ – 9⁴⁵ **Plenary Lecture Prof. PhD. George Elefterakis, *The Challenge of Emergent Phenomena in Emergent Applications Software***

9⁴⁵ – 10¹⁵ **Plenary Lecture Prof. PhD. Milan Tuba, *Swarm Intelligence Optimization Algorithms in Image Processing***

10¹⁵ – 10⁴⁰ **Presentation from Company Ropardo by Gabriela Cîndea**

Session 1 **Chairman Prof. PhD. Dana Simian**

11⁰⁰ – 11²⁰ *Inertial Measurement Unit Simulator*, Kiril Alexiev

11²⁰ – 11⁴⁰ *Algebraic model for the CPU arithmetic unit behavior*, Anca Vasilescu

11⁴⁰ – 12⁰⁰ *Theoretical and practical approaches for time series prediction*, Alina Bărbulescu, Dana Simian

12⁰⁰ – 12²⁰ *Knowledge about replenishable resources: the dynamics of unemployment and job creation*, Klaus Bruno Schebesch, Dan Stelian Deac

12²⁰ – 12⁴⁰ *A Method for Sampling Random Databases with Constraints*, Letiția Velcescu, Dana Simian, Marius Marin

Session 2 **Chairman: Prof. PhD. Kiril Alexiev**

15⁰⁰ – 15²⁰ *Approximation of bivariate functions by truncated classes of operators*, Octavian Agratini, Saddika Tarabie, Radu Trâmbițaș

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- 15²⁰ – 15⁴⁰ *Detecting influenza epidemics based on real-time semantic analysis of Twitter data*, Radu Balaj, Adrian Groza
- 15⁴⁰ – 16⁰⁰ *A Better Genetic Representation of a Fuzzy Controller Enabling the Determination of Its Parameters with the Help of a Genetic Algorithm*, Stelian Ciurea
- 16⁰⁰ – 16²⁰ *A Second Order-Cone Programming Formulation for Simple Assembly Line Balancing Problem*, Vasile Moraru, Sergiu Zaporozjan
- 16²⁰ – 16⁴⁰ *Splitting the structured paths in stratified graphs*, Daniela Danciulescu, Nicolae Tandareanu

FRIDAY, October 11, 2013

- 9⁰⁰ – 9³⁰ **Plenary Lecture Prof. PhD. Ioana Moisil, *Scheduling Algorithms. A review***

Session 3 Chairman Prof. PhD. Milan Tuba

- 9³⁰ – 9⁵⁰ *Using ATL model checking in agent-based applications*, Laura Florentina Stoica, Florin Stoica, Florian Mircea Boian
- 9⁵⁰ – 10¹⁰ *Computational intelligence in medical data sets*, Ionela Maniu, George Maniu, Daniel Hunyadi
- 10¹⁰ – 10³⁰ *The dangers of Social Media. A case study on children age 10 to 12*, Alina Elena Pitic, Ioana Moisil, Călin Bucur
- 10³⁰ – 10⁵⁰ *Methodological Framework for Creating a Workflow Model when Processing Data Research*, Alexandra-Mihaela Pop, Ioan Pop
- 10⁵⁰ – 11¹⁰ *Evaluating the Similarity between Unstructured Text Data*, Ahmad Rawashdeh, Anca Ralescu

Session 4 Chairman Lecturer PhD. Florin Stoica

- 11²⁰ – 11⁴⁰ *Comparative Study in Building of Associations Rules from Commercial Transactions through Data Mining Techniques*, Adrian Mircea Muşan, Ionela Maniu

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- 11⁴⁰ – 12⁰⁰ *Formal instruments used to describe economic processes*, Cristina Popenta
- 12⁰⁰ – 12²⁰ *Computerized systems for employment vacancies*, Cristina Răulea, Ciprian Răulea
- 12²⁰ – 12⁴⁰ *Adaptive Time Discretization for Retarded Potentials*, Alexander Veit
- 12⁴⁰ – 13⁰⁰ *An intrinsic approach for problems arising in potential theory*, Corina Simian
- 13⁰⁰ – 13²⁰ *Example of developing a loyalty program using CRM, SQL-queries and Rapid Miner tool*, Iryna Zolotaryova, Iryna Garbuz, Mykhailo Dorokhov
- 13²⁰ – 13⁴⁰ *A new approach in e-commerce applications by using modern technologies for web*, Livia Sângeorzan, Emanuela Petreanu, Claudia Cârstea, Nicoleta Enache-David

ABSTRACTS

Plenary Lecturer

The Challenge of Emergent Phenomena in Emergent Applications Software

George Eleftherakis

In the last few decades the application of distributed solutions to computerized systems has expanded to a variety of new domains, facing a growing number of users that demand more advanced services leading to emergent applications software. Present systems are not trustworthy, and this together with the predicted rise of complexity is going to lead us to an enormous increase of the cost aiming to build trustworthy systems. Combined with the vision of the Internet of things, and visions from leading companies like IBM's smarter planet, as well as the introduction of service oriented computing, cloud computing and similar technologies, has imposed a considerable strain on the design and operational performance of distributed systems. Consequently, the architectures upon which distributed systems are built have moved from the initial centralized structured approaches, to more decentralized solutions that avoid the single point failure problem and offer better utilization of network resources. Moreover, unstructured approaches, where the overlay network follows a random graph distribution, have been introduced in order to cope with churn, heterogeneity, as well as to avoid the topology constraints which create significant problems in open dynamic environments that utilize structured architectures. Latest research efforts have concentrated on developing hybrid solutions which combine different paradigms in terms of decentralization and structure.

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In this context, many novel approaches have used biological systems as inspiration in the design of artificial distributed systems aiming for solutions to various problems and challenges encountered. The rationale for looking in nature for inspiration is based on the notion that the structure, the behaviours of individuals and the laws that govern their interactions in decentralized biological systems existing in nature seems to solve seamlessly and effortlessly problems common in open distributed ICT systems. Large scale biological collectives like ant colonies and termite hives have shown a remarkable ability to produce a variety of useful behaviours including availability, scalability, self-organization and adaptation in a fully decentralized manner.

Emergence is known to be the enabler for a variety of beneficial properties in natural systems. Adaptability, scalability and robustness, as well as a multitude of self-* properties, have been shown to emerge out of simple interactions at the microscopic level of a system. Distributed systems are particularly well suited to hosting emergent phenomena especially in cases where the individual nodes possess a high degree of autonomy and the overall control tends to be decentralized. Being able to engineer macroscopic behaviours in distributed systems by introducing behaviours and interactions of individual nodes inspired by systems found in nature could greatly assist with managing the complexity inherent into artificial distributed systems.

This talk is discussing the challenge of emergent phenomena, either positive or negative towards the behaviour of the system, in emergent applications software, and identifies some possible research direction towards harnessing emergent phenomena in engineered systems.

Plenary Lecturer

Swarm Intelligence Optimization Algorithms in Image Processing

Milan Tuba

Image processing is one of the most applicable scientific areas; it has been widely used in medicine, astronomy, quality control, security etc. Image processing is a large collection of very different techniques. The only common element is the digital image itself, while low level signal processing, medium level morphological processing and segmentation for feature detection and high level artificial intelligence algorithms for object recognition, information extraction, representation and understanding, belong to completely different areas. On these different stages of image processing some hard optimization problems occur. For example, multilevel image thresholding is a step in segmentation, but even though this problem at first sight seems to be simple, to determine optimal n numbers in the range 0-255 is NP-hard combinatorial problem. Such hard optimization problems have been recently successfully solved using nature inspired metaheuristics. Swarm intelligence is an important branch of this class of nondeterministic optimization methods. Here we present successful application of the latest swarm intelligence algorithms: Firefly algorithm, Cuckoo search and Bat algorithm to multilevel image thresholding.

Plenary Lecturer
Scheduling Algorithms. A review

Ioana Moisil

Scheduling is one of the most complex topics that appear in almost all fields of activity, from scientific research to industrial applications. As most of the complex problems, scheduling is still a challenge for researchers, especially for those involved in optimization studies. In this contribution, after introducing the classification of scheduling problems, I will briefly present classical scheduling algorithms for solving single machine problems, parallel machine problems, and shop scheduling problems. Aspects concerning polynomial algorithms, procedures based on dynamic programming, combinatorial optimization and computational complexity will also be discussed. In the last part of the paper I will present some metaheuristic algorithms that are widely used in solving scheduling problems. The results of a computational study using metaheuristics i.e. an adaptive Ant Colony Optimization algorithm for the Resource-Constrained Project Scheduling will also be presented.

**Approximation of bivariate functions by truncated classes of
operators**

Octavian Agratini, Saddika Tarabie, Radu Trâmbițaș

The current research is focused on constructing tools for modelling and analysis of changes in motion perception that occur with age. Created software tools allow conducting psychophysical experiments for estimating the sensitivity to motion

direction of two age groups. The results were analysed and compared to evaluate the major changes in cognition with age. The differences in visual motion integration and in the decision-making strategies were assessed by a procedure for objective scenario estimation. In the framework of this procedure a trajectory detector estimates and classifies useful statistics for each test. A special measure is proposed for estimation of the temporal characteristics of the random scenario that determines the correctness of observer's decision. The interpretation of the results reveals new information about the age-related characteristics of visual processing of motion information. Moreover, it allows detecting subjects with significant degradation of visual processing.

Inertial Measurement Unit Simulator

Kiril Alexiev

During the last few years microminiaturized inertial sensors were introduced in many applications. Their small size, low power consumption, rugged construction open doors to many areas of implementation. The main drawback of these sensors is the influence of different type of errors, leading to an unavoidable wrong position and orientation estimation. In the paper a simulator of Inertial Measurement Unit is proposed. The simulator is a tool for assistance of trajectory set up and on the base of input data it generates IMU output according given error/noise parameters. It allows us to simulate different types of IMUs based on prior knowledge of the IMU error's properties. One of the main goals in developing of the simulator is to validate new methods involving inertial technology. Something more, the simulator is an excellent tool for tuning complex filtering procedures and enhancing navigation accuracy. The simulation of different scenarios gives more information to receive better understanding of the weight of different sensor noises and errors on the final results.

Detecting influenza epidemics based on real-time semantic analysis of Twitter data

Radu Balaj, Adrian Groza

This research presents a method for detecting influenza rates in a geographical region, using the information that can be extracted from Twitter messages. The novelty of this approach consists in using semantic technologies for this task. In order to analyze the data in a medical context, the content of a Twitter post is transformed into the RDF stream format and queried as such using the C-SPARQL query language. The work presented is based on a novel approach in computer science called stream reasoning.

Theoretical and practical approaches for time series prediction

Alina Bărbulescu, Dana Simian

The goal of this paper is to discuss two different modern approaches for modeling and prediction of time series – neural networks and support vector machine. It is known that the performances of different approaches from machine learning field are strongly dependent on data. We apply and evaluate our methods on six different real meteorological series. We address in our study improved adaptive Gene Expression Programming (GEP) and Support Vector Regression (SVR). In order to increase the SVR performances we develop a method for obtaining an optimal multiple kernel.

A Better Genetic Representation of a Fuzzy Controller Enabling the Determination of Its Parameters with the Help of a Genetic Algorithm

Stelian Ciurea

Since 1975, fuzzy controllers have fully proved their usefulness in the most diverse applications. The design of such a controller involves setting up inference rules and values for a large number of parameters. There are situations where this is possible either through the expertise of a human operator or through a knowledge stock. If we cannot rely on such information, genetic algorithms are a good alternative to determine these values. The first condition in solving a problem by means of a genetic algorithm is the genetic representation of the solution. In this paper, we present the genetic algorithm that we designed with a view to determining the parameters of a fuzzy controller for the Truck Backer-Upper Problem (this problem is considered an acknowledged benchmark in nonlinear system identification). The genetic representation used in this algorithm belongs to us.

Splitting the structured paths in stratified graphs

Daniela Dănciulescu, Nicolae Țăndăreanu

The concept of stratified graph introduce some method of knowledge representation ([6], [4]). The inference process developed for this method uses the paths of the stratified graphs, an order between the elementary arcs of a path and some results of universal algebras. The order is defined by considering a structured path instead of a

regular path. In this paper we give two splitting properties. First property shows that every structured path can be uniquely decomposed by means of two structured subpaths. A similar decomposition is shown for the accepted structured paths. The decomposition of the accepted structured paths is used to define the inference process allowed by a stratified graph. This process is restated in the vision of the new results presented in this paper. This description is included in a separate section, where we define the concept of knowledge processing system based on stratified graphs. We give a formalism for the inference process in such systems.

Computational intelligence in medical data sets

Ionela Maniu, George Maniu, Daniel Hunyadi

In recent years, collection of data, regardless of the field, has become a normal phenomenon. In the activity and evolution of an organization is imperative to take into account the data collected in order to achieve decision process. As the volume and complexity of data are in constant growth is necessary to use intelligent methods and fundamental tools for storing, processing, filtering and obtaining information from these data.

A Second Order-Cone Programming Formulation for Simple Assembly Line Balancing Problem

Vasile Moraru, Sergiu Zaporojan

The paper discusses the numerical solving of a task known as the Simple Assembly Line Balancing Problem (SALBP-I). In this context, a model based on the Second-Order Cone Programming it is proposed.

Comparative Study in Building of Associations Rules from Commercial Transactions through Data Mining Techniques

Adrian Mircea Musan, Ionela Maniu

In this paper we built a range of of data mining processes, programmed with the help of RapidMiner to generate association rules extracted from data sets representing commercial transactions. The specific statistical operations, we analyzed performances of data mining algorithms used in the construction of processes.

The dangers of Social Media. A case study on children age 10 to 12

Alina Elena Pitic, Ioana Moisil, Călin Bucur

Important legislative initiatives try to protect the children from the dangers of Social Media. One example is COPA - The Children's Online Protection Act, a law addressed to children under 13 years old. However, millions of children below 13 are active users of Social Media nowadays. We show some of the dangers the children are exposed and we try to propose some safe alternatives. We present some initial results from an ongoing study, started in the late 2012. We ask the pupils from some primary schools from Sibiu questions about how they perceive the Social Networks and about their on-line behavior.

Methodological Framework for Creating a Workflow Model when Processing Data Research

Ioan Pop, Alexandra-Mihaela Pop

In this article we present a methodological approach for creating workflow models. Using a workflow model for data processing research can be considered a tool for quantitative management into project. The advantage of the approach of a workflow model in the research is that the data collected by investigating a large population studied, is processed automatically, dynamically and executed with real-time machine learning methods. In practice, this approach leads to the enrichment of the "Project Management Body of Knowledge". Also the methodological framework can serve as

a tool to initiate and train students interested in developing research projects. The article describes a scenario for creating a workflow model for communication management.

Formal instruments used to describe economic processes

Cristina Popența

An economic model is a description of real economy, explaining economy's evolution in a certain period of time, starting from simplification and abstraction of observed data. No matter how complicated they are, economic models can only subjectively describe the real phenomena. But the processes of constructing, testing and improving economic models make a more precise description of reality and help in understanding the long time evolution of economy.

Evaluating the Similarity between Unstructured Text Data

Ahmad Rawashdeh, Anca Ralescu

Similarity evaluation between unstructured data poses particular challenges, including that of feature selection. This study integrates natural language processing for word extraction and tagging with Wordnet hierarchies in order to encode a text into a real valued vector. Cosine similarity is then applied to such vectors in order to evaluate similarity between the original texts. Experimental results obtained in the evaluation the similarity between Facebook profiles demonstrate the effectiveness of this approach.

Computerized systems for employment vacancies

Cristina Răulea, Ciprian Răulea

This article is based on a study conducted by „Lucian Blaga” University of Sibiu in September, October, November 2012, on a population sample of 1180 unemployed, registered in the counties of Sibiu, Hunedoara, Satu-Mare, Dâmbovița and Vaslui to highlight whether they use information technologies and communication in order to find vacancies or accessing various profile sites to submit their CVs, which can be taken by employers interested.

A new approach in e-commerce applications by using modern technologies for web

**Livia Sangeorzan, Emanuela Petreanu, Claudia Carstea,
Nicoleta Enache-David**

It is a fact that the field of informatics is extremely dynamic. Producers and users of software products are looking solutions to the multitude of problems they are confronted with. Everybody who wants to solve their shopping needs must access an online application and if possible, by just giving a mouse click. This paper presents some new approach, using modern technologies for the web, to resolve their needs as quickly as possible and to anticipate future wish lists for the purchaser. Services Oriented Architecture (SOA) could be such a solution and also a multi agent system.

Knowledge about replenishable resources: the dynamics of unemployment and job creation

Klaus Bruno Schebesch, Dan Stelian Deac

Defined in a general way resources are meant to enable the functioning of complex systems like human societies or biological and techno-economical networks. Apart from the primary inputs to such systems like raw materials, energy, raw information and finance there are a series of embedded or derived complex resources like housing, education and jobs which provide pivotal services. The latter may be often characterized by knowledge production and, on a more fundamental level, by time delays in otherwise quasi-continuously acting dynamical environment. We propose to analyze the role of time delays in order to better understand the dynamics of unemployment and job creation. Temporary and permanent jobs are highly context and delay-sensitive replenishable resources. Misunderstanding their dynamics can cause high and long lasting societal costs.

An intrinsic approach for problems arising in potential theory

Corina Simian

Efficient software simulation of real phenomena requires accurate mathematical models to describe them. Models of various phenomena from electromagnetism, gravitational potential, heat conduction, fluid flow, elasticity, water waves, etc are based on partial differential equations. The difficulties that arise in finding analytical solutions of these equations lead to the necessity of discretization, finite element

method being one of the most powerful and used method for this purpose. When the physical quantities of interest are not the primary unknown of the differential equation describing the problem but some derivative of it (like some partial derivative, gradient, symmetric gradient, etc.) their computation requires additional numerical differentiation which leads to a loss of accuracy. The aim of this article is to present an intrinsic discretization approach for the direct computation of the fluxes in potential theory problems (electric, magnetic and gravitational potential problem). We develop local conditions for the approximation of the gradient vector field and then develop conforming and nonconforming finite element spaces of any degree directly from these conditions. We perform an error analysis and prove that, for the nonconforming case, the weak compatibility conditions imposed at the interfaces between elements of the mesh lead to an optimal order of convergence. We exemplify method on a practical problem.

Using ATL model checking in agent-based applications

Laura Florentina Stoica, Florin Stoica, Florian Mircea Boian

Verification of a model executes an exhaustive search of errors in the state-space of the model, in order to verify that this model satisfies the correctness requirements. This search can be accomplished automatically, providing the answer if the verified requirement is satisfied within the model or is appearing a violation. In this paper we present an advanced technique to verify JADE software agents, using Alternating-time Temporal Logic. The proposed solution is based on our original ATL model checker.

Algebraic model for the CPU arithmetic unit behavior

Anca Vasilescu

Modern computer systems are regarded as a sum of interconnected and communicating resources. Both the design and the operation of each of these resources, and the global behaviour and performance of the entire computer system are equally important. This approach points to a component-based analysis and development of such systems, each component being able to be specified and verified as a specific agent. Formal methods represent a reliable solution for systematically and exhaustively studying the specific agents involved in describing computer components behaviour, providing the appropriate tools for both the agents' environment modeling and the target agents' properties formal verification.

An algebraic formal framework for modelling the interconnecting processes involved in the agents' description is advanced here using the SCCS process algebra and its corresponding automatic verification benchmark, CWB-NC. In this paper we add a new component model to our formal framework by considering the CPU arithmetic unit. The original approach followed in the present paper consists in developing an SCCS based algebraic model for the arithmetic unit behaviour. The authors' contributions are both the definitions of the SCCS agents for modelling the target behaviour and the proofs for the bisimulation equivalence between those agents. Adding these results to other similar results obtained in our framework, we have important prerequisites in the future work for modelling the behaviour of the entire ALU consisting of arithmetic unit, logic unit and specific control circuits.

Adaptive Time Discretization for Retarded Potentials

Alexander Veit

We consider retarded boundary integral formulations of the three-dimensional wave equation in unbounded domains. Our goal is to apply a Galerkin method in space and time in order to solve these problems numerically. In this approach the accurate computation of the system matrix entries is the major bottleneck. In order to simplify the arising quadrature problem we use globally smooth and compactly supported basis functions for the time discretization. This furthermore easily allows the use of a variable time-stepping and a variable order of the approximation in time.

In order to obtain a scheme that automatically adapts the time grid to local irregularities of the solution we use suitable a posteriori error estimators. Various numerical experiments show the behavior of the adaptive algorithm.

A Method for Sampling Random Databases with Constraints

Letiția Velcescu, Dana Simian, Marius Marin

In this article, we propose a method for sampling the contents of random databases. This type of database is important either in modeling uncertainty or storing data whose values follow a probability distribution. Such uncertain or random data appear in a variety of scientific fields. In order to perform analysis or validate the properties of these databases it is useful to have samples of their instances. Our work introduces a formalization of relations in databases, which will provide a sound basis for the sampling algorithms that we will present. We classified the categories of atomic

constraints and focused on them, thus obtaining algorithms that ensure that data satisfy each class of constraints defined in the database. For the modeling of the external constraints, our approach uses the graph theory. We illustrate the importance of the algorithm in the case of generating surface data.

Example of developing a loyalty program using CRM, SQL-queries and Rapid Miner tool

Iryna Zolotaryova, Iryna Garbuz, Mykhailo Dorokhov

The object of paper is the implementing of loyalty programs using methods for intelligent processing of information and analysis the effectiveness of such a program. The subject is researching the loyalty program effectiveness based on Data Mining for the company "Auto-Maximum". The aim is to study the effectiveness of loyalty program based on Data mining. Results of performance are analyzed and described concept of direct marketing and loyalty programs features, research loyalty program development tools and algorithms for data mining. The results can be used in research institutions different companies that are aimed at marketing.

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