BNAIC 2011
The 23rd Benelux Conference on Artificial Intelligence

PROGRAMME

Patrick De Causmaecker, Joris Maervoet, Tommy Messelis, Katja Verbeeck, Tony Wauters

Contents

Preface

On behalf of the *Combinatorial Optimisation and Decision Support Group* (CODeS, `http://www.kuleuven-kortrijk.be/CODeS/`) we would like to welcome you all at the *Technology Campus of KAHO Sint-Lieven in Ghent*, to join us for the 23rd annual Benelux Conference on Artificial Intelligence (BNAIC 2011).

As is the case for Artificial Intelligence itself, this year's venue has a rich history in innovative activities. Two hundred years ago, this area, called Rabot, was the scene for the flourishing cotton industry in Ghent. One century later, the textile industry began to suffer. Three schools that had until then been eductating high level technicians to the Flemish industry joined forces in 1977 and the site was being rebuilt and renovated into a Catholic school for technical engineering. The school has since kept expanding in size as well as in subjects. Today KAHO Sint-Lieven is to be situated at different locations and offers professional and academic bachelor and master programs in such a wide variety of topics as industrial sciences and technology, biotechnology, healthcare, education, commercial sciences and business administration. Besides, our Technology Campus hosts different internationally recognised research labs in industrial topics such as the Laboratory for Light and Lighting Technology and the Brewery Laboratory. Since 2002, KAHO is part of the K.U.Leuven Association. The CODeS research group, a subgroup of the Computer Science Department of K.U.Leuven is situated both at the KAHO Technology Campus in Ghent, and at the KULAK Campus in Kortrijk (ITEC-IBBT-K.U.Leuven, `http://www.kuleuven-kortrijk.be`). The group investigates the construction, the behaviour and the application of metaheuristics for combinatorial optimisation, centralised and distributed, at the common frontier of artificial intelligence and operational research.

This year's edition again shows that Artificial Intelligence is a very lively research area in the Benelux with very active research groups and a very broad range of topics, among others: machine learning, intelligent agents, metaheuristics and optimisation, semantic web, logic and formal reasoning, data mining. In total, we have received 110 papers, 60 of which were category A papers, 43 were short abstracts of work already published elsewhere and 7 demonstrations. After reviewing, our program and organizing committee decided to accept 57 papers for oral presentation, 31 papers for poster presentation and 7 demonstrations. On top of this, we have the pleasure to announce two most interesting invited speakers. Prof. Michael Trick from the Tepper School of Business, Carnegie Mellon, will give a talk entitled *Adventures in Sports Scheduling and Trends in Operations Research* and Prof. Tony Belpaeme from the Centre for Robotics and Neural Systems at the University of Plymouth will present his work on *Artificial Cognition through Robotics*.

We sincerely would like to thank our sponsors for their generosity, the help of BNVKI, our local organisation team and the program committee. But the conference could not exist without the inspiring work of all authors and participants, the enriching input of invited speakers and the whole thinking audience. We do hope to present you a nice piece of A.I. in combination with a nice piece of Ghent. Enjoy!

Patrick De Causmaecker
Katja Verbeeck
Joris Maervoet
Tommy Messelis

Ghent, November 2011

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Joris Maervoet	CODeS, KaHo Sint-Lieven, Belgium
Tommy Messelis	CODeS, K.U.Leuven Campus Kortrijk, Belgium

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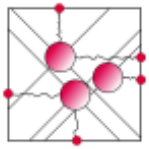

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www.unimaas.nl/bnvki

Wi-Fi access

- SSID: BNAIC2011
- Password: WelkomopKAHO

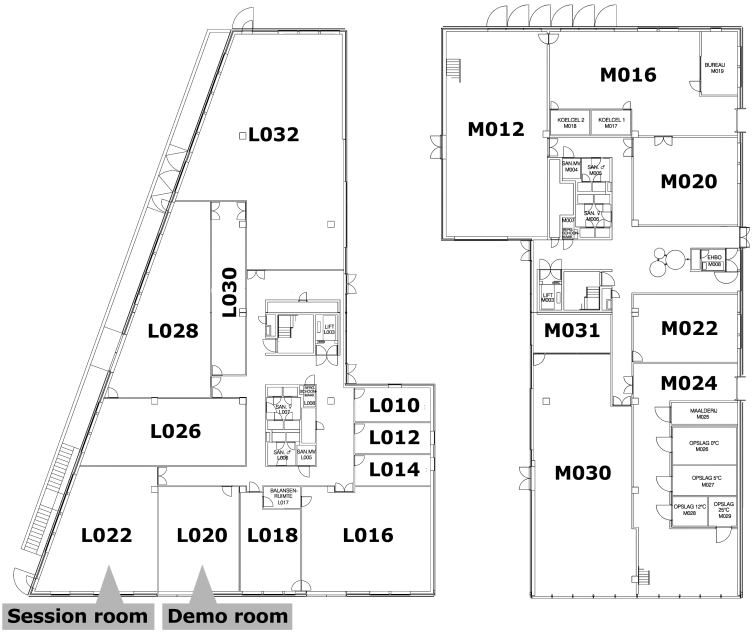
Maps

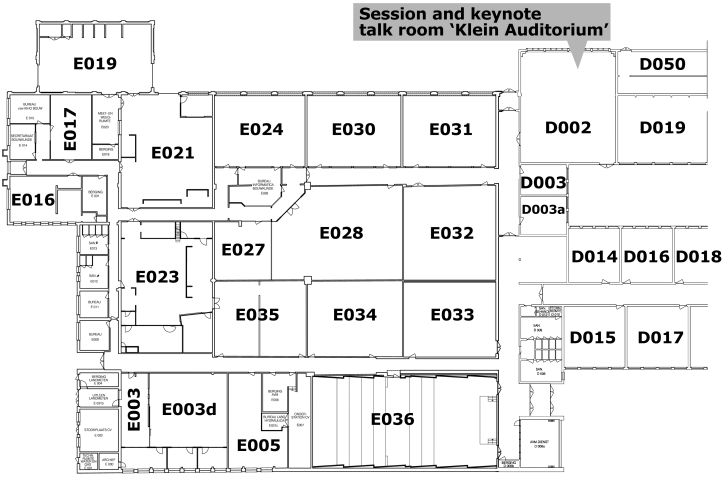
Main locations

- Conference venue: L & M buildings Technologiecampus Gent, Gebroeders De Smetstraat 1, 9000 Gent
- Conference dinner site: Monasterium Poortackere, Oude Houtlei 56, 9000 Gent (The unique location was sponsored by D-CIS LAB.)

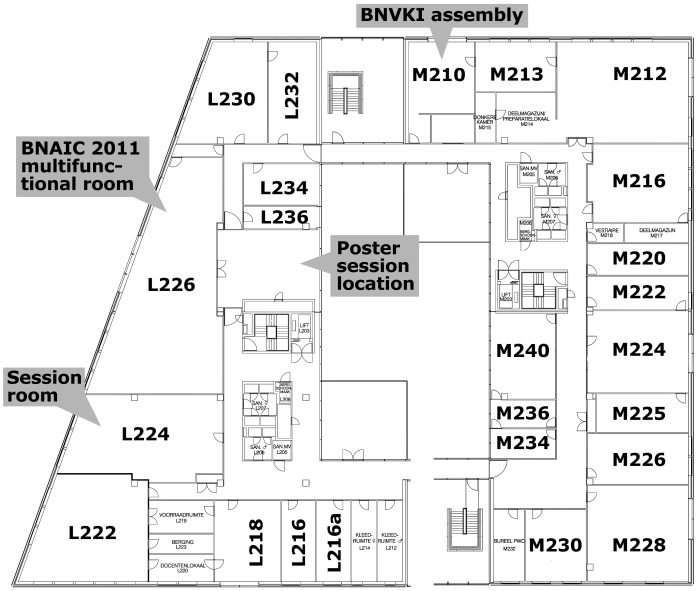
Map of Technologiecampus Gent

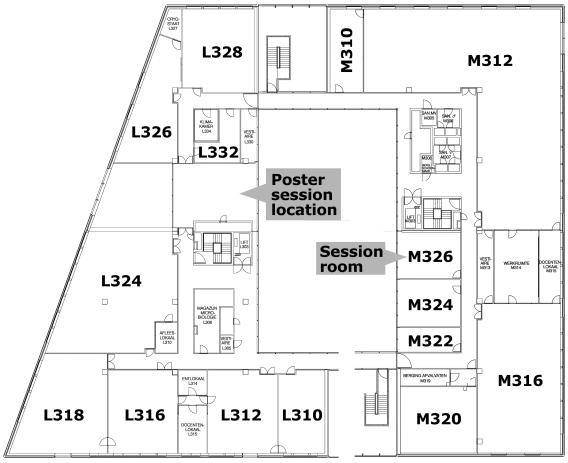
Ground floors L & M building and E & D building





Second and third floor L & M building





Programme Overview

	Wednesday, 2 November 2011		
19:30 - ...	**Preregistration event**		
	Thursday, 3 November 2011		
8:30 - 9:30	Registration *(L226)*		
9:30 - 9:45	Opening *(L226)*		
9:45 - 10:45	**Metaheuristics and Optimization 1** *(L022)*	**Logic and Formal Reasoning 1** *(L224)*	**Semantic Web 1** *(M326)*
10:45 - 11:15	Coffee break *(L226)*		
11:15 - 12:35	**Machine Learning 1** *(L022)*	**Multi-Agent Learning 1** *(L224)*	**Natural Language Processing** *(M326)*
12:35 - 14:00	Lunch and **Poster Session 1** *(L226)*		
14:00 - 15:00	**Keynote talk Tony Belpaeme** *(Klein Auditorium)*		
15:00 - 16:20	Coffee break *(L226)*		**Demo Session** *(L020)*
16:00 - 17:20	**Metaheuristics and Optimization 2** *(L022)*	**Intelligent Agents** *(L224)*	
17:30 - 19:00	City Tour in Ghent		
19:30 - ...	**Conference Dinner** *(Monasterium)*		

	Friday, 4 November 2011		
8:30 - 9:30	Registration *(L226)*		
9:30 - 10:30	**Keynote Talk Michael Trick** *(Klein Auditorium)*		
10:30 - 11:00	Coffee Break *(L226)*		
11:00 - 12:30	**Logic and Formal Reasoning 2** *(L022)*	**Multi-Agent Learning 2** *(L224)*	**Data Mining** *(Klein Auditorium)*
12:30 - 14:00	Lunch and **Poster Session 2** *(L226)*		
13:30 - 14:30	BNVKI Assembly *(M210)*		
14:00 - 15:00	**Machine Learning 2** *(L022)*	**Applications** *(L224)*	**Semantic Web 2** *(M326)*
15:00 - 16:00	**Machine Learning 3 and KION presentation** *(L022)*	**Metaheuristics and Optimization 3** *(L224)*	**Games** *(M326)*
16:00 - 16:15	Coffee break *(L226)*		
16:15 - 16:45	**Award Session and Closing** *(L226)*		

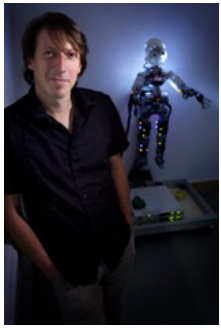
Invited Talks

Adventures in Sports Scheduling and Trends in Operations Research
Prof. Michael Trick
Friday, 4 November 2011 — 9:30 - 10:30 — Klein Auditorium

Major League Baseball is a multi-billion dollar per year industry that relies heavily on the quality of its schedule. Teams, fans, TV networks, and even political parties (in a way revealed in the talk) rely on the schedule for profits and enjoyment. Only recently have the computational tools of operations research been powerful enough to address the issue of finding "optimal" schedules. I'll discuss my experiences in scheduling college basketball, major league baseball, and other sports, and discuss major trends in optimization that lead to practical scheduling approaches, with some of these trends only appearing in the last two years.

Bio. Michael Trick is Professor of Operations Research and Associate Dean, Research at the Tepper School of Business, Carnegie Mellon, where he has been on faculty since 1989. His research interests are in sports scheduling, integer and constraint optimization, and social choice. In 2002 he was President of the Institute for Operations Research and the Management Sciences (INFORMS) and is a Fellow of the Society. The author of more than 50 journal articles and editor of six volumes of refereed articles, Trick is also a the author of a popular blog on the world of operations research, available at http://mat.tepper.cmu.edu/blog

Artificial Cognition Through Interacting with Robots
Prof. Tony Belpaeme
Thursday, 3 November 2011 — 14:00 - 15:00 — Klein Auditorium



The holy grail of artificial intelligence is the creation of human-like machine intelligence. While AI progresses in leaps and bounds and is currently ubiquitous, for example through its application in information filtering on the internet, we still are far from attaining human-like intelligence. A likely reason for this a disregard in AI for what it is that makes humans intelligent and how our cognition develops as we mature. Central to this is social interaction, where cognition is shaped through interacting with intelligent others. The talk will introduce a number of cognitive robotics experiments, using humanoid robots, which show how social interaction is a likely candidate for the development of cognition and how artificial cognition can be achieved by leveraging on the human innate predisposition for social multi-modal interaction.

Bio. Tony Belpaeme is Reader in Intelligent Systems at the University of Plymouth. He is associated with the Centre for Robotics and Neural Systems and is a member of the University of Plymouth Marine Institute. He is a member of the College of the EPSRC. His research interests include cognitive robotics, concept formation and artificial intelligence in general. At Plymouth he works alongside Angelo Cangelosi, Davide Marocco, Phil Culverhouse and Guido Bugmann on building intelligent and adaptive systems. Until April 2005 he was a postdoctoral fellow of the Flemish fund for scientific research (FWO Vlaanderen), and was affiliated with the Artificial Intelligence Laboratory, directed by Luc Steels, at the Vrije Universiteit Brussel. He held a guest professorship at the same university, where he taught introductory artificial intelligence and autonomous systems.

Abstracts by Session

Metaheuristics and Optimization 1
Thursday, 3 November 2011 — 9:45 - 10:45 — Room: L022

Chair: Greet Vanden Berghe

Scaling Up Optimal Heuristic Search in Dec-POMDPs via Incremental Expansion

Matthijs Spaan, Frans Oliehoek and Christopher Amato

Type: B - Compressed contribution

Planning under uncertainty for multiagent systems can be formalized as a decentralized partially observable Markov decision process. We advance the state of the art for optimal solution of this model, building on the Multiagent A* heuristic search method. A key insight is that we can avoid the full expansion of a search node that generates a number of children that is doubly exponential in the node's depth. Instead, we incrementally expand the children only when a next child might have the highest heuristic value. We target a subsequent bottleneck by introducing a more memory-efficient representation for our heuristic functions. Proof is given that the resulting algorithm is correct and experiments demonstrate a significant speedup over the state of the art, allowing for optimal solutions over longer horizons for many benchmark problems.

The full version of this paper appears in Proceedings of the 22nd International Joint Conference on Artificial Intelligence (IJCAI-11).

Benchmarking Parameter-free AMaLGaM on Functions With and Without Noise

Peter Bosman, Jörn Grahl and Dirk Thierens

Type: B - Compressed contribution

We describe a parameter-free Estimation-of-Distribution Algorithm (EDA) named Adapted Maximum-Likelihood Gaussian Model Iterated Density-Estimation Evolutionary Algorithm (AMaLGaM-IDEA, or AMaLGaM for short) for numerical optimization. AMaLGaM is benchmarked within the 2009 Black-Box Optimization Benchmarking (BBOB) framework and compared to a variant with incremental model building (iAMaLGaM). We study the implications of factorizing the covariance matrix in the Gaussian distribution, to use only a few or no covariances. Further, AMaLGaM and iAMaLGaM are also evaluated on the noisy BBOB problems and we assess how well multiple evaluations per solution can average out noise. Experimental evidence suggests that parameter-free AMaLGaM can solve a wide range of problems efficiently with perceived polynomial scalability. It is more robust to noise than iAMaLGaM due to the larger required population size. Using few or no covariances hinders the EDA to deal with rotations of the search space. Finally, the use of noise averaging is found to be less efficient than the direct application of the EDA unless the noise is uniformly distributed. AMaLGaM was among the best performing algorithms submitted to the BBOB workshop in 2009.

Recoverable robustness by column generation

Paul Bouman, Marjan Van Den Akker and Han Hoogeveen

Type: B - Compressed contribution

Real-life planning problems are often complicated by the occurrence of disturbances, which imply that the original plan cannot be followed anymore and some recovery action must be taken to cope with the disturbance. In such a situation it is worthwhile to arm yourself against common disturbances. Well-known approaches to create plans that take possible, common disturbances into account are robust optimization and stochastic programming. Recently, a new approach has been developed that combines the best of these two: recoverable robustness. In this paper, we apply the technique of column generation to find solutions to recoverable robustness problems. We consider two types of solution approaches: separate recovery and combined recovery. We show our approach on two example problems: the size robust knapsack problem, in which the knapsack size may get reduced, and the demand robust shortest path problem, in which the sink is uncertain and the cost of edges may increase.

Logic and Formal Reasoning 1
Thursday, 3 November 2011 — 9:45 - 10:45 — Room: L224

Chair: Nico Roos

Actual Causation in CP-logic

Joost Vennekens

Type: B - Compressed contribution

Given a causal model of some domain and a particular story that has taken place in this domain, the problem of actual causation is deciding which of the possible causes for some effect actually caused it. One of the most influential approaches to this problem has been developed by Halpern and Pearl in the context of structural models. In this paper, I argue that this is actually not the best setting for studying this problem. As an alternative, I offer the probabilistic logic programming language of CP-logic. Unlike structural models, CP-logic incorporates the deviant/default distinction that is generally considered an important aspect of actual causation, and it has an explicitly dynamic semantics, which helps to formalize the stories that serve as input to an actual causation problem.

Semantics for Conflict Resolution in Contextual Defeasible Logic

Antonis Bikakis and Grigoris Antoniou

Type: B - Compressed contribution

Domains, such as Ambient Intelligence and Social Networks, are characterized by some common features including distribution of the available knowledge, entities with different backgrounds, viewpoints and operational environments, and imperfect knowledge. Multi-Context Systems (MCS) has been proposed as a natural representation model for such environments, while recent studies have proposed adding non-monotonic features to MCS to address the issues of incomplete, uncertain and ambiguous information. In previous works, we introduced a non-monotonic extension to MCS and an argument-based reasoning model that handle imperfect context information based on defeasible argumentation. Here we propose alternative variants that integrate features such as partial preferences, ambiguity propagating and team defeat, and study the relations between the different variants in terms of conclusions being drawn in each case.

On the Limitations of Abstract Argumentation

Martin Caminada and Yining Wu

Type: A - Regular paper

In the current paper we re-examine the three-step procedure with respect to argumentation for inference. It is observed that when viewing the argumentation process in a holistic way, one encounters several problems that tend to be overlooked when restricting oneself to pure abstract argumentation. We describe three such problems, which have to do with the interaction between abstract argumentation and instantiated (structured) arguments. We argue that these problems are related to fundamental limitations in the approach of abstract argumentation.

Semantic Web 1
Thursday, 3 November 2011 — 9:45 - 10:45 — Room: M326

Chair: Stefan De Wannemaecker

News Recommendations using CF-IDF
Frederik Hogenboom, Flavius Frasincar, Uzay Kaymak and Franciska De Jong
Type: B - Compressed contribution

Most of the traditional recommendation algorithms are based on TF-IDF, a term-based weighting method. This paper proposes a new method for recommending news items based on the weighting of the occurrences of references to concepts, which we call Concept Frequency-Inverse Document Frequency (CF-IDF). In an experimental setup we apply CF-IDF to a set of newswires in which we detect 1,167 instances of a set of 65 concepts from a domain ontology. The proposed method yields significantly better results with respect to accuracy, recall, and F1 than the TF-IDF method we use as a basis for comparison.

Case Frames as Contextual Mappings to Case Law in BestPortal
Rinke Hoekstra, Arno Lodder and Frank Van Harmelen
Type: B - Compressed contribution

This paper introduces case frames as a way to provide a more meaningful structure to vocabulary mappings used to bridge the gap between laymen and legal descriptions of court proceedings. Case frames both reduce the ambiguity of queries, and improve the ability of users to formulate good quality queries. We extend the BestMap ontology with a formalisation of case frame based mappings in OWL 2, present a new version of BestPortal, and show how case frames impact retrieval results compared to simple contextual mappings and a direct full text search.

Finding the Achilles Heel of the Web of Data using network analysis tools
Christophe Guéret, Paul Groth, Frank Van Harmelen and Stefan Schlobach
Type: B - Compressed contribution

The Web of Data is increasingly becoming an important infrastructure for such diverse sectors as entertainment, government, e-commerce and science. The robustness of this Web of Data is now crucial. Prior studies show that this Web is strongly dependent on a small number of central hubs, making it highly vulnerable to single points of failure. In this paper, we present concepts and algorithms to analyse and repair the brittleness of the Web of Data. We take the betweenness centrality as a robustness-measure and determine which links should be added to the Web of Data to decrease the centrality index of the network. We are able to determine such links by interpreting the question as a very large optimisation problem and deploying an evolutionary algorithm to solve this problem.

Machine Learning 1
Thursday, 3 November 2011 — 11:15 - 12:35 — Room: L022

Chair: Karl Tuyls

Nonparametric Derivative Estimation

Kris De Brabanter, Jos De Brabanter and Bart De Moor

Type: A - Regular paper

We present a simple but effective fully automated framework for estimating first order derivatives nonparametrically. Derivative estimation plays an important role in the exploration of structures in curves (jump detection and discontinuities), comparison of regression curves, analysis of human growth data, etc. Hence, the study of estimating derivatives nonparametrically is equally important as regression estimation. Via empirical first order derivatives we approximate the first order derivative and create a new data set which can be smoothed by any nonparametric regression estimator. However, the new data sets created by this technique are not independent and identically distributed (i.i.d.) random variables anymore. As a consequence, automated model selection criteria (data-driven procedures) break down. Therefore, we modify the model selection criterion so it can handle this dependency (correlation) without requiring any prior knowledge about its structure.

Efficient Sensitivity Analysis in HMMs

Silja Renooij

Type: B - Compressed contribution

A Hidden Markov model (HMM) is a frequently applied statistical model for capturing processes that evolve over time. The parameters specified in a HMM are often inaccurate, and sensitivity analyses can be employed to study the effects of these inaccuracies on the output of a model. In the context of HMMs, sensitivity analysis is usually performed by means of a perturbation analysis where a small change is applied to the parameters, upon which the output of interest is re-computed. Recently it was shown that a simple mathematical function describes the relation between HMM parameters and an output probability of interest. We present a new and efficient algorithm for computing sensitivity functions in HMMs; it is the first algorithm to this end which exploits the recursive properties of an HMM, while not relying on a Bayesian network representation.

Instance-level Accuracy versus Bag-level Accuracy in Multi-Instance Learning

Vinicius Tragante Do ó, Daan Fierens and Hendrik Blockeel

Type: A - Regular paper

Multi-instance learning is a learning task where limited information about instance labels is given: instances are organized into bags, and a bag is labeled positive if it contains at least one positive instance, and negative otherwise; the labels of the individual

instances are not given. The task is to learn a classifier from this limited information. While the original task description involved the learning of an instance classifier, in the literature the task is often interpreted as learning a bag classifier. Similarly, classifiers (and the corresponding learners) can be evaluated based on the accuracy with which they classify instances, or bags. In the literature, the two different settings (instance versus bag classification) are often intermingled. In this paper, we investigate more closely the difference between bag-level and instance-level accuracy, both analytically and empirically. We show that there is a large difference in practice between these two, and results for bag-level accuracy do not necessarily hold for instance-level accuracy (and vice versa). It is therefore useful to clearly distinguish these two, and use the most suitable one for the task at hand.

Multiple-step Time Series Forecasting with Sparse Gaussian Processes

Perry Groot, Peter Lucas and Paul Van Den Bosch

Type: A - Regular paper

Forecasting of non-linear time series is a relevant problem in control. Furthermore, an estimate of the uncertainty of the prediction is useful for constructing robust controllers. Multiple-step ahead forecasting has recently been addressed using Gaussian processes, but direct implementations are restricted to small data sets. In this paper we consider multiple-step forecasting for sparse Gaussian processes to alleviate this problem. We derive analytical expressions for multiple-step ahead prediction using the FITC approximation. On several benchmarks we compare the FITC approximation with a Gaussian process trained on a large portion of randomly drawn training samples and show a mean prediction that is closer to the true system response with less uncertainty.

Multi-Agent Learning 1
Thursday, 3 November 2011 — 11:15 - 12:35 — Room: L224

Chair: Mathijs de Weerdt

Meta-strategies in the Colored Trails Game
Steven De Jong, Daniel Hennes, Karl Tuyls and Ya'Akov Gal
Type: B - Compressed contribution

This paper presents a novel technique to reduce large-scale strategic interactions to bilateral normal-form games with a significantly smaller strategy space, while preserving many of the strategic characteristics of the original setting. We demonstrate our technique on the Colored Trails (CT) framework, which allows to model a large variety of multi-agent interactions. We define a set of representative heuristics describing players' actions, called meta-strategies, and show that a three-player CT game decomposes into pairwise social dilemma games. We also present a set of criteria for generating interesting CT game instances and show that these instances indeed decompose into social dilemmas.

DESYDE: Decentralized (De)synchronization in Wireless Sensor Networks
Mihail Mihaylov, Yann-Aël Le Borgne, Karl Tuyls and Ann Nowé
Type: B - Compressed contribution

In the full version of this paper (Mihaylov et al., 2011) we propose DESYDE: a decentralized approach for coordinating the radio activity of wireless sensor nodes. Inspired by the win-stay lose-shift strategy from game theory, our approach allows individual nodes to schedule their radio transmission, reception and sleeping periods without any form of explicit coordination. We implement DESYDE in the OMNeT++ sensor network simulator and compare its performance to two state-of-the-art scheduling protocols, namely S-MAC and D-MAC. We show that our approach adapts the wake-up cycle of each node to its traffic load and significantly reduces end-to-end communication delays.

Adaptive state representations for Multi-Agent Reinforcement Learning
Yann-Michaël De Hauwere, Peter Vrancx and Ann Nowé
Type: B - Compressed contribution

When multiple agents act in the same environment, single-agent reinforcement learning (RL) techniques often fail, as they do not take into account other agents. An agent using single agent RL generally does not have sufficient information to obtain a good policy. However, multi-agent techniques that simply extend the state space to include information on the other agents suffer from a large overhead, leading to very slow learning. In this paper we describe a multi-level RL algorithm which acts independently whenever possible and learns in which states it should enrich its state information with information about other agents. Such states, which we call conflict states are detected using statistical information about expected payoffs in these states. We demonstrate through experiments that our approach learns a good trade-off between learning in the single-agent state space and learning in the multi-agent state space.

Roth-Erev learning in Signaling and Language games

David Catteeuw, Joachim De Beule and Bernard Manderick

Type: A - Regular paper

The relation between Lewis signaling game framework and Steels language game framework is discussed. The problem of pooling equilibria in signaling games is approached from both angles. Previous results about the requirements on learning for escaping pooling equilibria and achieving convergence are refined, and it is discussed why Roth Erev learning with forgetting should be a good learning rule in this context. This is confirmed empirically in simulation.

Natural Language Processing
Thursday, 3 November 2011 — 11:15 - 12:35 — Room: M326

Chair: Antal van den Bosch

Using Parallel Corpora for Word Sense Disambiguation

Els Lefever, Véronique Hoste and Martine De Cock

Type: B - Compressed contribution

This paper describes a set of exploratory experiments for a multilingual classification-based approach to Word Sense Disambiguation. Instead of using a predefined monolingual sense-inventory such as WordNet, we use a language-independent framework where the word senses are derived automatically from word alignments on a parallel corpus. We built five classifiers with English as an input language and translations in the five supported languages (viz. French, Dutch, Italian, Spanish and German) as classification output. The feature vectors incorporate both the more traditional local context features, as well as binary bag-of-words features that are extracted from the aligned translations. Our results show that the ParaSense multilingual WSD system shows very competitive results compared to the best systems that were evaluated on the SemEval-2010 Cross-Lingual Word Sense Disambiguation task for all five target languages.

Disambiguating Stickers. Grammatical Agreement as a Design Pattern.

Katrien Beuls

Type: A - Regular paper

Many of the world's languages exhibit grammatical agreement, meaning that at least two words in a sentence match in some way. For example, the words in the Spanish utterance "las casas altas" (the tall houses) all share the same ending "-as", which indicates the grammatical gender and number features of the houses the speaker is referring to. In this paper, I will address the function of what seems to be redundant marking by presenting the results of multi-agent language games. Faced with the ecological need to reduce parsing effort, agents are forced to group words that belong together. This is done through morphological markers such as "-as" which unlike their Spanish counterparts do not refer to any grammatical feature but only impose a linguistic sticker onto words that form a group. I will demonstrate how such stickers can propagate in a population of software agents based on their token frequency. The interactive web demonstration that accompanies this paper can be found on: http://arti.vub.ac.be/ katrien/disambiguating-stickers/index.xhtml.

A Comparison Study of Lexical and Syntactic Overlap for Textual Entailment Recognition

Sophia Katrenko and Assaf Toledo

Type: A - Regular paper

This paper discusses several types of overlap measures for textual entailment recognition, and studies their performance on five data sets. In addition to the commonly used lexical overlap, we consider syntactic overlap based on dependency triples and constituents, and combine these individual overlap features by means of logistic regression.

Dutch Named Entity Recognition using Classifier Ensembles

Bart Desmet and Véronique Hoste

Type: B - Compressed contribution

This paper explores the use of classifier ensembles for the task of named entity recognition (NER) on a Dutch dataset. Classifiers from 3 classification frameworks, namely memory-based learning (MBL), conditional random fields (CRF) and support vector machines (SVM), were trained on 8 different feature sets to create a pool of classifiers from which an ensemble could be built. A genetic algorithm approach was used to find the optimal ensemble combination, given various voting mechanisms for combining classifier outputs. The experiments yielded a classifier ensemble that outperformed the best individual classifier by 0.67 percentage points (F-score), a small but statistically significant margin. Experimental results also showed that ensembling classifiers from different frameworks benefits generalization performance.

Poster Session 1
Thursday, 3 November 2011 — 12:35 - 14:00 — Room: L226

Can Iterated Learning Explain the Emergence of Case Marking in Language?

Remi Van Trijp

Type: A - Regular paper

This paper compares two prominent approaches in artificial language evolution: Iterated Learning and Social Coordination. More specifically, the paper contrasts experiments in both approaches on how populations of artificial agents can autonomously develop a grammatical case marking system for indicating event structure (i.e. 'who does what to whom'). The comparison demonstrates that only the Social Coordination approach leads to a shared communication system in a multi-agent population. The paper concludes with an analysis and discussion of the results, and argues that Iterated Learning in its current form cannot explain the emergence of more complex natural language-like phenomena.

Time-Dependent Recommendation of Tourist Attractions using Flickr

Steven Van Canneyt, Steven Schockaert, Olivier Van Laere and Bart Dhoedt

Type: A - Regular paper

We propose a system that recommends tourist attractions based on the moment that the user visits a given city. We start from a large collection of georeferenced photos on Flickr, and use Mean Shift clustering to determine points of interest within a city. We then estimate the probability that a random user would visit a given place within a given temporal context. This system is compared against a baseline system whose only criterion is the overall popularity of the place. Our experimental results show that significant improvements over this baseline can be obtained.

Kernel Learning in Support Vector Machines using Dual-Objective Optimization

Auke-Dirk Pietersma, Lambert Schomaker and Marco Wiering

Type: A - Regular paper

Support vector machines (SVMs) are very popular methods for solving classification problems that require mapping input features to target labels. When dealing with real-world data sets, the different classes are usually not linearly separable, and therefore support vector machines employ a particular kernel function. Such a kernel function computes the similarity between two input patterns, but has as drawback that all input dimensions are considered equally important for computing this similarity. In this paper we propose a novel method that uses the dual objective of the SVM in order to update scaling weight vectors to scale different input features. We developed a gradient descent method that updates the scaling weight vectors to minimize the dual objective, after which the SVM is retrained, and this procedure is repeated a number of times. Experiments on noisy data sets show that our proposed algorithm leads to significantly higher accuracies than obtained with the standard SVM.

Can the eBay's Community Review Forum fairly resolve disputes?

Jaap Van Den Herik and Daniel Dimov

Type: A - Regular paper

eBay has to resolve sixty million disputes per year. For this task, the eBays Community Review Forum (ECRF) has been established. The aim of our research is to investigate whether ECRF provides a fair and lawful resolution. In this paper, we design and construct a concept of procedural fairness which is based on (a) the two principles of due process and (b) general theories of procedural fairness. Then, we assess to what extent the ECRF complies with our concept. From our investigations, we may conclude that the ECRF does not fully comply with the elements of fairness as embodied in our concept.

A Reconstructing Evolutionary Metaheuristic for the Vertex Coloring Problem

Nicolas Zufferey and Fred Glover

Type: A - Regular paper

Let G = (V,E) be a graph with vertex set V and edge set E. The k-coloring problem is to assign a color (a number chosen in 1, ..., k) to each vertex of G so that no edge has both endpoints with the same color. The graph coloring problem consists in finding the smallest k for which a k-coloring exists. We present a new evolutionary population based algorithm for graph coloring. At each generation, a solution s is selected from population P and subjected to a tabu search strategic oscillation step consisting of deconstruction, reconstruction and improvement, after which the resulting solution replaces a solution of P. Results are reported and show that the proposed algorithm is competitive with the best coloring methods, which are complex hybrid evolutionary algorithms employing forms of tabu search that do not incorporate strategic oscillation.

Patterns of clinical trial eligibility criteria

Krystyna Milian, Annette Ten Teije, Anca Bucur and Frank Van Harmelen

Type: B - Compressed contribution

Medical research would benefit from automatic methods supporting eligibility evaluation for patient enrollment in clinical trials and design of eligibility criteria. In this study we addressed the problem of formalization of eligibility criteria. Analyzing a large set of breast cancer clinical trials we derived a set of patterns, capturing typical structure of conditions, pertaining to syntax and semantics. We qualitatively analyzed their expressivity and evaluated coverage using regular expressions, running experiments on few thousands of clinical trials also related to other diseases. Based on early evaluation we conclude that derived patterns cover to large extent the language of eligibility criteria and could serve as a semiformal representation. We expect that extending presented method for pattern recognition with recognition of ontology concepts will facilitate generating computable queries and automated reasoning for various applications.

Predicting record linkage potential in a family reconstruction graph

Marijn Schraagen and Hendrik Jan Hoogeboom

Type: A - Regular paper

Record linkage is the process of matching records from different data sources containing information about the same entity (e.g., person), without a common uniquely identifying field. Link verification for non-artificial data sets proves to be difficult: if a record r is not linked, either the linkage method is too restrictive or the data set does not contain any record that links to r. Link prediction can be used to make a more informed decision on which of the two possibilities is the case. This paper describes a method to predict record linkage potential using the topology of a graph based on edit distance between records. An algorithm is developed to position additional records in the graph in order to increase the coverage of the prediction method. A semantic linkage method is introduced to evaluate the performance of the prediction algorithm across linkage approaches.

An Agent Based Inter-organizational Collaboration Framework: OperA+

Jie Jiang, Virginia Dignum and Yao-Hua Tan

Type: B - Compressed contribution

Inter-organizational collaboration often occurs in complex, dynamic and unpredictable environments. Regulating structures should be represented explicitly and independently from the acting components at different levels of abstraction in order for stakeholders to analyze the overall setup and decide on their participation. This paper proposes a framework for describing collaboration relationships in inter-organizational partnerships. The framework is based on the OperA model for multi-agent organizations and provides a specification dimension which describes what to do from the designers perspective and an enactment dimension which describes who does what from an implementation perspective. The adoption of composite roles and composite agents facilitates a modeling of nested organizations, which offers a suitable way to manage/regulate inter-organizational interactions.

Modeling negotiation using multi-focused answer sets

Kim Bauters

Type: B - Compressed contribution

Answer Set Programming (ASP) is a form of declarative programming based on the stable model semantics. The idea of ASP is to represent a computational problem by a set of (propositional) rules P such that particular minimal models of P, the stable models, correspond to the solutions of the original problem. Communicating ASP (CASP) allows for a number of ASP programs to collaborate by asking each other questions. In CASP, there is no longer a unique way to define a stable model. Using a mechanism called focusing it becomes possible to eliminate some of these stable models, i.e. to assign preferences to the stable models of a CASP program. As a case study, this paper considers modeling a coalition formation as a CASP program. We then illustrate how, using multi-focused answer sets, we can impose constraints so that we can reach a unique agreement (stable model) that optimizes the preferences of the parties involved.

Towards the Automated Derivation of Clinical Quality Indicators

Kathrin Dentler, Annette Ten Teije, Ronald Cornet and Nicolette De Keizer
Type: B - Compressed contribution

The full version of this paper appeared in: Workshop on Knowledge Representation for Health Care (KR4HC11) in conjunction with the 13th Conference on Artificial Intelligence in Medicine (AIME11), Slovenia, July 2011.

Dynamic chunking of compositional structure in Fluid Construction Grammar

Kevin Stadler
Type: A - Regular paper

Compositionality is a core property of human languages that sets them apart from other communication systems found in the animal world. But psycholinguistic evidence indicates that there is a significant amount of redundancy in a human's representation of compositional structure. This insight is well compatible with the Construction Grammar paradigm in which all linguistic structures, whether lexical or syntactic, are expressed in the same unified representation, the construction. This unified representation also allows co-occurring constructions to be combined into new holistic constructions which can again be handled by the very same representation. In this article we propose a model of how to efficiently perform chunking of constructions, and present a working implementation of the algorithm in Fluid Construction Grammar. We further investigate where cases of spontaneous combinations of productive constructions occur in natural languages, and explore areas of natural language processing in which the presented algorithm can be used.

Reciprocity Measures in Agent Dependence Networks

Patrice Caire, Baptiste Alcalde, Leendert Van Der Torre and Nicolas Genon
Type: A - Regular paper

In agents systems, reciprocity measures quantify interdependence in social dependence relations, representing the degree in which the system facilitates social interactions. Moreover, a normative system is a mechanism to change reciprocity by changing social dependencies, for example by creating new obligations. With the pervasive development of socio-technical systems, modelling such social settings has become increasingly important. We distinguish design time from run time measures. At design time, roughly, more interdependence increases reciprocity among groups of agents or coalitions, whereas larger coalitions may decrease the efficiency or stability of these involved coalitions. At run time, we consider the extension to temporal dependence networks, that is, sequences of dependence networks. We distinguish dominance, volatility and entropy requirements for reciprocity measures. We illustrate the use of our reciprocity measures with examples from gaming.

Discrete Tomography: A Neural Network Approach

Jonathan Vis, Walter Kosters and Joost Batenburg
Type: A - Regular paper

Tomography tries to reconstruct an object from a number of projections in multiple

directions. There are many obvious application domains, but we will focus on high throughput applications, and will therefore try to reduce the number of necessary projections, while being able to generate good quality reconstructions. We apply several forms of Neural Networks, an Artificial Intelligence method. These networks are especially suited for solving underdetermined problems, and therefore well suited to our problem.

Many different variants of Neural Networks are developed since its introduction; some simple, while other architectures can consist of many nodes in many hidden layers increasing the training complexity. We will here focus on the simpler forms of Neural Networks: feedforward (multilayer) perceptrons.

We show, for both artificial and real-life data, that these networks are capable of creating good quality reconstructions from a limited set of projections, while avoiding image artifacts that are often present in traditional approaches.

Reasoning With Different Time Granularities in Industrial Applications: A Case Study Using CP-logic

Johan Kwisthout and Peter Lucas

Type: A - Regular paper

Bayesian networks more and more become the framework of choice for modeling uncertainty in industrial applications, in particular dynamic variants that model events over time. These networks, however, cannot deal well with systems in which events take place on different time granularities, e.g., when the time scale of such processes varies from seconds to months. We investigate the possible use of probabilistic logics, in particular CP-logic, to reason with uncertainty under different time scales.

Thin slices of head movements during problem solving reveal level of difficulty

Bart Joosten, Marije Van Amelsvoort, Emiel Krahmer and Eric Postma

Type: B - Compressed contribution

This paper reports on the computational analysis of thin slices of video fragments showing children that solve either easy or hard mathematical puzzles. The objective of the analysis is to determine if head movements reveal whether the children consider the puzzle to be easy or hard. Our analysis method combines a facial-expression extraction method with a nonparametric classifier. Training and evaluating the classifier in a leaving-one-out cross-validation procedure on extracted head movements, we obtained a 71% correct classification rate. Children engaged in solving mathematical puzzles tend to make head movements in a prevailing orientation that depends on the experienced level of difficulty of the puzzles, i.e., vertically for easy puzzles and diagonally for hard puzzles. We conclude that (1) computational analysis methods may lead to the identification of hitherto unnoticed nonverbal behaviors that reflect the perceived difficulty of mathematical puzzles, and (2) computational analysis methods may be employed in automatic tutoring systems that automatically estimate the experienced difficulty of the problems presented.

Metaheuristics and Optimization 2
Thursday, 3 November 2011 — 16:00 - 17:20 — Room: L022

Chair: Dirk Thierens

A new hyper-heuristic implementation in HyFlex: a study on generality
Mustafa Misir, Greet Vanden Berghe, Patrick De Causmaecker and Katja Verbeeck
Type: B - Compressed contribution

Selection hyper-heuristics concentrate on using the strength of multiple low-level search mechanisms for solving instances from various problem domains. A traditional selection hyper-heuristic is composed of 1) a heuristic selection mechanism for choosing heuristics at each decision step and 2) a move acceptance strategy for deciding about whether or not to use the explored solutions by the selected heuristics. These mechanisms work together in a problem-independent manner to raise the level of generality on the one hand and to ease their applicability on the other hand. The present study provides a new selection hyper-heuristic equipped with various adaptive features.

Acceptance Strategies for Maximizing Agent Profits in Online Scheduling
Mengxiao Wu, Mathijs De Weerdt and Han La Poutré
Type: B - Compressed contribution

In the market of global logistics, agents need to decide upon whether to accept jobs sequentially offered to them. These jobs, which need to be executed in the near future, have different payments and time constraints. In the offering process we study here, an agent (with limited capacity) needs to make an immediate acceptance decision with little knowledge about future jobs. The goal of the agent is to maximize its profit in such a dynamic environment. We therefore study the online decision problem of acceptance of unit length jobs with time constraints. We consider the problem as a repeated take-it-or-leave-it game which involves online scheduling; we design strategies for when to accept an offered job. Specifically, we present theoretically optimal strategies for a fundamental case, and develop heuristic strategies in combination with an evolutionary algorithm for more general and complex cases. We show experimentally that in the fundamental case the performance of our heuristic solutions is almost the same as that of the theoretical solutions. In various settings, we compare the results achieved by our online solutions to those generated by the optimal offline solutions; the average-case performance ratios are about 1.1. We also analyze the impact of the ratio between the number of slots and the number of jobs on the difficulty of decisions and the performance of our solutions. Although we use a relatively simple scheduling problem to illustrate our approach, we show that it generalizes to online acceptance of jobs in more complex scheduling scenarios as well.

Solving the no-wait job shop problem: an ILP and CP approach
Henno Vermeulen, Han Hoogeveen and Marjan Van Den Akker

Type: A - Regular paper

The no-wait job shop problem is a variant of the traditional job shop scheduling problem, where the time between operations of the same job is fixed. The only variables left are the start times of each job. We show that all constraints can be expressed as a set of no-overlap constraints for each pair of jobs. This deceivingly simple-looking problem turns out to be quite hard to solve within a reasonable amount of time.

In this paper, we present exact solution methods using ILP (Integer Linear Programming) and a combination of binary search with CP (Constraint Programming) to find an optimal makespan. We derive two simple but effective propagators. We performed extensive experiments using different ILP formulations, lower bounds, constraint propagation strategies and branching strategies. We show that the edge-finding and not-first, not-last propagators used in solving the traditional job shop problem are less effective in the presence of no-wait constraints.

For medium-sized problem instances of 10 jobs the performance of our best CP strategy is comparable to that of the best-known branch-and-bound algorithm for the no-wait job shop problem. Our algorithm scales better with the number of machines and number of operations per job and the branch-and-bound methods scales better with the number of job.

Computing All-Pairs Shortest Paths by Leveraging Low Treewidth

Léon Planken, Mathijs De Weerdt and Roman Van Der Krogt

Type: B - Compressed contribution

Considering directed graphs on n vertices and m edges with real (possibly negative) weights, we present two new, efficient algorithms for computing all-pairs shortest paths (APSP). These algorithms make use of directed path consistency (DPC) along a vertex ordering d. The algorithms run in $O(n^2 w_d)$ time, where w_d is the graph width induced by this vertex ordering. For graphs of constant treewidth, this yields an $O(n^2)$ time bound, which is optimal. On chordal graphs, the algorithms run in O(nm) time. We show empirically that also in many general cases, both constructed and from realistic benchmarks, the algorithms often outperform Johnson's algorithm, which represents the current state of the art with a run time of $O(nm + n^2 log n)$. These algorithms can be used for temporal and spatial reasoning, e.g. for the Simple Temporal Problem (STP), which underlines its relevance to the planning and scheduling community.

Intelligent Agents
Thursday, 3 November 2011 — 16:00 - 17:20 — Room: L224

Chair: Steven de Jong

A satisficing agreements model
Guido Boella, Gabriella Pigozzi, Marija Slavkovik and Leon Van Der Torre
Type: B - Compressed contribution

The paper was accepted for publication at the 3rd International Workshop on Coordination, Organization, Institutions and Norms in Agent Systems, to be held in conjunction The 2011 IEEE / WIC / ACM International Conferences on Web Intelligence and Intelligent Agent Technology. In this paper we propose a model for reaching agreements by satisficing, for an adaptive team of agents. Satisficing, the concept proposed by Herbert Simon, as an approach to reaching agreements is little explored. The team consists of one human agent familiar with the problem and arbitrarily many artificial agents. Our model raises to the team level the recognition-primed decision model constructed in the field of cognitive decision-making by using social choice for reaching group opinions.

Acceptance Conditions in Automated Negotiation (Extended Abstract)
Tim Baarslag, Koen Hindriks and Catholijn Jonker
Type: B - Compressed contribution

In every negotiation with a deadline, one of the negotiating parties has to accept an offer to avoid a break off. A break off is usually an undesirable outcome for both parties, therefore it is important that a negotiator employs a proficient mechanism to decide under which conditions to accept. When designing such conditions one is faced with the acceptance dilemma: accepting the current offer may be suboptimal, as better offers may still be presented. On the other hand, accepting too late may prevent an agreement from being reached, resulting in a break off with no gain for either party.

Motivated by the challenges of bilateral negotiations between automated agents and by the results and insights of the automated negotiating agents competition (ANAC), we classify and compare state-of-the-art generic acceptance conditions. We focus on acceptance conditions that do not depend on the bidding strategy that is used. We performed extensive experiments to compare the performance of acceptance conditions in combination with a broad range of bidding strategies and negotiation domains. Furthermore we propose new acceptance conditions and we demonstrate that they outperform the other conditions that we study. In particular, it is shown that they outperform the standard acceptance condition of comparing the current offer with the offer the agent is ready to send out. We also provide insight in to why some conditions work better than others.

Adaptive Strategies for Dynamic Pricing Agents
Sara Ramezani, Peter A.N. Bosman and Han La Poutré
Type: B - Compressed contribution

Dynamic Pricing (DyP) is a form of Revenue Management in which the price of a (usually) perishable good is changed over time to increase revenue. It is an effective method that has become even more relevant and useful with the emergence of Internet firms and the possibility of readily and frequently updating prices. In this paper a new approach to DyP is presented. We design an adaptive dynamic pricing strategy and optimize its parameters with an Evolutionary Algorithm (EA) offline, while the strategy can deal with stochastic market dynamics quickly online. We design the adaptive heuristic dynamic pricing strategy in a duopoly where each firm has a finite inventory of a single type of good. We consider two cases, one in which the average of a customer population's stochastic valuation for each of the goods is constant throughout the selling horizon and one in which the average customer valuation for each good is changed according to a random Brownian motion. We also design an agent-based software framework for simulating various dynamic pricing strategies in agent-based marketplaces with multiple firms in a bounded time horizon. We use an EA to optimize the parameters of the pricing strategy in each of the settings and compare our strategy with other strategies from the literature. We also perform sensitivity analysis and show that the optimized strategy works well even when used in settings with varied demand functions.

Multi-Agent based simulation of FOREX exchange market

Vivien Delage, Christian Brandlhuber, Karl Tuyls and Gerhard Weiss

Type: A - Regular paper

The FOREX market is quite unique among the traditional financial markets. First, with a very high transaction volume, it is the most liquid market of the world. Second, this market is influenced by a vast and diverse panel of information. This ranges from macro-economic elements such as interest rate parity, inflation rate or unemployment rate to political elements such as changes in government. Third, the decentralized structure of this market makes its study and interpretation very challenging. This paper presents a distributed multi-agent based model for simulating the behaviour of the FOREX market. The model allows the replication of the market price and the study of the complex structure of the FOREX market. The multi-agent model is described and validated by extensive experiments.

Demonstrations
Thursday, 3 November 2011 — 15:00 - 17:20 — Room: L022

A Java IDP for a Knowledge Base System

Nick Calus and Joost Vennekens

Type: C - Demonstrations and Applications

A knowledge base consists of a declarative representation of an expert's knowledge about some domain, and offers also general inference algorithms that allow certain conclusions to be drawn from this knowledge. In general, it might be considerably easier to write such a knowledge base than to implement an imperative program that can reach the same conclusions. Knowledge bases are therefore interesting candidates to fill in the Model part of the Model-View-Controller architecture that is often used in software engineering today. However, this approach can only be successful if it is easy to link such a knowledge base to other software components, in particular the Graphical User Interface or GUI (the "View" component). This demo presents a Java API that allows a GUI to be attached to a knowledge base in the IDP system, an efficient reasoning system that uses a rich extension of first-order logic as its input language. This link can be made with minimal effort, allowing quick development of, in particular, configuration software.

Augmented mobile telepresence with assisted control

Sjriek Alers, Daan Bloembergen, Daniel Hennes and Karl Tuyls

Type: C - Demonstrations and Applications

We present a custom-build robot system specifically designed for augmented telepresence with assisted control called MITRO (Maastricht Intelligent Telepresence RObot). We invite people to engage in a hands-on experience of our MITRO telepresence system. A laptop computer running the web-based control interface and the video-conferencing application allows the user to steer the robot around, take part in conversations and test the assisted control. Additional information (such as an annotated map) is overlaid on the video-stream if desired. Furthermore, we will demonstrate autonomous drive to a chosen location (e.g. charging station) and people tracking.

The MESware scheduler: an adaptive production scheduling system with complex constraints

Tony Wauters, Paul Verstraete, Patrick De Causmaecker, Greet Vanden Berghe and Katja Verbeeck

Type: C - Demonstrations and Applications

In cooperation with MESware nv the authors have developed an adaptive and generic production scheduling system capable of handling complex real world constraints. While scheduling multiple customer orders, the scheduler can handle complex resource and time constraints. Examples include: different types of plant layouts, sequence-dependent setup times, time-lags, working times, resource (un)availabilities, and grouping/splitting multiple orders. The system applies a combination of artificial intelligence and operational research methods to produce good quality solutions in a short amount of time.

The capabilities of the scheduling system will be demonstrated using different real world production scheduling cases from the food industry.

Robust Decision Making: Multi-Criteria Scenario-Based Decision Analysis

Tina Comes, Claudine Conrado, Tiphaine Dalmas, Niek Wijngaards and Frank Schultmann

Type: C - Demonstrations and Applications

This demo presents an ICT system for collaborative situation assessment and strategic decision making that supports effective and efficient protection of the population and the environment against chemical hazards in industrial areas. Robust decision support taking into account multiple objectives entails the combination of Multi-Criteria Decision Analysis (MCDA) and Scenario-Based Reasoning (SBR). The ad-hoc formed workflow of (human and artificial) experts generates scenarios capturing uncertainties. Combining MCDA and SBR allows for structuring complex problems and accounting for uncertainties by the selection of a decision alternative that performs (sufficiently) well for various aims under a variety of different possible situation developments (i.e., scenarios).

Bee-inspired foraging in a real-life autonomous robot collective

Nyree Lemmens, Sjriek Alers and Karl Tuyls

Type: C - Demonstrations and Applications

In this demo, we show the emergence of Swarm Intelligence in physical robots. We transferred an optimization algorithm which is based on bee-foraging behavior to a robotic swarm with the advantage that this algorithm, and so the actual robots, do not require input of environmental parameters (e.g., pheromones).

Efficient aircraft loading: a mixed integer programming approach for the aircraft weight and balance problem

Wim Vancroonenburg, Jannes Verstichel, Greet Vanden Berghe and Wouter Souffriau

Type: C - Demonstrations and Applications

We present a mixed integer programming (MIP) approach to the aircraft weight and balance problem (AWBP), a combinatorial optimization problem encountered in the aircraft freight transport sector. The AWBP considers loading containers into an aircraft in such a way that the total cargo value (profit) is maximized. At the same time, the centre of gravity (CG) should approach an optimal point in order to minimize fuel consumption. The optimization procedure is implemented in the commercial software suite SABLE, developed by B. Rekencentra nv. The approach applies CPLEX 12.1 for solving the MIP model. We will demonstrate the SABLE weight and balance optimization module and compare our results to those of human experts.

Gesture Recognition for an Exergame Prototype

Brahim Gacem, Robert Vergouw, Harm Verbiest, Emrullah Cicek, Tim Van Oosterhout, Sander Bakkes and Ben Kröse

Type: C - Demonstrations and Applications

We will demonstrate a prototype exergame aimed at the serious domain of elderly fitness. The exergame incorporates straightforward means to gesture recognition, and utilises a Kinect camera to obtain 2.5D sensory data of the human user.

Logic and Formal Reasoning 2
Friday, 4 November 2011 — 11:00 - 12:30 — Room: L022

Chair: Leon van der Torre

Transforming Fuzzy Description Logic ALCFL into Classical Description Logic ALCH

Yining Wu

Type: B - Compressed contribution

In this paper, we present a satisfiability preserving transformation of the fuzzy Description Logic ALC_FL into the classical Description Logic ALCH. We can use the already existing DL systems to do the reasoning of ALC_FL by applying the result of this paper.

Semi-stable Extensions for Infinite Frameworks

Emil Weydert

Type: A - Regular paper

The (full) paper proves the Caminada-Verheij conjecture about the existence of semi-stable labelings for finitary argumentation frameworks. This is done in the context of a very general semantic formalism for abstract argumentation based on hyperframeworks and hyperextensions. The first-order methods are applicable to a broader range of hyperextension existence problems.

Attack Semantics for Abstract Argumentation

Serena Villata, Guido Boella and Leon Van Der Torre

Type: B - Compressed contribution

In this paper we conceptualize abstract argumentation in terms of successful and unsuccessful attacks, such that arguments are accepted when there are no successful attacks on them. We characterize the relation between attack semantics and Dung's approach, and we define an SCC recursive algorithm for attack semantics using attack labelings.

Four-valued Description Logic for Paraconsistent Reasoning

Wenzhao Qiao and Nico Roos

Type: A - Regular paper

Inconsistencies always exist in an open, constantly changing and collaborative environment. Paraconsistent reasoning can handle inconsistent information without resolving the inconsistencies. It is an effective way to deal with inconsistencies in the absence of information on how to resolve them. In this paper, a four-valued description logic for paraconsistent reasoning is presented. The four-valued semantics isolates inconsistencies enabling the derivation of conclusions from the consistent information. Moreover, two preferences, to derive useful conclusions from the inconsistent information, are proposed. One preference is based on an adaptation of the semantics of the subsumption relation, and the other preference implements specificity. The results demonstrate that this proposed approach avoids the spread of conflicts and enables the derivation of reasonable conclusions from inconsistent knowledge bases.

Multi-Agent Learning 2
Friday, 4 November 2011 — 11:00 - 12:30 — Room: L224

Chair: Yann-Michael De Hauwere

Lenient Learning in a Multiplayer Stag Hunt

Daan Bloembergen, Steven De Jong and Karl Tuyls

Type: A - Regular paper

This paper describes the learning dynamics of individual learners in a multiplayer Stag Hunt game, focussing primarily on the difference between lenient and non-lenient learning. We find that, as in 2-player games, leniency significantly promotes cooperative outcomes in 3-player games, as the basins of attraction of (partially) cooperative equilibria grow under this learning scheme. Moreover, we observe significant differences between purely selection-based models, as often encountered in related analytical research, and models that include mutation. Therefore, purely selection-based analysis might not always accurately predict the behavior of practical learning algorithms, which often include mutation.

Reinforcement Learning for Energy Efficient Routing in Wireless Sensor Networks

Maarten Devillé, Yann-A ̈el Le Borgne and Ann Now

Type: A - Regular paper

In this paper we study the potential of using energy aware metrics in reinforcement learning based routing algorithms for wireless sensor networks. This paper contributes with an enhanced version of an existing energy aware algorithm and with a study that tests the influence of combining energy aware metrics with load balancing metrics from delay based Q-routing. We show that our enhanced algorithm can significantly improve the lifetime of a network without requiring any extra information or communication, by propagating energy information beyond direct neighbors throughout the network. Our study also shows that topologies composed from heterogenous nodes can have a significant impact on an algorithm's performance. Furthermore we show that load balancing in routing algorithms can help to improve the network lifetime while only requiring energy information about a node's direct neighbors.

Opponent Modeling with POMDPs

Daniel Mescheder, Karl Tuyls and Michael Kaisers

Type: A - Regular paper

Reinforcement Learning techniques such as Q-learning are commonly studied in the context of two-player repeated games. However, Q-learning fails to converge to best response behavior even against simple strategies such as Tit-for-two-Tat. Opponent Modeling (OM) can be used to overcome this problem. This article shows that OM based on Partially Observable Markov Decision Processes (POMDPs) can represent a

large class of opponent strategies. A variation of McCallums Utile Distinction Memory algorithm is presented as a means to compute such a POMDP opponent model. This technique is based on Baum-Welch maximum likelihood estimation and uses a t-test to adjust the number of model states. Experimental results demonstrate that this algorithm can identify the structure of strategies against which pure Q-learning is insufficient. This provides a basis for best response behavior against a larger class of strategies.

Data Mining
Friday, 4 November 2011 — 11:00 - 12:30 — Room: Klein Auditorium

Chair: Stijn Meganck

Identifying and Characterising Anomalies in Transaction Data

Koen Smets and Jilles Vreeken

Type: B - Compressed contribution

In many situations there exists an abundance of positive examples, but only a handful of negatives. In this paper we show how in binary or transaction data such rare cases can be identified and characterised.

Our approach uses the Minimum Description Length principle to decide whether an instance is drawn from the training distribution or not. By using frequent itemsets to construct this compressor, we can easily and thoroughly characterise the decisions, and explain what changes in an example would lead to a different verdict. Furthermore, we give a technique through which, given only a few negative examples, the decision landscape and optimal boundary can be predicted—making the approach parameter-free.

Experimentation on benchmark and real data shows our method provides very high classification accuracy, thorough and insightful characterisation of decisions, predicts the decision landscape reliably, and can pinpoint observation errors. Moreover, a case study on real MCADD data shows we provide an interpretable approach with state-of-the-art performance for screening newborn babies for rare diseases.

Applying Subgroup Discovery for the Analysis of String Quartet Movements

Jonatan Taminau, Ruben Hillewaere, Stijn Meganck, Darrell Conklin, Ann Nowé and Bernard Manderick

Type: B - Compressed contribution

Descriptive and predictive analyses of symbolic music data assist in understanding the properties that characterize specific genres, movements and composers. Subgroup Discovery, a machine learning technique lying on the intersection between these types of analysis, is applied on a dataset of string quartet movements composed by either Haydn or Mozart. The resulting rules describe subgroups of movements for each composer, which are examined manually, and we investigate whether these subgroups correlate with metadata such as type of movement or period. In addition to this descriptive analysis, the obtained rules are used for the predictive task of composer classification; results are compared with previous results on this corpus.

Data Summarization with Informative Itemsets

Michael Mampaey, Nikolaj Tatti and Jilles Vreeken

Type: B - Compressed contribution

Data analysis is an inherently iterative process. That is, what we know about the data

greatly determines our expectations, and hence, what result we would find the most interesting. With this in mind, we introduce a well-founded approach for succinctly summarizing data with a collection of informative itemsets; using a probabilistic maximum entropy model, we iteratively find the most interesting itemset, and in turn update our model of the data accordingly. As we only include itemsets that are surprising with regard to the current model, the summary is guaranteed to be both descriptive and non-redundant. The algorithm that we present can either mine the top-k most interesting itemsets, or use the Bayesian Information Criterion to automatically identify the model containing only the itemsets most important for describing the data. Or, in other words, it will 'tell you what you need to know'. Experiments on synthetic and benchmark data show that the discovered summaries are succinct, and correctly identify the key patterns in the data. The models they form attain high likelihoods, and inspection shows that they summarize the data well with increasingly specific, yet non-redundant itemsets.

MapReduce and FCA Approach for Clustering of Multiple-Experiment Data Compendium

Elena Tsiporkova, Veselka Boeva and Elena Kostadinova

Type: A - Regular paper

In contrast to conventional clustering algorithms, where a single data set is used to produce a clustering solution, we introduce herein a MapReduce approach for clustering of data sets generated in multiple-experiment settings. It is inspired by the map-reduce functions commonly used in functional programming and consists of two distinctive phases. Initially, the selected clustering algorithm is applied (mapped) to each experiment, separately. This produces a list of different clustering solutions, one per each experiment. These are further transformed (reduced) by portioning the cluster centers into a single clustering solution. The obtained partition is not disjoint in terms of the different participating genes and it is further analyzed and refined by applying Formal Concept Analysis.

Poster Session 2
Friday, 4 November 2011 — 12:30 - 14:00 — Room: L226

Generating UML Class Models from SBVR Software Requirements Specifications

Imran Bajwa and Hina Afreen

Type: A - Regular paper

SBVR is the recent standard, introduced by OMG, can be used to capture software requirements in a natural language (NL) such as English. In this paper, we present a novel approach that can translate SBVR specification of software requirements into UML class models. We want to generate UML class models from SBVR specifications instead of NL specifications of software requirements as NL to UML translation exhibit lesser accuracy due to informal nature of natural languages. SBVR specifications can be quite helpful as SBVR is not only based on higher-order logic and easy to machine process but also easy to understand for human beings. The presented approach works as the user inputs the SBVR specification of software requirements and then the input SBVR is syntactically and semantically analyzed to extract OO information and finally OO information is mapped to a class model. The presented approach is also presented in a prototype tool SBVR2UML that is an Eclipse plugin and a proof of concept. A case study has also been solved to show that the use of SBVR in automated generation of class models provide better accuracy and consistency as compared with other available approaches.

Analyzing Sentiment while Accounting for Negation Scope and Strength

Alexander Hogenboom, Paul Van Iterson, Bas Heerschop, Flavius Frasincar and Uzay Kaymak

Type: B - Compressed contribution

Recent developments in automated sentiment analysis show a tendency of accounting for various aspects other than word frequencies. One of these aspects is negation. We compare several approaches to accounting for negation in sentiment analysis, differing in their methods of determining the scope of influence of a negation keyword. On a set of English movie reviews, the best approach turns out to be to consider the first two words, following a negation keyword, to be negated by that keyword. Additionally, we propose to optimize the sentiment modification in case of negation to a value of -1.27 rather than -1

Improving ontology matchers utilizing linguistic ontologies: an information retrieval approach

Frederik Schadd and Nico Roos

Type: A - Regular paper

Matching ontologies is a crucial process when facilitating system interoperability and information exchange. A reoccurring problem in this process is that names can be ambiguous, yielding uncertainty to whether entities of two heterogeneous ontologies are actually related. Linguistic ontologies provide a clear structure of meanings, rather than

names, allowing the quantification of the relatedness of any two given meanings. We propose an approach for the automatic allocation of correct meanings within a linguistic ontology through the use of virtual documents and information retrieval techniques. The benefits of this approach are tested and established using a data set from the Ontology Alignment Evaluation Initiative (OAEI) competition, while further improvements are revealed using a benchmark data set from the same competition.

Ontology-driven Elicitation of Multimodal User Interface Design Recommendations

Tom Tourwé, Elena Tsiporkova, Nicolas Gonzalez-Deleito and Anna Hristoskova

Type: A - Regular paper

In this paper, we argue that current design guidelines for multimodal user interface design focus mostly on high-level design objectives and do not capture and reflect on the considerable practical experience and valuable expert knowledge that interface designers rely on. We propose an ontology-driven modelling framework, which allows to capture the domain and expert knowledge available within the interface design community and to support designers in their daily design tasks by eliciting user and application dependent design recommendations. We illustrate how this framework can be used in practice with a concrete case study devoted to multimodal interface design for the purpose of emergency response applications.

Case study: an effective genetic algorithm for the chemical batch production scheduling

Dmitriy Borodin, Bert Van Vreckem and Wim De Bruyn

Type: B - Compressed contribution

The paper presents a case study two genetic algorithms for solving the integer programming part of the MILP formulation for a particular chemical batch production scheduling problem. The standard MILP formulation of the batch production scheduling problem is decomposed into two sub problems: 1) unconstrained integer programming problem involving two independent assignment and one permutation vectors as solution representation and having one objective function; 2) constrained continuous linear program representing the original MILP formulation with integer variables fixed in terms of the solution of the first sub problem. The first sub problem is known as NP-hard and is difficult to solve by exact algorithms, the second sub problem is easy to solve in terms of exact methods. Two genetic algorithms are proposed to solve the first sub problem; the linear program acts as an objective function by delivering the solution of the original MILP model using the values of integer variables found by genetic algorithms. It is explained how the complete production schedule and the objective function value (the schedule cost) are deduced. The genetic algorithms combine the approaches for solving both assignment and permutation sequencing problems. The solution representations, algorithms convergence and parameters are discussed. The efficiency of both algorithms is proved by the computational results that are compared with the optimal solutions and with another heuristic technique.

A Clustering Approach using Weighted Similarity Majority Margins

Raymond Bisdorff, Patrick Meyer and Alexandru-Liviu Olteanu

Type: A - Regular paper

We propose a meta-heuristic algorithm for clustering objects that are described on multiple incommensurable attributes defined on different scale types. We make use of a bipolar-valued dual similarity-dissimilarity relation and perform the clustering process by first finding a set of cluster cores and then building a final partition by adding the objects left out to a core in a way which best fits the initial bipolar-valued similarity relation.

Extracting emotions out of twitter's microblogs

Ruben Van Wanzeele, Katja Verbeeck, Annemie Vorstermans, Tom Tourwé and Elena Tsiporkova

Type: A - Regular paper

Due to the increasing popularity of social networks, emotional data is generated more than ever. Feelings, opinions, experiences and comments are expressed, whether or not explicitly, toward products, services, brands, events etc. Understanding or analysing these sentiments in an automatic way can leverage valuable knowledge for businesses, governments or individuals. Sentiment analysis is therefore becoming an exciting subfield of data mining, coined as emotion mining. In this paper we present an architecture to automatically extract the emotional connotation of twitters' microblogs in the context of events. This entails finding and filtering tweets based on their relevance, attaching emotional scores to words inside tweets and combining these scores into some global emotional evaluation. As an ontology, we use SentiWordNet to attach emotional scores to the words inside tweets. Based on these scores, we propose the notion of an emotional distance measurement. This measurement makes it possible to calculate distances between tweets and cluster them based on their emotional value. Our architecture is tested on the Betagroup conference series.

Accelerating reinforcement learning on a robot by using subgoals in a hierarchical framework

Bart Van Vliet, Wouter Caarls, Erik Schuitema and Pieter Jonker

Type: A - Regular paper

Reinforcement learning is a way to learn control tasks by trial and error. Even for simple motor control tasks, however, this can take a long time. We can speed up learning by using prior knowledge, but this is not always available, especially for an autonomous agent. One way to add limited prior knowledge is to use subgoals, defining points that the controller should aim for on the way to reaching the real goal. In this study, we use the MAXQ hierarchical framework to specify subgoals. This decreased the learning time by a factor two on a robot leg step-up task and we show that tests on a real robot give similar results. The worse end performance that is a result of the reduced solution space can be partially canceled out by hierarchical greedy execution. To our knowledge, this is the first time the MAXQ framework is applied to a real robot. For future work, we suggest the use of a method which is able to obtain optimal performance.

Common Sub-Space Transfer for Reinforcement Learning Tasks

Haitham Bou Ammar, Mathew Taylor and Karl Tuyls

Type: B - Compressed contribution

Agents in reinforcement learning tasks may learn slowly in large or complex tasks transfer learning is one technique to speed up learning by providing an informative prior. How to best enable transfer be- tween tasks with different state representations and/or actions is currently an open question. This research introduces the concept of a common task subspace, which is used to autonomously learn how two tasks are related. Experiments in two different nonlinear domains empirically show that a learned inter-state mapping can successfully be used by fitted value iteration, to (1) improve the performance of a policy learned with a fixed number of samples, and (2) reduce the time required to converge to a (near-) optimal policy with unlimited samples.

Ensemble Based Co-Training

Jafar Tanha, Maarten Someren and Hamideh Afsarmanesh

Type: A - Regular paper

Recently, Semi-Supervised learning algorithms such as co-training are used in many domains. In co-training, two classifiers based on different subsets of the features or on different learning algorithms are trained in parallel and unlabeled data that are classified differently by the classifiers but for which one classifier has large confidence are labeled and used as training data for the other. In this paper, a new form of co-training, called Ensemble-Co-Training, is proposed that uses an ensemble of different learning algorithms. Based on a theorem by Angluin and Laird that relates noise in the data to the error of hypotheses learned from these data, we propose a criterion for finding a subset of more reliable predictions and error rate for a classifier in each iteration of the training process. Experiments show that the new method in almost all domains gives better results.

Imperfect Information in Fair Non-Repudiation Protocols

Wojciech Jamroga, Sjouke Mauw and Matthijs Melissen

Type: B - Compressed contribution

We indicate two problems with the specifications of fairness that are currently used for the verification of non-repudiation and other fair-exchange protocols. The first of these problems is the implicit assumption of perfect information. The second problem is the possible lack of effectiveness. For both problems, we propose a new definition of fairness that solves them. Moreover, we establish a hierarchy of various definitions of fairness, and indicate the consequences for existing work.

A Multi-Model Ensemble Method that Combines Imperfect Models through Learning

Leonie Van Den Berge, Frank Selten, Wim Wiegerinck and Greg Duane

Type: B - Compressed contribution

At a dozen or so institutes around the world, comprehensive climate models are being developed and improved. Each model provides reasonable simulations of the observed

climate, each with its own strengths and weaknesses. In the current multi-model ensemble approach model simulations are combined a posteriori. We propose an approach in which the models in the ensemble exchange information during simulations and learn from historical observations to combine their strengths into a best representation of the observed climate. The method is developed and tested in the context of small chaotic dynamical systems, like the Lorenz 63 system. The main result of this study is that after learning the super-model is a very good approximation to the truth, much better than each imperfect model separately. These illustrative examples suggest that the super-modeling approach is a promising strategy to improve weather and climate simulations.

Towards Understanding Reasoning Complexity in Practice

Francisco Martin-Recuerda and Dirk Walther

Type: A - Regular paper

Although the computational complexity of the logic underlying the standard OWL 2 for the Web Ontology Language (OWL) appears discouraging for real applications, several contributions have shown that reasoning with OWL ontologies is feasible in practice. It turns out that reasoning in practice is often far less complex than is suggested by the established theoretical complexity bound, which reflects the worst-case scenario. State-of-the reasoners like FaCT++, HermiT, Pellet and Racer have demonstrated that, even with fairly expressive fragments of OWL 2, acceptable performances can be achieved. However, it is still not well understood why reasoning is feasible in practice and it is rather unclear how to study this problem. In this paper, we suggest first steps that in our opinion could lead to a better understanding of practical complexity. We also provide and discuss some initial empirical results with Hermit on prominent ontologies.

Efficient Workplan Management in Maintenance Tasks

Cees Witteveen, Michel Wilson, Nico Roos and Bob Huisman

Type: A - Regular paper

NedTrain is a Dutch company tasked with performing the maintenance of the rolling stock of the national railway company, NS. NedTrain owns several workshops at different locations. The scheduling in one such workshop will be taken as point of departure for the discussion in this paper. After discussing a suitable representation of the NedTrain task workplan problem that allows for a significant speed up in answering basic questions about schedules we address the problem of modeling possible delays of individual tasks in a NedTrain workplan in such a way that questions concerning the likelihood of violation of deadlines can be easily answered. In particular, a method is presented to make use of a probabilistic representation of the possible delays in task executions, making it possible to better evaluate the quality of the schedule with regard to makespan extensions and deadline violations.

Ontology-Driven Adaptive and Pervasive Learning Environments

Ahmet Soylu and Patrick De Causmaecker

Type: B - Compressed contribution

This paper reports an interdisciplinary research project on adaptive and pervasive learning environments. Its interdisciplinary nature is built on a firm collaboration between three main research domains, namely, instructional science, methodology, and computer science. In this paper, we first present and discuss mutual, as well as distinctive, vision and goals of each domain from a computer science perspective. Thereafter, we argue for an ontology-driven approach employing ontologies at run-time and development-time where for- malized ontologies and rules are considered as main medium of adaptivity, user involvement, and automatic application development. Finally, we introduce a prototype domain context ontology for item-based learning environments and demonstrate its run-time and development-time uses.

Learning revenue-maximizing orderings in sequential auctions

Sicco Verwer and Yingqian Zhang

Type: A - Regular paper

When multiple items are auctioned sequentially, the ordering of auctions plays an important role in the total revenue collected by the auctioneer. This is true especially with budget constrained bidders and the presence of complementarities among items. In such sequential auction settings, it is difficult to develop efficient algorithms for finding an optimal sequence of items. However, when historical data are available it is possible to learn good orderings that increase the revenue of the auctioneer. In this work, we show how such a learning model can be built based on previous auctions using regression trees. We provide a greedy method that finds a good sequence for a new set of items given the learned model. We design several experiment scenarios and test the performance of the proposed learning method. The experimental results are promising: they show that good orderings can be found quickly.

Machine Learning 2
Friday, 4 November 2011 — 14:00 - 15:00 — Room: L022

Chair: Marco Wiering

Adaptive Visual Face Tracking for an Autonomous Robot
Herke Van Hoof, Tijn Van Der Zant and Marco Wiering
Type: A - Regular paper

Perception is an essential ability for autonomous robots in non-standardized conditions. However, the appearance of objects can change between different conditions. A system visually tracking a target based on its appearance could lose its target in those cases. A tracker learning the appearance of the target in different conditions should perform better at this task. To learn reliably, the system needs feedback. In this study, feedback is provided by a secondary teacher system that trains the tracker. The learning tracker is compared to a baseline non-learning tracker using data from an autonomous mobile robot operating in realistic conditions. In this experiment, the learning tracker outperforms the non-learning tracker. This shows that we successfully used the teacher system to train a visual tracking system on an autonomous robot.

Learning Conditionally Lexicographic Preference Relations
Richard Booth, Yann Chevaleyre, Jérôme Lang, Jérôme Mengin and Chattrakul Sombattheera
Type: B - Compressed contribution

We consider the problem of learning a user's ordinal preferences on a multiattribute domain, assuming that her preferences are lexicographic. We introduce a general graphical representation called *LP-trees* which captures various natural classes of such preference relations, depending on whether the *importance* order between attributes and/or the *local preferences* on the domain of each attribute is conditional on the values of other attributes. For each class we determine the Vapnik-Chernovenkis dimension, the communication complexity of preference elicitation, and the complexity of identifying a model in the class consistent with a set of user-provided examples.

Towards Being Discrete in Naive Bayesian Networks
Roel Bertens, Linda C. Van Der Gaag and Silja Renooij
Type: A - Regular paper

Bayesian networks are often used in problem domains which include variables of a continuous nature. For capturing such variables, their value ranges basically have to be modelled as finite sets of discrete values. While the output probabilities and conclusions established from a network are dependent of the actual discretisations used for its variables, the effects of choosing alternative discretisations are largely unknown as yet. This paper describes the first steps of a study into the effects of changing discretisations on the probability distributions computed from a Bayesian network. We focus more specifically on the feature variables of a naive Bayesian network and demonstrate how

insights from the research area of sensitivity analysis can be exploited for studying how the network's output is affected by alternative discretisations.

Applications
Friday, 4 November 2011 — 14:00 - 15:00 — Room: L224

Chair: Niek Wijngaards

Pricing mechanism for real-time balancing in regional electricity markets
Mathijs De Weerdt, Wolfgang Ketter and John Collins
Type: B - Compressed contribution

We consider the problem of designing a pricing mechanism for precisely controlling the real-time balance in electricity markets, where retail brokers aggregate the supply and demand of a number of individual customers, and must purchase or sell power at the wholesale level such that the total supply matches total demand. This is typically done for future time periods by buying and selling power, and by setting variable prices for retail customers. In real time, balancing must be done through purchase of regulating services, and by remotely controlling portions of retail customer loads and sources. We enumerate the desirable properties of a market-based balancing mechanism, and analyze the applicability of known theory in two scenarios: a baseline scenario in which brokers have no ability to manipulate their customers' supply and demand, and a single-period scenario with controllable loads. The latter provides promising results for a scenario that takes interactions among time periods into account.

Integrating power and reserve trade in electricity networks
Nicolas Höning, Han Noot and Han La Poutré
Type: B - Compressed contribution

As power markets become liberalised and include more intermittent generation, the trade of reserve energy will become more important. We propose a novel bidding mechanism to integrate power and reserve markets. It facilitates planning while bidding in both markets and adds expressivity to reserve bids.

A Learning Approach to the School Bus Routing Problem
Kristof Van Moffaert, Mihail Mihaylov, Bert Van Vreckem and Ann Nowé
Type: A - Regular paper

In this paper, we introduce a solution to the School Bus Routing problem (SBRP), using a reinforcement learning technique that we previously applied in the domain of transportation logistics. This approach consists of bundling transportation requests between several locations in order to construct combinations of items in a cost-efficient way. We investigate how the combination of reinforcement learning and our novel bundling algorithm can be used to increase the efficiency in logistics and how it can be applied to other domains. In particular, we discuss how the SBRP can be transformed to resemble a problem in transportation logistics and thus solve the SBRP using our combined technique. We obtain results comparable to those presented in literature, namely from a cost minimization approach that is specifically tailored to the SBRP. We conclude that our reinforcement learning and bundling algorithms are flexible enough

to be applied in different domains and offer significant reductions in the cost of the stakeholders.

Semantic Web 2
Friday, 4 November 2011 — 14:00 - 15:00 — Room: M326

Chair: Virginia Dignum

Identifying Prominent Actors in Online Social Networks using Biased Random Walks

Frank Takes and Walter Kosters

Type: A - Regular paper

In this paper we describe the structural characteristics of prominent actors that reside within an online social network. We will show how structural properties can be used in a classification algorithm based on biased random walks for distinguishing between prominent and regular nodes in a social network. The effectiveness of our approach is demonstrated on a large social network dataset with 8 million users and almost 1 billion links, in which the prominent people are already labeled. We show that we can efficiently identify a large portion the prominent people in the network using our algorithm, outperforming standard web-inspired methods such as HITS and PageRank.

A Cluster-Based Approach for Search and Exploration of Tag Spaces

Joni Radelaar, Aart-Jan Boor, Damir Vandic, Jan-Willem Van Dam, Frederik Hogenboom and Flavius Frasincar

Type: B - Compressed contribution

Although Semantic Web technology is increasingly becoming more and more important, tagging remains a popular method to describe Web resources. Therefore it is important to address the issues that are found in current tagging search engines, such as Flickr. We find that the free nature of tagging results in many issues for tag search engines, such as synonyms, homonyms, syntactic variations, etc. The Semantic Tag Clustering Search (STCS) framework deals with these issues by detecting syntactic variations of tags and by clustering semantically related tags. We evaluate our framework using Flickr data from 2009 and compare the STCS framework to two previously introduced tag clustering techniques.

Using Open Source Automatic Speech Recognition for Conceptual Knowledge Monitoring

Ruben Lagatie, Fridolin Wild, Patrick De Causmaecker, Piet Desmet and Peter Scott

Type: A - Regular paper

Useful in many applications, text mining techniques offer the possibility to analyze texts and discover their semantic meaning. Unfortunately, most of these methods only work on textual data, while they are equally useful when dealing with spoken conversations. In this contribution we show how an open source and freely available Automatic Speech Recognition engine can be used as a preprocessing step for topic spotting by transcribing spoken conversations. We show how such a system needs to be set up and configured and how this combines with an existing topic spotting implementation.

Machine Learning 3
Friday, 4 November 2011 — 15:00 - 16:00 — Room: L022

Chair: Marco Wiering

Modeling Inter-practice Variation of Disease Interactions using Multilevel Bayesian Networks

Martijn Lappenschaar, Arjen Hommersom, Peter J.F. Lucas and Stefan Visscher

Type: A - Regular paper

Multimorbidity is becoming a significant health-care problem for western societies, especially within the elderly. Since medical knowledge is mostly organized around single diseases, it is unlikely that the elderly patient with multiple diseases receives appropriate treatment. To get a grip on complex interactions, we aim to model domains using hierarchies, for example, patient characteristics, pathophysiology, and symptomatology. For this we introduce *Multilevel Bayesian networks*, which we have applied to clinical data from family practices in the Netherlands on heart failure and diabetes mellitus. We compare the outcomes to conventional methods, which reveals a better insight of interactions between multiple diseases.

Basic Properties of Class Hierarchies regarding Probability Distributions

Wenyun Quan, Patrick Van Bommel and Peter J. F. Lucas

Type: A - Regular paper

Concepts from object orientation have been applied to many fields to facilitate solving complex real-world problems. Medicine is an example of such a complex field, where, however, also the modeling of uncertainty is of major importance. It is our belief that object orientation can also play a role in the medical field to make representing and reasoning with uncertain knowledge easier. However, there is little known about how ideas from object orientation affect the specification and use of probability distributions. In this paper it is studied in what way structured probabilistic models can be organized in class hierarchies. We will provide a theoretical foundation of probabilistic models with object orientation, which are called probabilistic class hierarchies. This is expected to offer a basis for the modeling of complex problems, such as those in medicine, from which the examples used in this paper come.

Tuning Methods in Statistical Machine Translation

Anne Schuth

KION Thesis Award Presentation 2010-2011

Metaheuristics and Optimization 3
Friday, 4 November 2011 — 15:00 - 16:00 — Room: L224

Chair: Patrick De Causmaecker

Optimal Mixing Evolutionary Algorithms

Dirk Thierens and Peter Bosman

Type: B - Compressed contribution

A key search mechanism in Evolutionary Algorithms is the mixing or juxtaposing of partial solutions present in the parent solutions. In this paper we look at the efficiency of mixing in genetic algorithms (GAs) and estimation-of-distribution algorithms (EDAs). We compute the mixing probabilities of two partial solutions and discuss the effect of the covariance build-up in GAs and EDas. Moreover, we propose two new Evolutionary Algorithms that maximize the juxtaposing of the partial solutions present in the parents: the Recombinative Optimal Mixing Evolutionary Algorithm (ROMEA) and the Gene-pool Optimal Mixing Evolutionary Algorithm (GOMEA).

Optimal Temporal Decoupling in Task Scheduling with Preferences

Leon Endhoven, Tomas Klos and Cees Witteveen

Type: A - Regular paper

Planning and scheduling are important problems, but unfortunately hard to solve in general. They aren't any easier in multiagent contexts, where different autonomous agents' schedules may interfere with the overall goal. A solution to this problem is *decoupling*, which entails adding local constraints for the agents so that they can schedule autonomously within those constraints, while they guarantee that a conflict-free global solution can be constructed from the individual agents' plans. In this paper we investigate finding an optimal decoupling, that maximizes the sum of the agents preferences about their scheduling of tasks. We show using a Linear Programming (LP) approach that optimal decouplings can be found efficiently by exploiting the properties of a task scheduling instance.

An algorithm selection approach for nurse rostering

Tommy Messelis and Patrick De Causmaecker

Type: A - Regular paper

In this paper, we investigate the possibility of building an algorithm portfolio solver for the practical real world combinatorial optimisation problem of nurse rostering. As a basis for this paper, we use the First International Nurse Rostering Competition 2010. A number of competitive algorithms are combined to form a super-algorithm that performs better than any of its components individually. This is shown through an experimental study.

Games
Friday, 4 November 2011 — 15:00 - 16:00 — Room: M326

Chair: Jaap van den Herik

Best-Reply Search for Multi-Player Games

Maarten Schadd and Mark Winands

Type: B - Compressed contribution

This extended abstract proposes a new algorithm, called Best- Reply Search (BRS), for deterministic multi-player games with perfect information. In BRS, only the opponent with the strongest counter move is allowed to make a move. More turns of the root player can be searched resulting in long-term planning. We test BRS in the games of Chinese Checkers, Focus and Rolit. In all games, BRS is superior to the maxN algorithm. We show that BRS also outperforms paranoid in Chinese Checkers and Focus. In Rolit, BRS is on equal footing with paranoid. We conclude that BRS is a promising search method for deterministic multi-player games with perfect information.

Monte-Carlo Tree Search for the Game of Scotland Yard

J. A. M. Nijssen and Mark H. M. Winands

Type: B - Compressed contribution

This paper describes how Monte-Carlo Tree Search (MCTS) can be applied to play the hide-and-seek game Scotland Yard. It is essentially a two-player game in which the players are moving on a graph-based map. We show how limiting the number of possible locations of the hider by using information about the hider's moves increases the performance of the seekers considerably. We also propose a new technique, called Location Categorization, that biases the possible locations of the hider. The experimental results show that Location Categorization is a robust technique which significantly increases the performance of the seekers in Scotland Yard. Next, we show how we handle the coalition of the seekers in Scotland Yard, using Coalition Reduction. Coalition Reduction balances each seeker's participation in the coalition by letting them seek the hider more greedily. This technique improves the performance of the seekers significantly. Furthermore, we explain how domain knowledge is incorporated by implementing epsilon-greedy playouts for the hider and the seekers and move filtering to improve the performance of the hider. Finally, we test the performance of our MCTS program against a commercial Scotland Yard program on the Nintendo DS. The results show that the MCTS-based program plays stronger than this program.

Active Opening Book Application for Monte-Carlo Tree Search in 19x19 Go

Hendrik Baier and Mark H. M. Winands

Type: A - Regular paper

The dominant approach for programs playing the Asian board game of Go is nowadays Monte-Carlo Tree Search (MCTS). However, MCTS does not perform well in the opening phase of the game, as the branching factor is high and consequences of moves

can be distant. Human knowledge about Go openings is typically captured in joseki, local sequences of moves that are considered optimal for both players. The choice of the correct joseki in a given whole-board position, however, is difficult to formalize.

This paper presents an approach to successfuly apply global as well as local opening moves, extracted from databases of high-level game records, in the MCTS framework. Instead of blindly playing moves that match local joseki patterns (passive opening book application), knowledge about these moves is integrated into the search algorithm by the techniques of move pruning and move biasing (active opening book application). Thus, the opening book serves to nudge the search into the direction of tried and tested local moves, while the search is able to filter out locally optimal, but globally problematic move choices.

In our experiments, active book application outperforms passive book application and plain MCTS in 19x19 Go.

Award Session and Closing
Friday, 4 November 2011 — 16:15 - 16:45 — Room: L226

Best paper award
Sponsored by Platform Machine learning/SNN (www.mlplatform.nl)

Best demo award
Sponsored by SKBS / Strukton

List of Participants

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