NEWSLETTER

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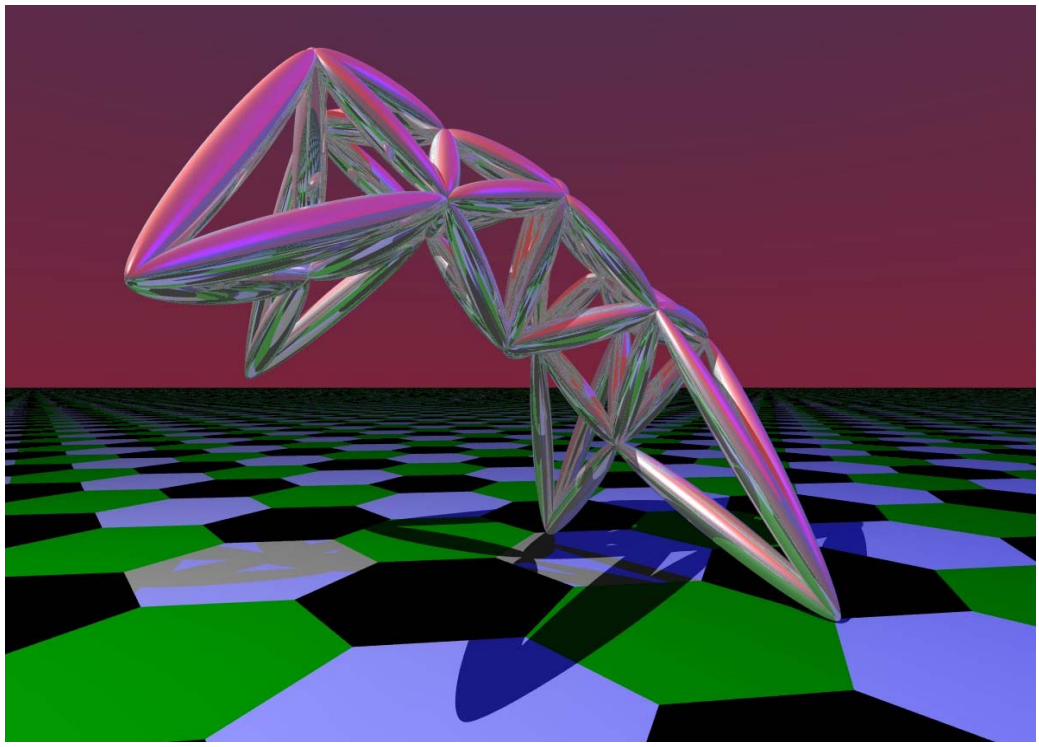

IKS Research in The Netherlands

BNAIC 2005: session reports

From Geometry to Evolution

News from the Belgium-Netherlands Association for Artificial Intelligence

Trends in AI

Editor-in-chief

This is the last issue of the Newsletter of the year 2005. I believe it was a rather successful year for the AI community, both regarding quality and quantity. To witness this statement this issue presents circumstantial evidence.

First, Richard Starmans reports in a lengthy article (see pp. 128-135) on current topics in IKS research. Based on five research questions he developed a questionnaire for SIKS Ph.D. researchers with the aim to identify a structure in the field. Analyzing the results of over 200 filled-in questionnaires he arrived at five sub-areas in the IKS-field, all very "AI-related". Though Software Engineering seems to lose some influence in the last years, Database / Information Systems and Artificial Intelligence show a clear rising trend. Also, a growing number of researchers consider him- or herself to be an AI researcher.

Second, as reported by Jaap van den Herik (see pp. 150-152) the number of SIKS Ph.D. theses continues in growing. The number of AI(-related) theses, as reported in this Newsletter, though somewhat more whimsical, also follows the trend, with a doubling of the average number of Ph.D. theses per year to over 40 in the last decade.

Third, this year's BNAIC conference was again a great event. General impressions were already give in the previous issue. This issue reinforces this feeling by providing ten session reports by the session chairs of BNAIC 2005 (see pp. 135-141). Moreover, this issue contains a report on two prize-giving events during the BNAIC, i.e., the 2005 SKBS Prize for the best demonstration, handed out to Gerald de Jong, and the KION M.Sc. Thesis Award, handed out to Olaf Booij.

During the BNVKI General Assembly Meeting at the BNAIC 2005, which was well attended compared to previous years, the members elected as new board member Marie-Francine (or Sien, in short) Moens. Since she has been a section editor of the Newsletter for many years, providing me with many contributions, I expect her to yield many fruitful contributions to the Board also. Sien, welcome!

Regarding the prize-winning demonstration at BNAIC 2005, mentioned above, we are glad that its author, Gerald de Jong, provided us with an inside story of the birth and rise of his *Fluidiom* software, which really generates fascinating creatures. Several pictures of these have been included in this issue. Of course it is a pity that no movies can be attached, since to see the creatures glide, crawl, walk or jump is even more intriguing. Therefore I sincerely advise anyone interested to visit the *Fluidiom* webpage (see URL below), on which several movies can be seen and which contains many more details.

Another noteworthy event in 2005 was the annual SIKS day, as reported by André Meyer and Niek Wijngaards (see pp. 145-146). This event witnessed the stepping down of the scientific director of SIKS, Prof. John-Jules Meyer. His successor is Prof. Roel Wieringa. We join the authors in thanking John-Jules wholeheartedly for all his efforts and in wishing Roel much success for the years to come.

I wish you all a very happy and most of all very fruitful 2006!

SIKS homepage: http://www.siks.nl/
BNAIC 2005: http://como.vub.ac.be/bnaic2005/
Fluidiom: http://fluidiom.sourceforge.net/

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The photographs in this issue are by courtesy of Gerald de Jong (front cover and pp. 143-144) and the Universiteit van Amsterdam (p. 142).

Front cover: Survival of the Quickest (see the article by Gerald de Jong on pages 143-145).

The deadline for the next issue is: **February 3, 2006**.

BNVKI-Board News

Han La Poutré

First of all, the Board of the BNVKI wishes you a happy and successful 2006. Also, the Board welcomes a new board member, Marie-Francine Moens, who was elected into the board during the General Assembly of last October. This year, several activities organized under the umbrella of the BNVKI will take place. Noticible are of course the BNAIC in Namur in October and the BNAIS in Nijmegen in June.

The Board is also carrying out various other activities. As discussed in the last General Assembly of the BNVKI (in Brussels), we are considering the future organisation of activities and finance of the BNVKI. Important aspects here are, e.g., the form of the Newsletter; a good financial structure of the BNVKI in the future; the position, form, and costs of the BNAIC; the relation to or cooperation with sponsors; and others. Since these all address fundamental aspects of the BNVKI, the Board is considering each of them carefully and also in relation to each other. It is expected that in the spring we can make some decisions for the future, and that this can be presented at the next General Assembly in October. As already mentioned in the last General Assembly, the Board welcomes input from members.

Also, the Board is concluding its activities of formalizing (i.e., giving concrete form to) several of its activities, guidelines and procedures. In the recent past, guidelines for, e.g., type of BNAIC papers (A, B, and C) have been set; a financial framework between BNAIC and BNVKI has been designed; the by-laws have been updated and improved; official web-domains for BNVKI and BNAIC as well as an ISSN number for the BNAIC proceedings have been issued; and the mission of the BNAIC has been formulated. At the moment, the scenario for organizing BNAICs is being finalized; and the participation of (industrial) sponsors for BNAIC is being organized.

So, 2006 will be an important year for the BNVKI, for both the organized activities and for the organization of the BNVKI itself. The Board is actively working on this, and looks optimistic into the future. Again, we wish you a happy and successful 2006.

Current Topics In IKS-Research A Quantitative Approach

Richard Starmans
Utrecht University

INTRODUCTION

The area of information and computing sciences is a relatively new, but by now it is a well-established academic discipline. At the same time, it is a heterogeneous, dynamic and therefore complex research area as well. It is heterogeneous, in the sense that it comprises many different disciplines and subdisciplines, emerging from different scientific traditions; each with its own topics, methodologies, research approaches, research strategies, reference disciplines, vision on validation / evaluation and application areas. It is dynamic in the sense that the field is in a continuous state of transition: existing disciplines and paradigms may be redefined or adjusted, new themes and topics emerge rapidly and research agenda's are amended repeatedly. Nature and structure of the field are not predetermined or fixed for eternity; at the most an equilibrium for some time can be expected.

Purely from a scientific point of view it might be important to get insight into the nature and structure of the information and computing sciences: to identify its disciplines and subdisciplines, their relative "importance" and "relevance" and their interrelations, similarities and dissimilarities regarding research approaches, research methods and methodology, reference disciplines, scientific output, etc. These issues might be of some concern for those researchers interested in the foundations or philosophy of computer science, studying its epistemological claims and methodological status. Also, if one acknowledges that scientific research in information and computing disciplines is an important mechanism through which progress in the field of ICT gets initiated, then insight into the nature and structure of scientific research as it is currently being conducted, certainly is worthwhile.

Obviously, many studies examine the nature of research in computer science, but typically they tend to focus on specific areas and sub-areas, rather than scrutinizing the field as a whole (see for example Ramesh, Glass, and Vessey, 2004; Glass, Ramesh, and Vessey, 2004). More specifically, large-scale empirical studies to identify nature and structure or to monitor developments in the field are quite rare.

KEYWORDS AND INDEX TERMS

Be that as it may, it is far from trivial to obtain this insight without doing research. For example, one can hardly rely on generally acknowledged

classification schemes or taxonomies. In fact, most attempts to break down the field and come up with classification systems have not been very successful. For instance, the ACM-classification and sub-classification of computer science (CS), information systems (IS) and software engineering (SE) is well known, but much criticized at the same time. And more importantly, scientific conferences and journals are very reluctant to use rigid classification systems or even delineate the research area at stake. Although there are considerable differences between the journals, typically, most of their editorial boards only publish a very small "scope and aims" section, followed by a list with key-words or index terms, usually with no specific order, structure or further explanation. By and large, these terms are rather heterogeneous. Some are very narrowly focused, others cover a broad field. Sometimes two terms do look almost synonymous, another time one term seems to be subsumed by the other. Also, they are frequently taken from different reference disciplines and taxonomies / classifications.

Now, considering the goals of any editorial board or conference board, this policy is certainly understandable and defendable. But for those interested in the nature and structure of computer science, such an unordered list is not of much use. However, we believe it can be the starting point to gain this insight and understanding. This contribution is based on the assumption that a detailed analysis of the use of the aforementioned keywords can contribute to our understanding of the field of information and computing sciences, its underlying structure and the relative importance of its topics.

AIM

In this contribution, we obviously cannot cover the entire research in information and computing sciences, but we confine ourselves to the research on information and knowledge systems (IKS), which still is a broad field. The aim of this study is to contribute to the insight into the current state and structure of scientific research in the IKS-field in the Netherlands by analyzing the use of a large number of keywords or index terms, mainly taken from conferences and journals in the IKS-field. Following the "meaning is use" adage of the ordinary language philosophy, we believe that meaning, significance and scope of the terms can actually be established "bottom-up" by analyzing how a relevant and sufficiently large group of language-users applies them. By studying the occurrence, interrelations of the index terms, their relative importance, scope and in fact their meaning can be established and (underlying) structures or patterns in the IKS-field can be recognized.

POPULATION

We therefore conducted a large-scale empirical research and asked over 200 researchers working in the IKS-field if and to what extent their research can be related to/associated with these keywords. These researchers had two things in common; they were all involved in Ph.D. research in the Netherlands in the period October 2003 – October 2005 and in the same period they were all registered in the National Dutch Research School for Information and Knowledge Systems (SIKS). Founded in the mid-nineties by researchers in the field of Artificial Intelligence (AI), Databases / Information Systems (DB/IS) and Software Engineering (SE), SIKS currently identifies eight research themes:

- Agent technology (AGENT)
- Computational intelligence (CI)
- Knowledge representation and reasoning (KR_R)
- Web-based information systems (WEB)
- E-business systems (E_bus)
- Human computer interaction (HCI)
- Data management, storage and retrieval (D_S_R)
- Architecture-driven system development. (Archi)

The over 200 researchers were employed at ten universities and the CWI and although our research population is not a full representation of all research conducted in IKS in the Netherlands, it is sufficiently representative for our explorative purposes in this contribution.

RESEARCH QUESTIONS

Since these "founding disciplines" AI, DB/IS and SE are all internationally identifiable fields of research with their own conferences and journals, it is worthwhile to (re)assess their relevance for current research in IKS in our study. For the eight research themes the same argument applies. Confronting the researchers with these topics does not violate our bottom-up approach; rather it is to be considered as a first, preparatory step towards describing and understanding the field and it can be instrumental to better understand or validate the results of an analysis of the other keywords and vice versa.

Given the chosen objective and the population, we try to answer the following five questions:

1. To what extent are AI, DB/IS and SE still recognizable and relevant in the IKS-field?
2. What is the "joint" profile of the IKS-community, based on the eight research themes?
3. What are the "separate" profiles of the AI-researchers, DB/IS-researchers and SE-researchers, based on the eight research themes?

4. How can the eight research themes be further characterized and interpreted with the help of a list of selected keywords?
5. What underlying structure of the IKS fields can be established, based on an analysis of the list of keywords and taking into account the answers to the previous four questions?

Clearly, the first three questions are preparatory and "top-down" in the sense that they are based on an existing classification or rather framework. Question 5 is the key-question we address; it is "bottom-up" oriented, reflecting the original explorative purpose of the contribution. Question 4 is intermediary in the sense that it relates the research themes to the keywords and index terms.

MATERIALS

To answer the aforementioned research questions we developed an electronic questionnaire with over 80 questions, all keywords followed by a 5-point scale ranging from "not at all" to "very much". The general idea is that by indicating if and to what extent these terms are relevant / characteristic for a specific research project, these notions will get shape and their relative importance for IKS can be established. The questionnaire comprised three clusters of questions.

First, in cluster 1 we asked the respondent if and to what extent his research fits into / can be related to the fields of AI, DB/IS and SE. Put differently, to what extent does the researcher consider himself to be an AI-researcher, or a BD/IS- researcher or a SE-researcher? Obviously, since these three fields are not mutual exclusive categories of one variable, we should not force the respondent to choose for one of them. Therefore, we needed three questions, the answers of which give us some information on the dependencies between the three fields as well.

Secondly, in cluster 2, we asked if and to what extent the research fits into / can be related to one or more of the aforementioned eight research themes. Put differently, to what extent does the researcher consider himself to be an Agent-researcher, involved in "E-business systems" or associated with "Human computer interaction", etcetera? Analogously to Cluster 1 we are not dealing with mutual exclusive categories, so eight variables/items in the questionnaire were considered necessary.

Finally, and most importantly, in the third cluster of questions, we confronted the researchers with a set of 70 heterogeneous "keywords". Not only can we use them to find patterns and structure in the field, but we can utilize them to better understand and validate answers on the questions formulated in clusters 1 and 2, and vice versa.

Data manipulation

For some analyses we use the ordinal ranking provided by the respondents; for example in calculating ordinal correlation coefficients and performing principal components analysis, although formally, the latter technique demands interval level information. For other analyses, we dichotomized the data. We did that in two different ways, using two cut-off points. In the "strong" sense someone is considered to be an DB/IS-researcher/involved in DB/IS-field if he scores "much" or "very much" on that particular item, and is considered not involved else. In the "weak" sense someone is an DB/IS researcher if he scores "fairly", "much", or "very much", and is considered not involved else. So, to make the analysis more robust, we performed analyses twice, using both the strong and weak version. Generally speaking, the differences appeared to be rather small. We only report the results of the "strong"-sense approach. In this short contribution neither these differences are taken into account, nor the statistical details concerning the analyses.

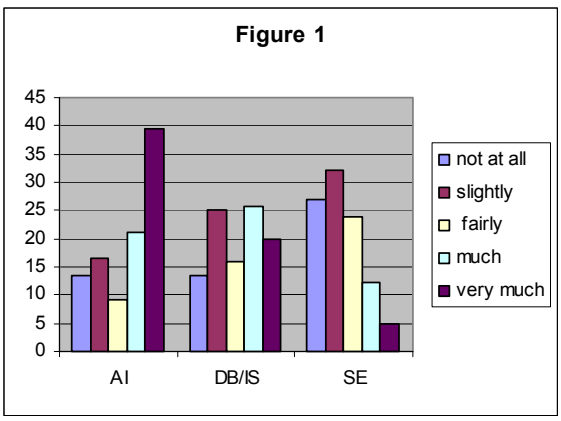
RESULTS

The response percentage was over 90% which is very encouraging. In presenting the main results we follow the order of the five research questions.

Question 1: To what extent are AI, DB/IS and SE still recognizable and relevant in the IKS-field?

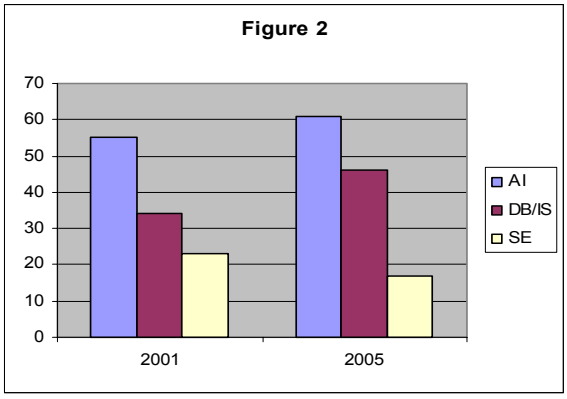
Figure 1 gives a first impression of the relevance of AI, DB/IS and SE for the IKS-field today. It shows the percentages of all five categories of the items. Clearly, AI has a very dominant position. Over 60% scores "much" or "very much" and no less than 40% of the researchers indicates to be "very much" involved. Also noticeable is the fact that very few respondents score "fairly". Put roughly; researchers do seem to easily make up their mind whether they are involved in AI-research or not.

Figure 1



Regarding the research in DB/IS the distribution is more balanced. Still, 46% scores "much" or "very much", which suggests a highly relevant research area. Finally, SE plays a rather modest role in the research projects of our population today. Remarkable is that the category "fairly" is stronger represented than in the AI-field or DB/IS-field. Put roughly; relatively many researchers do feel being involved in SE, but not too strongly.

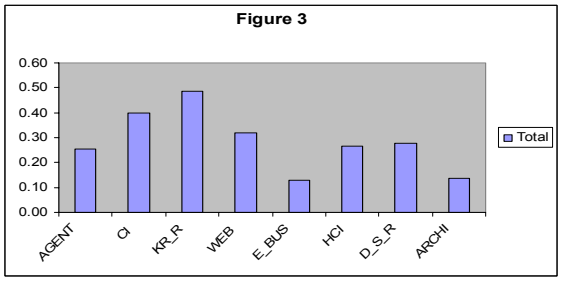
In Figure 2 we compare the results with the situation in 2001, but here the variables are dichotomized in the "strong sense": only if one scores "much" or "very much" one is considered to be an AI-researcher. Figure 2 suggests that in 2005 AI became even more important. Its relative frequency increased from 54% to 61%. However, the increase of relevance is even stronger in DB/IS-research. We observe a rise from 34% to 49%. Figure 2 also suggest that the role of SE in our population loses some influence.



The variables are not independent; there still is a distinctive negative correlation between AI and DB/IS (r = –0.39) and a very weak negative correlation between AI and SE (r = –0.12) Unsurprisingly, the correlation between DB/IS and SE is positive, though not strong (r = 0.22). After dichotomizing the data, only 18% of the researchers associates its research with both AI and DB/IS. At this level of analysis the data still suggest two separate worlds.

Question 2: What is the "joint" profile of the IKS-community, based on the eight research themes?

Figure 3 gives a first impression of the relevance of the eight research themes by showing the distribution of their relative frequencies. It suggests that KR_R (49%) and CI (40%) are by far the most dominant themes in IKS-research as represented in our population. KR_R typically is referred to as the foundational area of classical, symbolic AI, whereas CI usually is rather associated with sub-symbolic, numerical techniques. Whether these characterizations are adequate will be made clear in answering the third and fourth research question. Secondly, we observe that WEB, AGENT, HCI and D_S_R are all considered important research areas with scores in the range of 25% to 35%. Finally, our data suggest that ARCHI and E_BUS are numerically relatively small research areas in the IKS-field as represented in our population. Only 17% and 13% respectively indicates to be involved in this research.



This distribution is a first indicator of the relative importance of these themes, but as such does not give much insight in the structure of the field. However, the eight research themes do already shed some light on (the differences in) the profiles of the AI-researchers, the DB/IS-researchers and the SE-researchers, as Table 1 points out.

Question 3: What are the "separate" profiles of the AI-researchers, DB/IS-researchers and SE-researchers, based on the eight research themes?

TABLE 1	Total	AI	DB/IS	SE
AGENT	0.25	0.39	0.13	0.25
CI	0.40	0.52	0.28	0.11
KR_R	0.49	0.63	0.5	0.50
WEB	0.32	0.24	0.58	0.67
E_BUS	0.13	0.12	0.24	0.48
HCI	0.27	0.20	0.36	0.37
D_S_R	0.28	0.17	0.55	0.36
ARCHI	0.14	0.10	0.20	0.44

Table 1 should be read as follows. From the AI-researchers only 12% considers himself involved in E-BUS, from the DB/IS-community more than half associates its research with D_S_R and from the SE-researchers nearly 70% is involved in WEB. This rather condensed table shows some interesting observations that ask for further analysis and explanation. In this short contribution, we confine ourselves to the most relevant ones.

First, it is noteworthy that KR_R is the most dominant among AI-researchers (63%), but also

very important for DB/IS and SE-researchers (both 50%). So in this respect, it is not a very distinctive characteristic or subgroup for this population and the use of the term is not restricted exclusively to the foundational area of classical, symbolic AI. The at first sight paradoxical fact that the overall score (49%) is lower than the scores of the three founding disciplines, can easily be explained by the fact that AI, DB/IS and SE are three distinct variables, not three mutually exclusive and totally exhaustive categories of one variable.

Next, CI appears to be a leading research theme in the IKS-field: among AI-researchers it scores 52% and in DB/IS and SE considerably lower, the data suggest it is a rather distinctive characteristic of the population.

Thirdly, the data indicate that WEB plays a rather important role in DB/IS (58%) but is considerably less dominant in AI (24%). This is noteworthy given the fact that many AI-researchers are involved in Semantic Web, Ontologies and metadata and Web intelligence. Also the high score of WEB in the SE-community (67%) is notable.

Fourthly, we observe that E_BUS and ARCHI are relatively small, not only in the entire population, but even among DB/IS-researchers. On the other hand WEB (58%) and D_S_R (55%) are very important in DB/IS-research. This suggests that the remarkable rise in DB/IS-research in the Netherlands that Figure 2 suggests is due to a rise in research in database technology (DB) rather than in information systems (IS).

Finally, we can summarize some relations. Roughly put, KR_R, CI and AGENT are associated with AI. KR_R, WEB, HCI and D_S_R are dominant in DB/IS and SE is best associated with the research themes WEB, E_BUS, KR_R and ARCHI. So with the exception of KR_R the eight research themes do seem to be pretty distinctive in characterizing the AI-, DB/IS- and SE-community.

Question 4: How can the eight research themes be further characterized and interpreted with the help of the selected keywords?

We will sketch a very short profile of each research theme by indicating to what extent its researchers are involved in the three founding disciplines, how it is correlated with the other research themes, what are the most relevant keywords and what roles qualitative empirical research (QUAL) and quantitative empirical research (QUAN) play in it.

AGENT TECHNOLOGY

Agent researchers consider themselves heavily involved in AI-research (93%) and only slightly in DB/IS (22%) and SE (20%). The NOAG-ICT theme Intelligent systems scores highly as well (85%) Considering the other research themes: KR_R unsurprisingly scores high (59%), and less unsurprisingly CI scores 32%. Regarding the correlations with the other research themes only a few weak associations can be found. Remarkably the correlation with WEB is weakly negative ($r = -0.17$) and with ARCHI it is weakly positive ($r = 0.27$).

Furthermore, the field is best characterized with the keywords Agent architectures (73%), Agent languages (60%), KR_R (59%), Cooperative systems (57%), Interactive systems (57%), Distributed systems (50%), and Adaptive systems (50%). In addition, the other keywords suggest that AGENT is rooted for the main part in the classical, logical or symbolic tradition. Remarkable is that Semantic web only scores (15%) among AGENT-researchers. Amongst AGENT researchers QUAL scores 75% and QUAN scores only 15%.

COMPUTATIONAL INTELLIGENCE

CI-researchers consider themselves heavily involved in AI-research (88%), noticeably in DB/IS (36%) and only slightly in SE (7%). The NOAG-ICT theme Intelligent systems scores highly as well (70%). Considering the other research themes: only KR_R scores high (59%) and D_S_R still notably (28%) There are no relevant correlations with the other research themes. Furthermore, the field is best characterized with the keywords Machine learning (72%), Intelligent data-analysis (48%), Bayesian networks (42%), Data-mining (40%), Statistical simulation (39%), Reasoning under uncertainty (39%). In addition the other keywords indicate that CI has few concern with classical AI-issues like Model-based reasoning, Common-sense reasoning, (modal) Logic, Planning, etc. QUAN scores 33%, QUAL scores 66% amongst CI-researchers.

KNOWLEDGE REPRESENTATION AND REASONING

KR_R-researchers find themselves heavily involved in AI-research (78%) and DB/IS (46%) and slightly in SE (19%). The NOAG-ICT theme Intelligent systems scores highly as well (68%). Considering the other research themes: CI, AGENT WEB and even D_S_R all have rather high scores. There are no relevant correlations with the other research themes. Furthermore, the field is best characterized with quite diverging keywords: Metadata and ontologies (48%), Reuse of information (44%), Knowledge acquisition and elicitation (44%), Semantic web (43%), Reasoning under uncertainty

(40%), Intelligent data-analysis (37%), Digital library (33%), Machine learning (32%), XML-technology (31%), and Agent architectures (30%). We already observed in Table 1 that the data suggest that KR_R is not only the foundational area of classical AI. The other keywords from the list confirm this view. Finally, among KR_R-researchers QUAL scores 58% and QUAN only 23%.

WEB-BASED SYSTEMS

WEB-researchers find themselves heavily involved in DB/IS (81%), strongly in AI-research (45%) and considerably in SE (33%). The NOAG-ICT theme Intelligent systems scores highly as well (44%). Considering the other research themes: KR_R scores 52%, D_S_R 48% and HCI 40%. Regarding the correlations with the other research themes there are strong associations with E-BUS (r = 0.43) and D_S_R (r = 0.42) and a weak negative relation with Agent (r = –0.17).

Furthermore, the field is best characterized with quite diverging keywords: XML/semi-structured data (81%), Digital library (62%) Metadata and ontologies (60%) Semantic web (52%), Reuse of information (48%), Knowledge acquisition and elicitation (44%), Semantic web (43%), Reasoning under uncertainty (40%), Intelligent data-analysis (37%). The analysis of these and other keywords suggest that the research theme WEB essentially has two separated subgroups: one emerging from the DB/IS-community dealing with XML, database technology, D_S_R; the other emerging from the AI-community focusing on semantic web, KR_R, intelligent systems, metadata and ontologies. Under WEB-researchers QUAL scores 67% and QUAN 27%.

E-BUSINESS SYSTEMS

E_BUS researchers consider themselves heavily involved in DB/IS (67%) and considerably in SE (40%) and AI (40%). The NOAG-ICT theme Intelligent systems scores 40%. Considering the other research themes, WEB scores 80%, KR_R 40% and ARCHI 27%. Regarding the correlations with the other research themes there are strong associations with WEB (r = 0.43), D_S_R (r = 0.42) HCI (r = 0.28) and ARCHI (r = 0.31).

Furthermore, the field is best characterized with the keywords: Business process modeling (80%) E-services (80%) Distributed systems (60%) Enterprise modeling (52%) Business process alignment (47%). Remarkably under E-BUS-researchers QUAL (13%) and QUAN (20%) obtain low scores.

HUMAN COMPUTER INTERACTION

HCI-researchers consider themselves strongly involved in DB/IS (60%), AI (44%) and weakly in SE (22%). The NOAG-ICT theme Intelligent systems scores highly as well (45%). Considering the other 7 research themes: again KR_R scores high (55%), just like WEB (48%) and D_S_R (36%). There are no relevant correlations with the other research themes. Furthermore, HCI is most associated with Interactive systems (66%), Interface design (44%), Multimedia (43%), Hypertext and hypermedia (43%) XML-technology (36%) and Usability engineering (36%). More than the other research themes HCI-researchers are involved in quantitative empirical research: QUAN scores 40%. QUAL scores 41%.

DATA-MANAGEMENT, STORAGE AND RETRIEVAL

D_S_R-researchers consider themselves strongly involved in DB/IS research (87%). AI scores 38% and SE scores 22%. The NOAG-ICT theme Intelligent systems scores 36%. Considering the other 7 research themes: WEB scores 57%, KR_R 53%.

Furthermore, D_S_R is most associated with quite divergent keywords: Digital library/document retrieval (75%), XML-technology (68%), DB technology (67%), Metadata and ontologies (66%), Information retrieval (66%), Semantic web (50%), Intelligent data analysis (48%), Reuse of information (45%) Information enrichment (41%), data-mining (40%). Remarkably under D_S_R-researchers QUAL scores 75% and QUAN 27%.

ARCHITECTURES

Archi-researchers consider themselves strongly involved with DB/IS (64%) and SE (55%). AI scores 45%. The NOAG-ICT theme Intelligent systems scores 57%. Considering the other 7 research themes: WEB scores 50%, E_BUS 45%, AGENT 45%, and KR_R 41%. Regarding the correlations with the other research themes there are some associations with E-BUS (r = 0.31), AGENT (r = 0.27), and WEB (r = 0.25). Furthermore, the field is best characterized with quite diverging keywords: Distributed systems (68%), Software architectures (62%) XML (52%), Database technology (48%), Metadata and ontologies (48%), Component-based development (48%), Adaptive systems (42%), and Information management (43%). Remarkably, under Archi-researchers QUAL scores 75% and QUAN only 5%.

These eight profiles do give a more detailed view on what the eight research themes are all about. Some of them can be described in a straightforward way, others do not seem to be easily and consistently depicted with the keywords and suggest that a

different, more simple structure in the field could be identifiable. This issue will be addressed in the last question of this paper.

Question 5: What underlying structure in the IKS-field can be established, based on an analysis of the list of keywords and taking into account the answers to the previous four questions?

To answer this question we first conducted a few principal-component analyses on subsets of the entire list of items. In some analyses we restricted ourselves to subsets of the items of cluster 3, in other analyses we also entered the items from cluster 1 and/or cluster 2 to validate the findings from questions 3 and 4, to see how they affect the solutions and to what extent consistency is possible. It is well known that analyses like these are sensitive to the applied algorithms for factor extraction, rotation procedures, the (number of) variables that entered the analysis, etc. However, for our explorative purposes consistency in solutions and interpretability of a solution (also taking into account the answers to the previous questions) is sufficient to meaningfully identify or suggest an underlying structure.

Rather easily in many analyses five factors/components, were consistently found, representing five separate sub-areas in the IKS-field, only based on our empirical data and for the main part in line with the previous results. It appeared rather straightforward to find a simple structure (where all relevant keywords have high loadings on one particular factor and distinctively lower loadings on the others).

COMPUTATIONAL INTELLIGENCE

In all analyses that we performed, very consistently a component was recognizable / extracted with high loadings for the research theme CI, as well as for the keywords Machine learning, Intelligent data-analysis, Data-mining, Bayesian networks, Probabilistic reasoning, Neural networks, Evolutionary computing, Statistical modeling and simulation, Reasoning under uncertainty, and Pattern recognition. There is no reason why we should not keep hold of the old label "Computational intelligence" to depict this component.

AGENT SYSTEMS

Analogously, we found in all analyses a component with high loadings for the SIKS-research theme AGENT as well as for the keywords Agent languages, Agent architectures, Cooperative systems, Distributed systems, Cooperative planning and problem solving, and Compositional design of IKS. There is no reason why we should not retain the old label "Agent systems" to describe this component.

HUMAN COMPUTER INTERACTION

In the different analyses quite easily and consistently a factor could be extracted with high loadings for the research theme HCI, as well as for the keywords Interactive systems, Interface design, Groupware / CSCW, Virtual reality, Usability engineering, and Quantitative empirical research. There is no reason why we should not retain the old label "Human computer interaction" to depict this component.

WEB AND DATABASE TECHNOLOGY

We also found in different analyses quite easily and consistently a factor with high loadings for the research themes WEB and D_S_R, for the founding discipline DB/IS, as well as for the keywords Information retrieval, Multimedia retrieval, Semantic web, Metadata and ontologies, Reuse of information, XML and semi-structured data, Database technology, Information enrichment, as well as Digital library, content management. Put roughly, it covers the wide-ranging field of retrieval and presentation of semi-structured document-centric information, but also the supporting technology (storage, novel architectures, algorithms) that scale towards the data volumes that are required in real-life applications. We therefore label this research area here "Web and database technology".

ENTERPRISE INFORMATION SYSTEMS

Analogously, we consistently found in several analyses a factor with high loadings for the SIKS-research theme E-bus and Archi, the founding discipline SE, as well as the keywords Enterprise modeling, Requirements engineering, Business process modeling, Workflow management, Social and organizational implications of ICT, Alignment, Component-based development, and Software architectures.

Because all these items are related to / are situated at the "organizational level" (processes, infrastructure, information), we label this factor here "Enterprise information systems".

CONCLUSION

To obtain real insight into the nature and structure of a scientific discipline one should address many things, including the research topics that researchers deal with, their research approaches, research methods, reference disciplines and the "level of analysis" (Ramesh *et al.*, 2004). However, in a complex area like IKS, it seems more recommendable to first identify some structure of disciplines or subdisciplines, before addressing the aforementioned issues. Such a structure can best be

identified bottom-up, especially in the absence of a universally acknowledged classification or partition. In this explorative study we essentially tried to identify the most important topics and find some structure in the IKS-field, as it is currently represented in the projects of 200 Ph.D. students in the Netherlands. The five components that we identified are sufficiently large, internally homogeneous and externally heterogeneous and denote communities as they exist in the field, which makes them a good starting point for further pursuing the aforementioned goal.

Our approach is not without limitations: not all IKS-research is represented; we confined ourselves to Ph.D. projects and Ph.D. researchers in our population, our approach was entirely quantitative. Many relations have not been further investigated; not the least the observed differences in QUAL and QUAN between the research areas.

In a next contribution, that will be more qualitatively rather than quantitatively in nature, we will try to overcome some of these limitations, endeavor for (further) validation and interpretation of the results thus far, and – most importantly – try to describe and compare in more detail the five established subareas of the IKS-field along the dimensions we indicated above.

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BNAIC 2005: Session Reports

In the previous issue of this Newsletter Karl Tuyls has provided us with general impressions on BNAIC 2005. In this issue we provide the reader with many session reports.

Session 1A: Evolutionary Computation I

Report by Edwin de Jong
Utrecht University

The first session on the technical programme dealt with evolutionary computation, and took place in the majestic Troonzaal. Guido de Croon presented a paper from the Maastricht artificial intelligence group on a situated model of active vision. The group has consistently worked on the topic of active vision, and the current paper compared the probabilistic approach, based on belief states, to the situated approach, in which a mapping from observations to actions is learned directly. It is found that the situated model reduces uncertainty. It does so by effectively using the fixation location as a memory of past observations.

The second paper, by Bill Langdon and Ricardo Poli, presented an original idea that turns around the usual setup of an experiment. Whereas in most papers the problem is given and methods are investigated to solve the problem, here the question was how suitable problems can be found to learn about the differences between two given methods. This is done by evolving fitness landscapes using genetic programming. The fitness of a fitness landscape is given by the difference between the performances of the two methods; a successful fitness landscape must reveal a large difference between the two methods. Using this approach, relative strengths and weaknesses of Particle Swarm Optimisation, Differential Evolution, and gradient based search were identified.

The third and last paper in the session was by Peter Bosman, and concerned dynamic online optimization. The problems considered were a time-deceptive numerical problem and a dynamic pickup problem, where given the current location of a truck and a package, it must be decided whether to use the truck to pick up the package or to drive elsewhere. The feature that renders this problem difficult, is that an action performed at time t influences the state of the environment (by affecting the location of the truck), and thereby changes the potential for collecting rewards at future points in time. This issue is faced in any reinforcement learning problem that has multiple states. In this work, it is addressed by predicting future rewards based on past information. It is found that postponing the use of learning until a higher reliability is obtained leads to improved results.

Session 2A: Multi-Agent Systems I

Report by Tomas Klos
CWI, Amsterdam

This was the first of the relatively many sessions on multi-agent systems mentioned in the BNAIC report in the previous BNVKI Newsletter (22/5), including 1 A- and 3 B-type papers. The first three presentations, with shared co-authors and references to each others' work on the presentation slides, visited the problem of artificial agents learning in controlled domains characterized by uncertainty,

possibly caused by the presence of other agents, while the fourth paper made the agent's problem even more challenging by including humans (in human-agent teams) and focusing on real-world scenarios. All papers obviously shared the feature of increasing realism by adding complexity, and then introducing sensible limitations and assumptions for dealing with this complexity.

In a little more detail, the first (A) paper, *Multi-Agent Reinforcement Learning with Adaptive State Focus* by Lucian Busoniu (presenter), Bart De Schutter and Robert Babuska from Delft University of Technology approaches the coordination problems that arise when single-agent Q-learning is applied in multi-agent settings, by limiting the state space about which individual agents learn, and by letting them simultaneously monitor the convergence of learning. Widening the state space only when learning fails to converge (implying a coordination problem) makes the agents consider and learn about their interdependence with others only then, and was shown in simulation experiments to lead them to the solution when single-agent learning does not, and also much faster than full-state learning.

The second paper, *Using the Max-Plus Algorithm for Multi-Agent Decision Making in Coordination Graphs* by Jelle Kok (presenter) and Nikos Vlassis from the University of Amsterdam (UvA), also deals with a simplification of a full multi-agent learning problem, by considering that an agent's coordination problem usually involves just a subset of all the agents in a multi-agent system. As an approximation to the exact Variable Elimination (VE) algorithm for solving action-selection problems in such coordination graphs, the localized message-passing algorithm Max-Plus is proposed, which was shown experimentally to yield quite good approximations to VE's results quite quickly, and can be applied in densely connected graphs, to which VE does not scale well.

The third paper, *Robot Planning in Partially Observable Continuous Domains* by Josep Porta from Barcelona and Mathijs Spaan (presenter) and Nikos Vlassis from the UvA, focuses, because of their practical relevance for robotic problems, on continuous-state-space Partially Observable Markov Decision Problems (POMDPs). The simplication featured in this paper for being able to deal with this extension, is to focus on identifying just the so-called alpha functions for the agent's beliefs about its current location, and generalize them to the rest of the belief space to construct an approximate value function for the whole belief space. An algorithm that does this for discrete case POMDPs is extended to the continuous case and shown to yield encouraging results.

The fourth paper, *Towards Sustained Team Effectiveness* by Masja Kempen, Annika Smit (presenter), Niek Wijngaards (presenter) and Kees Nieuwenhuis from Decis in Delft, (rather graphically) introduced by far the most challenging problem domain of the session, focusing on the highly dynamic, even chaotic environment generated in disaster-response situations. The remainder of the presentation outlined research plans in the context of measuring individual (human and agent) and team performance, as this is required for managing and sustaining team effectiveness over time, as well as on different levels of aggregation.

Session 2C: Machine Learning I

Report by Hendrik Blockeel
Katholieke Universiteit Leuven

This first session on machine learning opened with a talk on *Generalization to Unseen Cases*, a paper authored by Teemu Roos, Peter Grünwald, Petri Myllymäki, and Henry Tirri. With a very comprehensible presentation, Peter Grünwald explained how the well-known *no free lunch* theorems relate to the so-called off-training set error, which is different from the generalization error. (The latter is measured over the whole example space, the former over the example space excluding the training set.) The relationship between the two is studied and a bound on the difference between them is derived. The results shed new light on existing results in learning theory: for instance, they allow bounds on generalization error to be transferred to off-training-set error, and also clarify that certain interpretations of the no free lunch theorems are overly pessimistic. This paper was a worthy winner of the BNAIC-2005 best-paper award.

The second talk of the session was on *Tuning the Hyperparameter of an AUC-Optimized Classifier*, by David Tax and Cor Veenman. The point of departure of this work is that many learning systems try to produce a model with optimal accuracy, even though models are often evaluated not just based on their accuracy but based on their AUC (Area Under the ROC Curve). The authors present an approach to building a classifier that directly optimizes the AUC. It is a modification of the classical support vector machine (SVM) approach. A linear SVM normally finds a linear separation with maximal margin between the classes; the modified version proposed here finds a linear separator with a slightly

different orientation that is optimal in the sense that when moving the line without changing its orientation (which amounts to changing the threshold above which a prediction is considered positive), an optimal ROC curve is obtained. Experimental results show that the novel method often outperforms the classical approach, especially on smaller datasets.

The third speaker was Antal van den Bosch, who presented the paper *Improving Sequence Segmentation Learning by Predicting Trigrams* that he co-authored with Walter Daelemans. This is a B-paper that occurred originally in the 9th Conference on Computational Language Learning. An often re-occurring task in language learning is that all symbols in a sequence need to be classified, and a frequent problem in this context is that the classification of a symbol is made independently of classification decisions made earlier. As a result, predictions can be made that are incompatible with each other. A possible solution, explored in this paper, is to predict the class of multiple consecutive symbols simultaneously. More specifically, the authors predict overlapping trigrams of classes, using a voting mechanism to combine the multiple class predictions for each symbol that this results in. Experimental results show a clear improvement over standard techniques with this approach.

Finally, the paper *Combining Model-Based and Instance-Based Learning for First Order Regression* by Kurt Driessens and Saso Dzeroski, published in the 22nd International Conference on Machine Learning, was presented by Kurt Driessens. The context of this work is *relational reinforcement learning*, a subfield of reinforcement learning that focuses on learning in complex environments, where states have complex descriptions and the task is to learn a relationship between the quality of an action and the structural properties of the state in which that action is performed. Kurt Driessens and colleagues had previously explored multiple relational learning methods in this context, and in this work they propose a technique that essentially combines model-based (decision trees) and instance-based relational learning. Experimental results show that this combined approach inherits the computational efficiency of the model-based approach and the accuracy of the instance-based approach.

Session 3C: Data Mining

Report by Jan van den Bussche
Hasselt University

In *Speeding up Feature Selection by Using an Information Theoretic Bound* (by P. Meyer, O. Caelen and G. Bontempi), Patrick Meyer described a new method to select a representative subset of features from a multidimensional set of points. The method is based on a newly proposed information-theoretic bound for estimating the information loss, which allows an efficient computation.

In *Mining Tree Queries in a Graph* (by B. Goethals, E. Hoekx and J. Van den Bussche), Eveline Hoekx described an algorithm for mining tree-conjunctive database queries that return large enough answers on a graph stored in the database. The algorithm allows for a database-oriented implementation and is careful to avoid double work by detecting and exploiting equivalent queries.

In *Benchmarking Artificial Immune Systems* (by P. van der Putten and L.J. Meng), Peter van der Putten presented the results of an empirical evaluation of the AIRS classifier (a variation of the genetic algorithm, inspired by the immune system). The conclusion was that AIRS performs reasonably, compared to standard classifiers such as *k*-nearest neighbors.

Session 4A: Language

Report by Tony Belpaeme
University of Plymouth

In the session on Language, Bart De Vylder presented an elegant paper, co-authored with Karl Tuyls, on how a group of agents can agree on the use of words. If agents have to agree on a name for a particular object and there is no central coordination guiding the process, how can they ever agree on one name and thus avoid synonymy? De Vylder and Tuyls' take a formal approach and prove that all agents will eventually end up using the same word for a particular object as long as the agents have a *sampling-amplification* learning function. This particular function samples words of other agents and at the same time amplifies the statistical distribution of words, so that – just as in real life – the agents will be more likely to use the words they often hear others using. Their formal proof shows that agents do not need a global view on the population to guarantee convergence, a rather strong assumption made in earlier work. They show how the population can be seen as a dynamical system, which inevitably ends up in a stable fixed point where every agent uses the same word to designate an object.

Bart de Boer and Willem Zuidema presented a model in which they show how combinatorial phonology can emerge from local interactions between speakers. Combinatorial phonology is a fundamental characteristic of human speech: speech uses a limited number of building blocks to construct utterances – for example: more, lore, mice, lice, my, lie. In the study of language evolution it is always necessary to show an evolutionary trajectory of a particular linguistic feature. If only one agent has a particular communicative feature this does not have a selective advantage if no other agent has got the same feature. De Boer and Zuidema show that if agents want to make their utterances as distinctive as possible, this results in utterances that are combinatorial. A quite remarkable result, as it explains combinatorial phonology without the need for a specific cognitive module and without the need to lay out an evolutionary trajectory leading to combinatoriality.

Paul Vogt presented a model in which language was transmitted horizontally as well as vertically. In horizontal transmission a language is learned from your peers, while in vertical transmission one learns a language from ones ancestors. It is known that compositionality – the use of structured sequences of words to express something – can evolve in vertical transmission scenario when agents are exposed to only a limited number of training examples (this has become known as the *transmission bottleneck*). Vogt shows how this also applies when agents combine horizontal and vertical learning. In addition he shows under what circumstances compositionality emerges when the agents do not have pre-programmed concepts, as is the case in many other models.

Joachim de Beule presented work with Bart de Vylder on learning concepts under the influence of language, a mechanism which is known in linguistics and cognitive science as *linguistic relativism*. In their simulation, agents had to agree on words for communicating concepts during one-to-one interaction. Crucial to the learning mechanism is that an agent receives feedback if the use of a particular word is clear or not for the other agent. This feedback then influences the concepts of the agent. When feedback is switched off, the performance of all agents deteriorates, showing that in order to learn a successful communication system there needs to be feedback and language needs to shape the way we conceptualise the world.

Session 4C: Evolutionary Computation II

Report by Geert Jan Bex
Universiteit Hasselt

Although the session took place in parallel with two other sessions, all four talks were well-attended. The Rubens auditorium provides a beautiful, even stately setting for the occasion.

In this session, four papers were presented:

- *Evolutionary Planning Heuristics in Production Management* by Steven de Jong, Nico Roos and Ida Sprinkhuizen-Kuyper
- *On the Complexity of Hierarchical Problem Solving* by Edwin de Jong, Richard Watson and Dirk Thierens
- *An Adaptive Pursuit Strategy for Allocating Operator Probabilities* by Dirk Thierens
- *Compressed Linear Genetic Programming: empirical parameter study on the Even*-n-*parity problem* by Johan Parent, Ann Nowé, Anne Defaweux and Kris Steenhaut

The first paper was an original BNAIC paper, the latter three extended abstracts.

The presentations engendered a lively round of questions and discussion, illustrating that the work presented was timely and of interest to the audience.

Evolutionary Planning Heuristics in Production Management. The work presented by Steven de Jong of the Universiteit Maastricht deals with resource allocation in an environment that evolves over time, complicated by the fact that those resources are inter-dependent. This setting differs from traditional planning problems in that the availability of one or more resources has to be assured, that actions have effects on the resources and that multiple agents are competing, hence introducing nondeterminism. First, the problem is properly formalized so that heuristics can be introduced that are experimentally validated. It is shown that an evolutionary planning algorithm is superior to a fixed planning heuristic.

On the Complexity of Hierarchical Problem Solving. The subject of Edwin de Jong's (Universiteit Utrecht) presentation is a fundamental one: what classes of problems can be addressed by genetic algorithms. Successful application of these algorithms usually exploits the structure inherent in the problem to be solved. The class considered here is that of hierarchical dependencies how its properties influence the efficiency with which it can be solved. The Hierarchical Genetic Algorithm

(HGA) is studied analytically and experimentally to investigate the influence of the factors that determine the problem's complexity.

An Adaptive Pursuit Strategy for Allocating Operator Probabilities. In his presentation, Dirk Thierens of the Universiteit Utrecht studies operator allocation in a dynamic setting. Operators are applied to an environment that gives feedback. The latter determines the choice of operators to be applied. Environments considered change over time. An operator is selected according to a probability vector which is updated over time based on the environment's feedback. Estimations of future rewards associated with each operator are computed incrementally from past experience using an exponential recency-weighted average. The Adaptive Pursuit Algorithm is formulated that pursues the operator having the largest estimated reward. Care has to be taken that probabilities exceed neither a minimum, nor a maximum threshold to ensure that the algorithm is suited for non-stationary environments.

Compressed Linear Genetic Programming: empirical parameter study on the Even-*n*-parity problem. The session's last presentation was given by Johan Parent of the Vrije Universiteit Brussel. Compression of individuals in an GA is considered: promising combinations of alleles are replace by placeholder symbols. This technique protects valuable traits in the genotype against cross-over and mutation. The compressed linear Genetic Programming (cl-GP) algorithm is tested experimentally with respect to several parameters such as the fraction of the population selected for compression, the pool-size and the length of the substrings that are replaced by placeholder symbols. It is shown that the use of compression always improves the GP performance but that the substring length should be short, i.e., combinations of two characters perform optimally on average for all problem sizes presented.

Session 5C: Bayesian Modeling and Learning

Report by Sam Maes
Vrije Universiteit Brussel

In the first presentation entitled *Causal Inference in Multi-Agent Causal Models*, Stijn Meganck introduced multi-agent graphical modeling techniques. More specifically, an algorithm for performing causal inference in a multi-agent setting was discussed.

The second paper treated the *Use of the Noisy Threshold Function in Building Bayesian Networks* and was presented by Rasa Jurgelenaite. It introduced the noisy threshold models, which are a new type of causal independence model based on the Boolean threshold function.

In *Modeling Bayesian Networks by Learning from Experts*, Wim Wiegerink argued that domain experts often have ideas of some of the quantitative probabilistic relations that should hold in the model. However, these relations usually do not translate easily into CPT parameters. The paper discussed techniques for learning CPTs from a database of probabilistic relations.

Finally, Daan Fierens presented the paper *Logical Bayesian Networks and Their Relation to Other Probabilistic Logical Models*. It introduced logical Bayesian networks, which are models that combine aspects of probability theory with aspects of logic programming. They solve some problems related to expressiveness and intuitiveness from which existing techniques suffer.

Session 6A: Machine Learning III

Report by Kurt Driessens
Katholieke Universiteit Leuven

The machine learning III session consisted of two A-track papers and two B-track papers. The first presentation was given by Kees Joost Batenburg, on *Neural Networks for Discrete Tomography*, a paper that was co-authored by Walter Kosters. Kees Joost talked about the problem of reconstructing two-dimensional binary images from one-dimensional projections in a limited number of directions. He compared using feed-forward networks extended with the concept of local nodes and Hopfield networks for this task.

The second talk titled *A Comparison between Different Context Weights*, also on an A-track paper, was presented by Bram Vanschoenwinkel on joint work with Bernard Manderick. In this work, the authors studied the use of weighted kernel functions for support vector machines in natural language problems (part of speech tagging and named entity recognition). They showed that using a "gain-ratio" context-sensitive weighting scheme can result in both better classification results and simpler models.

The third presented paper titled *Reducing Spike Train Variability: A Computational Theory of Spike-Training Dependent Plasticity*, was a B-track paper that was accepted at NIPS. In his talk on joint work

with Michael Mozer, Sander Bohte presented a theory which proposes noise reduction as a major objective of cortical computation and the STDP behaviour of neurons.

The paper presented by Onno Zoeter, co-authored by Tom Heskens, was also a B-track paper and was presented at AISTATS this year. With the title *Gaussian Quadrature Based Expectation Propagation*, the authors presented a method for approximating Bayesian inference problems. The algorithm was illustrated on a model from mathematical finance. When asked why he was not rich yet, Onno answered that that was under consideration for future work.

Session 6B: Multi-Agent Systems IV

Report by Paul Vogt
Tilburg University & University of Edinburgh

One of the main themes in this session related to plan repair in and using MAS, as presented in two of the papers: one by Robbert-Jan Beun and Rogier van Eijk, and the other by Roman van de Krogt and Mathijs de Weerdt. In Beun and van Eijk's presentation, this problem was used in the context of human-machine interaction, where the machine was designed to alter communicative strategies to better align the knowledge of human subjects. Van de Krogt and de Weerdt's application was more related to systems where MAS try to solve complicated tasks such as found in logistics. They argued that using a predefined librabry of sub-actions could successfully be incorporated to repair plans efficiently.

Adriaan ter Mors and Cees Witteveen investigated the coordination of planning problems with autonomous agents that are self-interested. They argue that because revising plans while performing them in MAS can be computationally intractable, it is most efficient if agents coordinate their actions before they calculate their plans. David de Groot, Martine Boonk, Frances Bazier and Anja Oskamp discussed issues in mobile-agents-based information retrieval. If MAS are used to retrieve all sorts of information, clearly the need rises to discuss all sorts of legal, privacy and security issues. De Groot *et al*. presented their work in trying to specify generic protocols dealing with such issues.

To summarise, this was an interesting session in which a number of important problems in MAS are being tackled, using some interesting approaches to try and solve practical problems. On a personal critical note, I have missed attempts of trying to deal with such problems using adaptive methods. In the past decade, huge advancements have been made in adaptive approaches to multi-agent systems, which are often used to solve either toy problems or to investigate biological systems or robotics. It would be very interesting to see these adaptive approaches being used to solve practical and socially relevant problems in future BNAIC events.

Session 6C: Applications

Report by Jaap van den Herik
Universiteit Maastricht

The BNAIC 2005 in Brussels went very smoothly due to the organizer's versatility to find solutions for small obstacles and to communicate them adequately. In the session Applications, Professor Maarten de Rijke was scheduled as the last speaker, but he had an appointment in Amsterdam and requested to act as the first speaker. At first blush, this is easily solved by a simple agreement. However, all BNAIC participants should know this change, otherwise they may enter the Stevinzaal for the wrong lecture. It is a typical communication problem for agents with a variety of applications in the real world. Below, we follow the order of the lectures as they happened in the actual world.

The first speaker was Maarten de Rijke (UvA) who presented the paper *Boosting Web Retrieval through Query Operations* by Gilad Mishne and Maarten de Rijke. The question was: can we combine the use of phrases and proximity terms? Phrases are highly beneficial for precision, and proximity terms for effectiveness. Pros and cons were given for a range of retrieval tasks, such as web retrieval and document retrieval. Moreover, attention was given to specific domains such as Genomics. The topic has been presented before, namely, at the Advances in Information Retrieval Conference, where the full paper has been published.

The second speaker was Filip Miletic (Delft University of Technology) who presented the paper *Design Considerations for an Infrastructure-less Mobile Middleware Platform* (co-author Patrick Dewilde). He described a middleware architecture for mobile devices, called DWEAM. It stands for Distributed Workflow Execution Architecture for Mobile. The design goals are: (1) operation without a fixed communication infrastructure and (2) supportive for distributed, cooperative workflow execution in uncertain, chaotic environments. Three models were described: the environment model, the storage model, and the execution model. Thereafter

an algorithm was presented to match producers and consumers. The algorithm relied on a supercube approximation. The goal of the algorithm was to enable workflow execution on mobile devices under condition of changing resources and changing connections.

The third speaker was Geert Jonker (UU) who presented the paper *Efficiency and Fairness in Air Traffic Control* (co-authors John-Jules Meyer and Frank Dignum). The key idea of the paper is to improve safety in Air Traffic Control (ATC) with multi-agent systems. So, agents should have a task and a goal. At the start, the well-known notions are safety and punctuality. Seen as a resource allocation problem the question is: how to improve global ability and fairness? To arrive at a reasonable solution one should take into account the planning history. To arrive at a better solution the researchers would like to improve the current techniques and therefore they investigate three dedicated techniques, viz. decision-making functions with compensation potential. The compensation is taken from the planning history. The three functions examined are: (1) a standard function involving history; (2) a function with a threshold mechanism below which unfairness holds; (3) a function with a dynamic threshold mechanism (dynamic slides) below which unfairness holds. Experimental results were given. One of the conclusions was that functions (1) and (3) were overall the best choices.

The fourth speaker was Laurens van der Maaten (IKAT, UM) who presented the paper *Improving automatic written identification* (co-author Eric Postma). For alerted BNVKI Newsletter readers, it is remarked that IKAT deals with automatic *painting* recognition and not with automatic *written* identification. However, Laurens was a M.Sc. student of Eric Postma, and did his M.Sc. thesis in cooperation with Lambert Schomaker and Marius Bulacu. They provided Laurens with a plethora of techniques and publications in which he had to navigate. He did well and completed the M.Sc. thesis successfully. This BNAIC paper was a result. The lecture was a day after Bulaca's presentation at the Demo-session and so, it was instructive to see that the ideas had the same background. Van der Maaten was aware of all the pitfalls in which the team Schomaker-Bulaca had stumbled into. Hence, he did his utmost to come up with new ideas, performed new experiments using new directions of research etc. We mention: "improving the statistical approach", "improving the model-based approach", etc. Whatever he did, he formulated his conclusions as follows: "In our research, we achieved the same identification performance as presented in Schomaker *et al.* [6]. As a result we were unable to show that our improved approaches lead to better performances. Nevertheless, our research leads to three important new observations." For these, we refer the interested reader to the excellent produced Proceedings of the BNAIC 2005. Our compliments to the Koninklijke Vlaamse Academie van België voor Wetenschappen en Kunsten, and to the five editors: Verbeek, Tuyls, Nowé, Manderick, and Kuijpers.

The 2005 SKBS Prize

Jaap van den Herik
Director of SKBS

The Foundation for Knowledge Based Systems (SKBS) continued its policy of awarding the SKBS prize to the best demonstration of the Demo-session of the BNAIC 2005. The referee committee consisted of Professor Jaap van den Herik (chair), Professor Maurice Bruynooghe, Dr. Tony Belpaeme, Dr. Antal van den Bosch and Dr. Niek Wijngaards.

The referee committee had to consider four submissions which were eligible for the SKBS Prize. In Table 1 we list them by author (in alphabetical order).

(1)	Marius Bulacu and Lambert Schomaker. *GRAWIS: Groningen Automatic Writer Identification System.*
(2)	Dragos Datca and Leon Rothkrantz *AI Techniques for Face Detection.*
(3)	Peter Hofgesang *Web Usage Mining Framework.*
(4)	Gerald de Jong *Fluidiom : the Evolution of Locomotion.*

Table 1: The 2005 candidates of the SKBS prize.

In previous years we organized this Demo-session as an industrial exhibition and the referee committee then interviewed the demo-presenters one after another. It did so together with the visits of the interested participants of the BNAIC. In Brussels, there were two pre-sessions in which poster-presenters and demo-presenters were allotted three minutes to give an overview (in practice it was an overview of an overview) of their work. Once in the demo-room the referee committee decided to set aside for each demo-presentation a quarter of an hour to present their demo in combination with an introductory talk. This turned out to be a great success. The performances of the four presentations were attended by a large audience and after every presentation there was a lively discussion (of five minutes). Gerald de Jong started his presentation with apologies: "My presentation and demo is

totally different from what I have seen so far, maybe I misunderstood the idea of the Demo-session." At the end, the opposite turned out to be true.

He received the SKBS prize, since the committee's judgement was as follows (a) the quality of the four submissions was good, (b) the originality was different. Other criteria were: (c) scientific element, (d) AI-relation, and (e) the applicability (in industry or education). The spirit of the SKBS prize is in criterium (e). The committee assessed that three of the four "demos" were best characterized as very good research tools, but not precisely an original demo. From these research tools, the demo given by Marius Bulacu was most impressive. Therefore GRAWIS received an honorary mention by the referee committee. The author of Fluidiom has been requested to contribute to this BNVKI Newsletter and he kindly agreed (see elsewhere in this issue).

The emergence of locomotion is a next step in the development of intelligent agents that will have appropriate cognition and perception abilities at their disposal. In Table 2 we provide an overview of the winners of the SKBS prize so far.

1999 Maastricht M. van Wezel, J. Sprenger, R. van Stee, and H. La Poutré *Neural Vision 2.0 - Exploratory Data Analysis with Neural Networks*
2000 Kaatsheuvel (shared prize) E. Zopfi *HKT* G. Schram *LubeSelect*
2001 Amsterdam Alexander Ypma, Rob Kleiman, Jan Valk, and Bob Duin *MINISOM – A System for Machine Health Monitoring with Neural Networks*
2002 Leuven F. Brazier, D. Mobach, and B. Overeinder *AgentScape Demonstration*
2003 Nijmegen Bert Kappen, Wim Wiegerinck, Ender Akay, Marcel Nijman, Jan Neijt, and André van Beek *Promedas: A diagnostic decision rapport system*
2004 Groningen Wouter Teepe *The Secret Prover: Proving Possession of Arbitrary Files While not Giving Them Away*
2005 Brussels Gerald de Jong *Fluidiom: The Evolution of Locomotion*

Table 2: Overview of SKBS prizes.

KION M.Sc. Thesis Award for Olaf Booij

Stefan Schlobach
Vrije Universiteit Amsterdam

For the fourth year running KION, the association of Kunstmatige Intelligentie Opleidingen in Nederland, awarded its KION thesis award for the best Master thesis in Artificial Intelligence in the study year 2003/04. In a festive closing ceremony at this year's BNAIC in Brussels the award was given to Olaf Booij from the Universiteit van Amsterdam for his outstanding thesis on "Temporal Pattern Classification using Spiking Neural Networks". In addition to the certificate for the KION thesis award and the award of 600 Euros, Olaf received a nice collection of AI books by Luc Steels, and a box of Belgian beers.

Olaf Booij

Each of the 6 study programs of Artificial Intelligence, related to the Radboud Universiteit Nijmegen, the Rijksuniversiteit Groningen, the Universiteit Maastricht, the Universiteit Utrecht, the Universiteit van Amsterdam, and the Vrije Universiteit Amsterdam nominated their best eligible Master thesis. From these high-quality nominations this year's jury, consisting of Bart de Boer (RUG), Leo Dorst (UvA), Eduard Hoenkamp (RUN), Stefan Schlobach (VU), Jos Uiterwijk (UM) and Albert Visser (UU) unanimously chose Olaf's thesis for its strong scientific contributions, the clear and concise reporting, and the relevance of the results to future AI research.

In his research Olaf Booij has developed a new supervised-learning algorithm for Spiking Neural Networks (SNNs) using the gradient-descent method. Previously known learning rules for SNNs limit the spiking neurons to fire only once. Booij's algorithm, however, is specially designed to cope

with neurons that fire multiple spikes, taking full advantage of the capabilities of spiking neurons. By successfully applying his new algorithm to the task of lip-reading Booij described a first application of his method, which has the potential to advance the use of Spiking Neural Networks significantly.

Fortunately, for the field of Artificial Intelligence in the Netherlands, Olaf Booij will continue doing research in AI, as he has recently started Ph.D. studies at the Intelligent Autonomous Systems Group of the Universiteit van Amsterdam on robot localisation.

From Geometry to Evolution

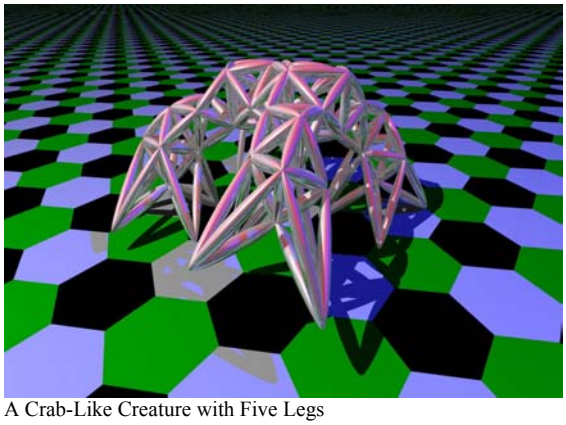
Gerald de Jong
Almende BV, Rotterdam

In the fall of 1995, I started work on a project that had been brewing for years in my mind. The geometrical and architectural work of Buckminster Fuller [1] and the unique sculptures of one of his students Kenneth Snelson [2] had captured my imagination, and after spending hours admiring a Snelson piece outside at Museum Kroller Muller in the east of Holland I resolved to try and recreate this sculpture in software.

After a few months of experimenting I released a first version of an open source program which made it possible to build these fascinating tensegrity [3] structures by hand, and algorithmically. A small community of enthusiasts for the program gathered on an internet mailing list and we built and played with many interesting virtual structures based on nothing more than push and pull forces.

Throughout the rest of the 90's the program was expanded to allow for collaborative building via internet, and the resulting structures were eventually introduced into the Virtual World community by generating beautiful and unique objects for the Active Worlds [4] chat environment.

The driving force behind my effort was to return to the first principles of spatial structure, distilling it to the simplest elements: springs. Springs push when they are too short and pull when they are too long, and when they are connected at their ends, many fascinating things can be built which not only have shape but also dynamic behavior. Only basic vector math was necessary, and some of the structures (specifically tensegrities) exhibited unique robustness. When a tensegrity is mangled, it almost invariably returns to its original shape.


A Crab-Like Creature with Five Legs

I presented my work in 1998 at a small conference in Cambridge, England called "Digital Biota 2", where the keynote speaker was one of my intellectual heroes Richard Dawkins [5], the prominent Oxfordian evolutionary biologist. I demonstrated my software for him privately just before he left for Oxford, and when I asked, he scratched his chin and said "Yes... you could evolve these...". I was inspired to start work on a new version of the software I call "Fluidiom" (Fluid – Idiom), which was initially intended to build structures based on a kind of genetic instruction set. This proved to be more difficult than expected at the time, so other activities began to take priority.

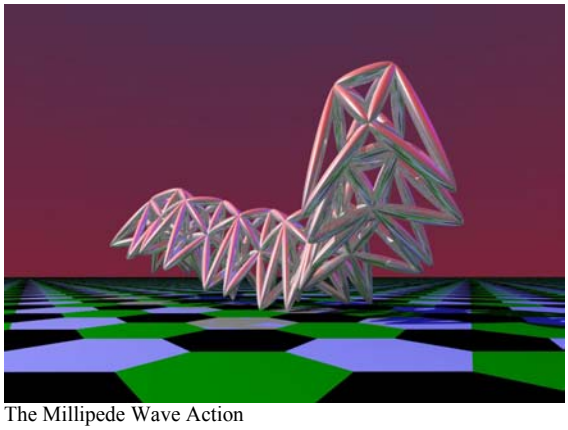
Having played extensively with a diversity of springy structures, a seemingly natural question arose: If we suppose that these structures are bodies, what could they learn to do? I decided that they should learn to run. The goal would be simply to move as far as possible in a fixed number of iterations (amount of time). I was unsure how difficult it would be, and since Fluidiom was a hobby project, I was a little concerned about spending too much time on it.

In the spring of 2004 I was on vacation on the island of Mallorca and the weather was less than ideal, so I spent an afternoon adding gravity, a non-slippery floor, and turned the springy intervals into muscles by varying their desired length over time according to a global cycle. Muscle behaviour was just a slight extension of spring behaviour, and there was no brain involved since the only thing evolving was blind coordination of muscle contractions. Each muscle is "unaware" of the others.

That same evening I built the basic mutation and the natural-selection system, and before going to sleep I set the process running. The following morning I went to look at what had developed and was completely shocked! The creature was galloping desperately and at hazardous speeds in order to avoid the grim fate of its weaker brothers: death.

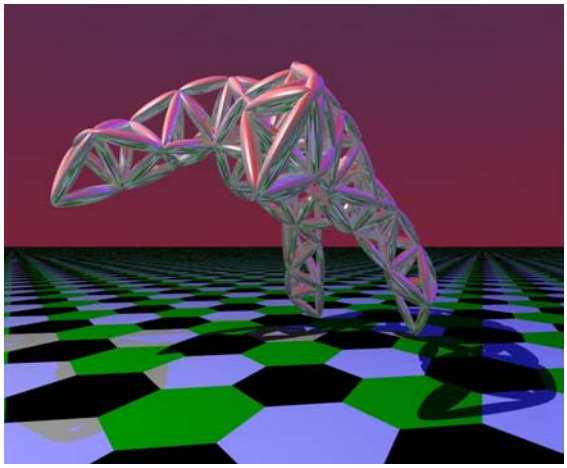
The natural selection process had effectively explored the fitness gradient overnight. It looked dramatically purposeful, even though it was obviously just an optimization algorithm. It was clear that I was on to something.

I rebuilt the software, switching the emphasis from building structures to evolving running behaviour instead, and then began to explore the effects of different parameters on the evolution process. It turned out that tweaking the physics parameters (gravity, damping, rigidity) produced very different evolved behaviors.


The Millipede Wave Action

Some bodies jumped or galloped while others crawled ploddingly, depending on the challenge with which they were confronted. Also, bodies did not have to resemble existing animals at all, yet they still learn locomotion, some better than others. Three-legged or circle-shaped bodies work quite nicely even though there are perhaps no biological equivalents. Long thin bodies develop snaking motion, many-legged creatures evolve millipede-like waves of movement, and quadripeds tend to walk or crawl.

The evolution algorithm itself worked on the basis of parameters such as population size and mutation rate, and making these tweakable revealed some fascinating idiosyncracies of what was essentially a minimalistic bacterial evolution (non-sexual). Playing "God" during the evolution is very entertaining indeed. For example, it is exhilarating to observe a sudden rise in fitness at the moment that a mutation causes the body to be airborne during its stepping movement, and the new leaping body genome rapidly dominates and displaces the population of crawlers.


Frog-like Leaping Movement

Repeatedly evolving the same structure proved that the algorithm was exploring local maxima, since different locomotive behavior resulted from each run. For example, a six-legged creature once evolved to raise its front two legs and walk quickly on its rear four legs, while in other runs of the evolution it used all six legs. Some form of sexual crossover may provide a solution for this.

Key to the algorithm's success is the strict limitation on the domain explored by the mutation/selection. A mutation involves simply changing the timing of a single muscle contraction, of which there are often hundreds in a single body. This provides a relatively well-behaved fitness gradient, and since the algorithm very consistently capitalizes on lucky mutations, progress is almost always assured. Also, the visually compelling nature of the end result turned out to be accessible to all kinds of people instead of only specialists in the AI field.

My demonstration of Fluidiom at BNAIC 2005 involved building a body from scratch by hand with the mouse, and then launching the evolution algorithm. Having built many bodies, it only took a minute or two, and that was fortunate since there were only twelve minutes available for the demo. After ten minutes of explaining how the algorithm was doing its work, while pointing to the graph of increasing fitness as the generations quickly came and went, I showed the resulting evolved body. Ten minutes is not a great deal of time for an evolution to proceed, especially when compared to the millions of years available to biological life, but it was enough to clearly show the first rudimentary locomotive activity.

It was very gratifying afterwards to receive a series of sharply formulated questions from such a knowledgeable audience, and the interest that the BNAIC attendees had for my work was solid motivation to pursue it further. Receiving the prize

for best demonstration from the BNVKI was icing on the cake!

My hope is that students with diverse academic interests might be inspired to eventually take the solid first-principles geometrical basis of Fluidiom as an environment in which to perform their own evolution experiments. I can imagine many different applications in the domain of artificial intelligence which would do well to use the Fluidiom wheel instead of reinventing their own, and the visually compelling nature of the software is useful both for finding inspiration, developing intuitions, and for presenting results. It is an open source program [6], remarkably small and simple, and carefully constructed to be a framework upon which many different things can be made to happen independently.

My own personal interest in the further development of the software and the genetic algorithm will be to apply it to the domain of architecture. In a sense this is coming full-circle for me because the original inspiration for the project was geometry and actual physical structures.

I am in the process of constructing an application which applies Darwinian selection to optimize physical architecture, of course choosing among multitudes of candidate variations in search of an optimum. Here, however, the fitness function will not be as straightforward as locomotion, but will instead involve the genetic evolution of building processes and it will attempt to optimize construction and material costs. Hopefully this approach can play a role in the creation of future inexpensive smart buildings and other structures made of real atoms instead of bits.

Part of my current research efforts at Almende BV was to create a platform for multi-agent systems, which is called "Emerge" [7]. The Emerge platform represents a somewhat unusual approach to agent systems because it integrates agent visualizations, and because it allows agents to be persisted individually in the form of readable XML files (persistence, but no database!). It also permits the creation of very large numbers of autonomous agents, each of which can be persisted at any time.

With the new tools available in the Emerge platform, I am now able to revisit the idea from a number of years back: to evolve the structure itself, instead of only the behaviour of a structure that must be built by hand. Emerge agents can have an arbitrary number of parallel tasks, and all tasks can be persisted in XML at any time, so I will be attaching an Emerge agent to each Fluidiom body and evolving tasks that do building. Fluidiom bodies will then have an evolving embryology!

If you find yourself interested and wanting to know more, contact me at geralddejong@gmail.com.

[1] Buckminster Fuller
http://en.wikipedia.org/wiki/Buckminster_Fuller
[2] Kenneth Snelson
http://www.kennethsnelson.net/
[3] Tensegrity
http://en.wikipedia.org/wiki/Tensegrity
[4] Active Worlds
http://www.activeworlds.com/
[5] Richard Dawkins
http://www.world-of-dawkins.com/
[6] Fluidiom Project
http://fluidiom.sourceforge.net
[7] Emerge Project
http://chap.sourceforge.net/emerge

Annual SIKS Day: Funny Science

André Meyer
DECIS Lab / TNO Defence, Security and Safety
The Netherlands

Niek Wijngaards
DECIS Lab / Thales Research & Technology
The Netherlands

On November 11, 2005, the School for Information and Knowledge Systems organised its annual SIKS-day at the conference center Hoog Brabant in Utrecht. "The main aim of the event is to give SIKS-members – participating in research groups all over the country – the opportunity to meet each other in an informal setting and to inform them about current developments and some new activities and plans for the coming year."

Of course, every annual SIKS day lived up to this promise and today is no exception. Yet, this year the setup was slightly different. At this meeting, for the first time in the history of SIKS the current scientific director was to step down. The (old) scientific director Prof.dr. John-Jules Meyer decided on the focus of this meeting: multi-agent systems / agent technology. He hand-picked four speakers to elucidate the SIKS research community on advances in agent-related research fields. Prof. dr. Hans Akkermans (VU), chair of the SIKS board of governors, chaired the day.

The first speaker was Prof.dr. Frances Brazier (VU), on the topic of *Agents in Many Disguises*. She spoke about issues that underlie the application of agent

technology in (semi-)open systems. To begin with, she questioned the need and usefulness of agents in autonomous adaptive systems, such as peer-to-peer and autonomic computing systems. Fortunately, she explained how well agents fit the requirements of such systems with respect to transparency, integrity, confidentiality and trustworthyness, for example. To foster the growth of agent technology in general, she argued for the need for more openness in technology and standardisation; the current efforts notwithstanding. In addition, she explained the importance of trust and legal aspects in the design, specification and deployment of multi-agent systems. Brazier sketched a realm of agent applications, and provided a framework for the remainder of the day.

The second slot was for official purposes: the hand-over of the office of scientific director. Or, as Hans Akkermans put this: *SIKS Scientific Directors: How to Manage a KNAW-accredited Research School*. Hans gave an eloquent overview of the dawn of SIKS and its progress during the last decade – the same decade that John-Jules Meyer held the office of scientific director. Prof.dr. Roel Wieringa (UT) was welcomed as the new scientific director for SIKS. He provided an outline of his goals for SIKS. He wants to strengthen our SIKS community such that we can better negotiate with government on research and funding issues. In addition, he explicitly seeks alliances with companies and other institutions to provide grounding for research problems within SIKS and validation of research results. Both the former and the new scientific director were given glassware art objects, hand-picked by Hans from Scandinavia.

The second speaker was Prof.dr. Han la Poutré (CWI/TUE) on *Computational Intelligence in Multi-Agent Games*. He provided demonstrations and rationale for a currently under-researched field: negotiation between autonomous self-interested parties. The motivation for this field lies in a paradigm shift in ICT in society that leads to large-scale continuous interaction among independent parties about specific attributes of goods and services, such as price, quality and timing. In particular, he focused on theories for negotiating with bounded rationality, incompleteness of information, bounded resources, and combining items in purchasing bundels.

The third speaker of today was Prof.dr. John-Jules Meyer (UU) talking about funny ideas: *From Funny Logics via Funny Programming Languages to Funny Applications*. The trick, of course, is not only to have fun when researching, but also to focus work on odd subjects: substitute funny with agent. John-Jules provided an overview of his approach on these three interdependent aspects of agent technology, including a number of his contributions in the past, present and future. He explained the philosophical foundations of agents and their application to the logics of reasoning. Of particular interest (to the writers of this piece) is his work on bringing 'fun' to agents: research on using emotions as a design tool for agents.

The final speaker was Prof.dr. Andrea Omicini (University of Bologna) who spoke about *Artefacts and Workspaces for the Engineering of Multiagent Systems*. He argued that multi-agent systems cannot be studied without taking their environment into account. The amount of structure in the environment can compensate for cognitive simplicity: the more structured the perception of the environment, the more explicit social practices become. This, in turn, enables and constrains agents' behaviours, for example in shared workspaces. His research includes investigating a taxonomy of (shared) artefacts and the relation between agent intelligence in relation to artefacts. He strives to develop a language for usage interfaces and operating instructions for artefacts to be used by agents.

Again, the annual SIKS day was a success. We thank John-Jules Meyer for his countless inspiring contributions to SIKS and wish Roel Wieringa a fruitful time as the new scientific director. We look forward to next year's installment of this 'funny' series.

The Nature of Representation

Symposium, Maastricht
November 30, 2005

Joyca Lacroix
MICC-IKAT, Universiteit Maastricht

The symposium "The Nature of Representation" was held on the day before the Ph.D. defence of Michel van Dartel (IKAT) at Maastricht University. The notion of the representation of knowledge plays a central role in the cognitive (neuro)sciences and in artificial intelligence. The aim of the symposium was to present views on representations from both disciplines. The five speakers were Eric Postma, John-Jules Meyer, Tom Ziemke, Rainer Goebel, and Michel van Dartel. Jaap van den Herik acted as a skilled Chairman by introducing the speakers and guiding the discussions.

The Representation of Nature – Eric Postma (MICC-IKAT, Universiteit Maastricht)

The first speaker presented an overview of the history and the current states of representations. In the cognitive sciences, the debates between Skinner and Chomsky demarcate the introduction of representations in models of the brain and of cognition. Skinner claimed that intelligent behaviour can be fully explained in terms of chains of stimulus-response associations that are learned during development. No internal representations are needed to explain intelligence. Chomsky forcefully countered Skinner's claims by pointing at the importance of symbolic representations for language and thought. The power of formal symbolic representations was already being exploited for some time in artificial intelligence, when Newell and Simon published about their Human Problem Solver on the interface between AI and cognitive science. Since the work of Newell and Simon, many researchers in cognition employ symbolic models for interpreting their behavioural and neuro-imaging findings. These models are very powerful for explaining reasoning, planning, and similar high-level problem-solving processes. However, symbolic models are not appropriate for modeling low-level cognitive processes such as perception, action, and their coordination. Symbolic approaches are "top-down" approaches in that they attempt to explain cognition starting from the higher-level functions towards lower levels. The main challenge is to relate the formal symbols to real-world objects that are partially perceived through imperfect sensors. In the so-called "new AI" an opposite approach is followed by developing robot models that are fully situated in the (sometimes simulated) real world. Such approaches try to work their way upwards towards the level of symbols and are therefore often referred to as "bottom-up" approaches. Postma ended his presentation by positioning the other four speakers on the (assumed) continuum from bottom-up to top-down approaches.

Representation in Agent Programming – John-Jules Meyer (ICS, Utrecht University)
The presentation by Professor Meyer described a top-down agent-based approach to representation. He started his presentation by emphasising that he was not interested whatsoever in the psychological plausibility of his agent models. Despite the fact that the venue of the symposium was the Faculty of Psychology and that many faculty members were present, the audience seemed to appreciate the remark. Meyer gave a gentle introduction to agents and agent-oriented programming. As is common in agent research, he employed many mental concepts such as beliefs, desires, and intentions. He emphasised that these concepts were only loosely coupled to their psychological counterparts and merely used to aid the understanding of the mental dynamics of the agents. In the last part of his presentation, Meyer illustrated the expressive power of the 3APL agent programming language that is being developed at his lab. He also indicated how knowledge about other agents and the state of the (synthetic) world is represented and manipulated in 3APL.

Embodiment, Emotion and Representation – Tom Ziemke (School of Humanities and Informatics, University of Skövde, Sweden)
Professor Ziemke's modeling studies follow a bottom-up approach. He described various experiments in which (virtual) robots are optimised to navigate through a maze or to perform low-level cognitive tasks. Ziemke pointed out that the role of emotions and bio-regulatory processes are largely neglected in both the bottom-up and top-down approaches to cognition. Citing Parisi he stated that "*... behaviour is the result of the interactions of an organism's nervous system with both the external environment and the internal environment, i.e. with what lies within the organism's body. ... While robotics has concentrated so far on the first type of interactions (external robotics), to more adequately understand the behaviour of organisms we also need to reproduce in robots the inside of the body of organisms and to study the interactions of the robot's control system with what is inside the body (internal robotics).*" In the context of a recently awarded European project, called Integrating Cognition, Emotion, and Autonomy (ICEA) he aims at studying internal robotics. To Ziemke, internal robotics is not just an extension of the embodied approach but it is a prerequisite for truly autonomous systems that behave in accordance with self-preservation requirements to ensure that they can survive in threatening environments and circumstances. Building on views from Damasio and other neuroscientific researchers, he distinguished between emotion and feeling. Emotions are bioregulatory bodily responses that facilitate survival whereas feelings (of emotions) are "*the mental representation of the physiologic changes that occur during an emotion*" (Damasio). In that sense, in contrast to emotions, feelings are detached from the perception-action cycle allowing anticipating on bodily responses. Such anticipation occurs through an internal sensory-motor loop in which the predicted consequences of actions are fed back though sensory stages leading to an internal simulation of events in the external world. In the bottom-up approach, internal simulation is an initial step towards high-level cognitive reasoning.

Representations in the Brain: Insights from multi-cell recordings and functional brain imaging – Rainer Goebel (Department of Neurocognition, Maastricht University)

Professor Goebel gave a stimulating and inspiring presentation on his neuro-cognitive research with an emphasis on representations. His presentation featured results of a large number of functional magnetic resonance imaging (fMRI) experiments. This report focuses on two main experiments: inverted vision and brain pong.

In 1879, the psychologist Stratton wore upside-down prisms for a few weeks to study the long-term perceptual effects of being confronted with an upside-down world. Initially, Stratton experienced considerable difficulty in behaving appropriately in an inverted world. However, after a few days his visual system adapted to the new situation and he was very well able to behave appropriately. Students in psychology are quite familiar with Stratton's experiment and are taught that, after a few days, Stratton's perception of the world became normal. In other words, after a few days the upside-down world was perceived as an upright world. Some years ago, Professor Goebel decided to redo the experiments by Stratton and to perform fMRI studies to examine the resultant changes in brain activity. His expectation was that some change should be visible in the visual part of the brain. He convinced a number of Ph.D. students to wear upside-down glasses for an extended period of time. The results agreed largely with those reported by Stratton. Initially, the students had great difficulty to deal with the inverted world, but after a few days they were fully adapted to it. The fMRI studies performed before and after the adaptation revealed that the major changes in brain activation occurred in motor areas, rather than in perceptual areas. This suggests that the students adapted their motor programs to the new situation, whereas the perceptual processes remained unaffected. This suggestion is supported by the experience reported by the students. After being adapted to the inverted world, they state that they still perceive the world as upside-down but that they have acquired the appropriate skills to deal with the new situation. These experiments offer a unique insight into the representation of the visual world in the brain. Goebel emphasized that the experimental results made him aware of the importance of sensorimotor coordination in understanding the nature of mental representations.

Professor Goebel ended his presentation with a recent experiment in which two subjects were trained to control the positions of bats in the game of Pong using their own brain activity. Employing two fMRI scanners, the activities in selected regions (voxels) of the brains of the subjects were fed back visually. In this way, the subjects were quickly able to learn to decrease and increase the activity in the selected part of the brain. Subsequently, the vertical position of the bat was directly coupled to the brain activity. Goebel showed a recording of a game that was played by two trained subjects. Although the playing rate of the game of Pong was somewhat slowed due to the sluggish response of the fMRI signal, both subjects were very well able to play it. The Pong experiment indicates that human beings can learn to manipulate activity within their brain quite precisely. Moreover, it offers interesting possibilities for psychological treatments of addictions or fears and allows for the fundamental study of representations.

Situated Representation – Michel van Dartel (MICC-IKAT, Maastricht University)
The final presentation was given by Michel van Dartel and contained an overview of his thesis work. Van Dartel employed a purely bottom-up approach in which he studied representations in robots that acquired low-level cognitive skills. The first study involved a robot model of perceptual categorization in which robots were optimized to catch and avoid falling objects. The categorization model was constructed in such a way that in order to be successful, a robot was required to respond differently to identical perceptual input. This perceptual ambiguity forced successful robots to represent adequately the information they needed to perform the task. Van Dartel showed that despite the perceptual ambiguity, reactive agents are able to successfully perform the categorization task by using the environment as an external memory. Therefore, he concluded that representations in situated systems can be both internal and external. Van Dartel continued his presentation by providing mechanisms for each of these types of representations. The nature of internal representations was demonstrated with a robot model of the Tower of London task, which is a task akin to the Towers of Hanoi task. The task is often employed by psychologists to assess a subject's planning abilities. The task involves transforming the starting configuration of three coloured balls into a goal configuration. Van Dartel explained that in order to perform the Tower of London task, the robot relies on a mechanism that internally simulates the interaction with the environment. After illustrating the nature of internal representations, Van Dartel proceeded by demonstrating the nature of external representations with a robot model of foraging behaviour. He showed that optimized foraging robots tune to the food distribution in the environment. They access and use the externally represented knowledge to optimally perform the foraging task.

After clarifying the nature of internal and external situated representations, Van Dartel presented the audience with an operationalisation of situated

representation based on the results of his robot studies. The formulation of the operationalisation reads: "*…for an entity to be adequately represented by a system, it is implied that the system is able to perform and/or simulate internally the entity-specific interaction with the environment.*"

With this promising new operationalisation and the important implications that it may have for the fields of artificial intelligence, cognitive neuroscience, and cognitive psychology, Van Dartel ended this inspiring symposium on the evening before his defence.

How to Catch Fish

Review of 'Situated Representation'
Ph.D. thesis by Michel van Dartel

Rens Kortmann

In her book, 'Vision and Art – the biology of seeing', Margaret Livingstone discusses the perception of art from the perspective of cognitive neuroscience. She explains the mechanisms by which our brain sees pieces of art, notably paintings, and how artists use those mechanisms to turn their 2D arrays of colour and intensity values into lively pictures that catch our imagination. Nobel Laureate David Hubel wrote the forword in which he expressed the hope that the book would enhance art as much as did the knowledge of bones and muscles some centuries ago. I believe Michel van Dartel's Ph.D. thesis 'Situated Representation' has even more potential than Livingstone's book. Let me explain why.

Cognitive neuroscience has provided us with valuable insights into the ways our brain processes visual scenes. This branch of scientific investigation couples the material biophysical level – optical properties of the eye and brain chemistry – to the abstract level of cognitive psychology: internal representation and symbol manipulation. Livingstone's book clearly shows how painters have exploited the tricks that our brain plays with our imagination. The configuration of light receptors in the eye retina, for instance, makes us wonder whether Mona Lisa secretely smiled when we looked away from her. Moments before, she seemed perfectly serious, almost serene…

Livingstone unveils the mystery of the Mona Lisa by pointing at the internal representations of the painting in our mind. Different parts of the retina create different representations: Lisa smiling or serene. The way one sees her depends on the angle of view. Internal representation is the centrepiece of the computational theory of mind. It allows cognitive psychologists to explain human thought in terms of logic computations, somewhat similar to the workings of a computer. During the past decade, many alternative theories of cognition were developed that rejected this computer metaphor of the mind. However, the notion of internal representation is so powerful that it has largely prevented the alternatives from becoming generally accepted. Michel van Dartel has boldly set himself to developing an alternative to internal representations: a theory of situation representation.

Situated representations, he claims, are essentially encoded in certain brain structures called sensory-motor couplings. This means that, according to Van Dartel, visual perception is an activity. It requires intelligent beings to look around for clues, to hold objects, to follow them with the eyes, in fact, to engage into active interaction with the visual scene. During his Ph.D. defense he explained the concept clearly by using an example. Imagine a bear catching fish in a stream. In order to distinguish between edible and poisonous fish, the bear looks around the stream. The sensory-motor couplings in his brain guide his actions and make the bear eat the fish or leave it alone. Note that this example does not rely on abstract logic statements and symbol manipulation as does the computational theory of mind. Van Dartel's theory of situated representation explains visual perception and recognition in terms of sensory-motor couplings.

Although elementary, this example gives a nice impression of the potential of Van Dartel's work. Where Livingstone stopped by focussing at still images, Van Dartel could continue to the realms of 3D and moving art. This is important since much of modern-day, contemporary art deals with active perception, not still paintings. The interaction between a piece of art and its audience, moving visual scenes, and advanced electronics are all examples of popular themes in contemporary art. Themes that are also embraced by his new employer, the Rotterdam-based art and science institute V2_. Van Dartel will act as a negotiator between artists and scientists to develop new concepts combing cutting-edge techniques from computer science, electronics, cognitive neuroscience, etc. It seems the perfect place to further develop his ideas.

Let me finish by returning to Hubel. It feels good to follow the footsteps of a Nobel Laureate! I sincerely hope that the cognitive neurosciences will enhance art as much as did the science of anatomy in earlier centuries. Van Dartel's Ph.D. thesis shows great potential for doing so.

The 2005 Number of Theses: SIKS Follows the Trend

Jaap van den Herik
IKAT, Maastricht

A trend is more than one observation point. Last year we believed to reveal a trend by the observation of an actually very good performance of our group of Ph.D. supervisors. They delivered 45 Ph.D. theses which meant a jump of 8 (see Table 1). The number, although exceptionally high, did fit in the trend of a steady increase. Based on the results of eleven years counting Ph.D. theses, I predicted that the number of theses in 2005 would be somewhere in the fourties. It now turns out that we just exceeded this number. I believe that it is still good, but it should be improved considerably.

If we partition the range of 12 years, we see a definitive increase. The period 1994 to 1998 stands for 20 theses, the period 1999 to 2002 stands for 30 theses, and now we live in the period 2003 to 2005 with 40 theses per year. It should be remarked that these theses are AI, AI-related and DB/IS theses. A specific overview of what "related" may imply can be read in the contribution by the manager of SIKS, Dr. Richard Starmans (elsewhere in this issue). Moreover, there are three important domains that also contribute to our score, namely AI and Medicine, AI and Law, and AI and Civil Engineering.

Year	# of Theses
1994	22
1995	23
1996	21
1997	30
1998	21
1999	28
2000	19
2001	25
2002	33
2003	37
2004	45
2005	**41**
Grand Total	345

Table 1: Scores and grand total.

PREVIOUS EXPECTATIONS

In December 2004, I adapted my prediction of February 2004 being 2005 (42), 2006 (45), 2007 (48), and 2008 (51), to the following: 2005 (46), 2006 (47), 2007 (49), and 2008 (51). Obviously, that was too optimistic. Yet, I believe that the trend is alright and that we are still running towards 50 in 2008.

A brief look at SIKS (School of Information and Knowledge Systems) may support this opinion. There we see the following result: 2001 (11), 2002 (17), 2003 (18), 2004 (20), 2005 (21).

We believe that the SIKS trend is more accurate than the BNVKI Newsletter trend, since the inclusion of theses is directly related with the activity of the supervisors. The SIKS school is more disciplined and takes care of the theses since they have an intrinsic interest. Below we give the total numbers over the years, we mention the successful Ph.D. defenders, and we provide the 2005 SIKS list. We complete with a list of new announcements.

As a courtesy to the Ph.D. students who completed their thesis in 2005 we list them below together with their promotion date.

E.M. Pakalsha (17-1), L.J. Hommes (26-1), F. Grootjen (26-1), E.C.D. van der Werf (27-1), F. Verdenius (28-1), Z. Stojanović (22-2), N. Meratnia (23-2), G. Infante-Lopez (6-4), E. Ogston (5-4), S. Daskapan (27-4), F. Mulder (12-5), P. Spronck (20-5), F. Frăsincar (20-6), R. Vdovják (20-6), J. Broekstra (4-7), A. Bouwer (6-7), W. van Ast (8-9), J. Eggermont (14-9), E.L. van den Broek (21-9), B. Shishkov (26-9), O. Zoeter (6-10), B. Omelayenko (12-10), J. Graaumans (17-10), C. Boer (21-10), P.H.M. Jacobs (15-11), J. van Wamelen (16-11), W. Derks (16-11), K. Franke (18-11), I. Hendrickx (21-11), D. Sent (21-11), T. Bosse (23-11), F. Hamburg (24-11), M. van Dartel (1-12), M. Reynaert (2-12), M.P. McDonald (7-12), J.M. Valk (12-12), R. ter Borg (14-12), T. Tewoldeberhan (15-12), I. van der Sluis (19-12), C. Coteanu (20-12), R.P.J. van der Krogt (21-12).

EXPECTATIONS

The expectations given above should be adapted slightly. Since it is very difficult to be precise, I would like to predict a slow increase of the current number towards 50 in 2008. For SIKS, I expect an increase to 25 in 2008 and to 30 in 2012. The reason for this increase is, among others, the trend of the European Minister of Education, in collaboration with the vice-chancellor, to change the Ba/Ma system (the two cycle) into the Ba/Ma/Ph.D. system (the three cycle). More on this topic in the February 2006 issue of the BNVKI Newsletter.

SIKS PROMOVENDI 2005

2005-01

Floor Verdenius (UVA). *Methodological Aspects of Designing Induction-Based Applications.* Promotor: Prof. dr. B.J. Wielinga (UVA). Co-promotor: dr. M.W. van Someren (UVA). Promotion: 28 January 2005.

2005-02

Erik van der Werf (UM). *AI techniques for the game of Go*. Promotor: prof. dr. H.J. van den Herik (UM). Co-promotor: dr. J.W.H.M. Uiterwijk (UM). Promotion: 27 January 2005.

2005-03

Franc Grootjen (RUN). *A Pragmatic Approach to the Conceptualisation of Language*. Promotores: prof. dr. ir. Th. P. van der Weide (RUN), prof. C.H.A. Koster (RUN). Promotion: 26 January 2005.

2005-04

Nirvana Meratnia (UT). *Towards Database Support for Moving Object data.* Promotores: prof. dr. P.M.G. Apers (UT). Co-promotor: Dr. Ir. R. A. de By (ITC). Promotion: 23 February 2005.

2005-05

Gabriel Infante-Lopez (UVA). *Two-Level Probabilistic Grammars for Natural Language Parsing*. Promotores: prof. dr. M. de Rijke (UVA), prof. dr. R. Scha (UVA). Promotion: 06 April 2005.

2005-06

Pieter Spronck (UM). *Adaptive Game AI.* Promotores: prof.dr. H.J. van den Herik (UM), prof.dr. E.O. Postma (UM). Promotion: 20 May 2005.

2005-07

Flavius Frasincar (TUE). *Hypermedia Presentation Generation for Semantic Web Information Systems.* Promotores: Prof.dr. P. De Bra (TUE) Prof.dr.ir. G-J. Houben (VUB/TUE). Co-promotor: Prof.dr. J. Paredaens (TUE/UA). Promotion: 20 June 2005.

2005-08

Richard Vdovjak (TUE). *A Model-driven Approach for Building Distributed Ontology-based Web Applications*. Promotores: Prof.dr. P. De Bra (TUE) Prof.dr.ir. G-J. Houben (VUB/TUE). Co-promotor: Prof.dr. J. Paredaens (TUE/UA). Promotion: 20 June 2005.

2005-09

Jeen Broekstra (VU). *Storage, Querying and Inferencing for Semantic Web Languages*. Promotor: Prof.dr. F. van Harmelen (VU). Promotion: 04 July 2005.

2005-10

Anders Bouwer (UVA). *Explaining Behaviour: Using Qualitative Simulation in Interactive Learning Environments*. Promotores: Prof. dr. B. J. Wielinga (UVA), Prof. dr. J. A. P. J. Breuker (UVA). Co-promotor: Dr. B. Bredeweg (UvA). Promotion: 06 July 2005.

2005-11

Elth Ogston (VU). *Agent Based Matchmaking and Clustering - A Decentralized Approach to Search.* Promotores: prof.dr. F.M.T. Brazier (VU), prof.dr.ir. M.R. van Steen (VU). Promotion: 05 April 2005.

2005-12

Csaba Boer (EUR). *Distributed Simulation in Industry*. Promotor: prof.dr. A. de Bruin (EUR). Prof.dr.ir. A. Verbraeck (Delft University/University of Maryland). Promotion: 21 Oktober 2005.

2005-13

Fred Hamburg (UL). *Een Computermodel voor het Ondersteunen van Euthanasiebeslissingen.* Promotores: prof.dr. H.J.van den Herik (UM/UL), prof.dr. H.M.Dupuis (UL), prof.dr. E.O.Postma (UM). Promotion: 24 November 2005.

2005-14

Borys Omelayenko (VU). *Web-Service configuration on the Semantic Web; Exploring how semantics meets pragmatics.* Promotores: prof dr. A.Th. Schreiber (VU), prof dr. J.M. Akkermans (VU). Promotion: 12 October 2005.

2005-15

Tibor Bosse (VU). *Analysis of the Dynamics of Cognitive Processes.* Promotores: Prof. dr. J. Treur (VU) , Prof. dr. C.M. Jonker (RUN). Promotion: 23 November 2005.

2005-16

Joris Graaumans (UU). *Usability of XML Query Languages.* Promotor: Prof.dr.ir. G.J. van der Steen (UU). Co-promotor: dr. H. van Oostendorp (UU). Promotion:17 October 2005.

2005-17

Boris Shishkov (TUD). *Software Specification Based on Re-usable Business Components.* Promotor: prof.dr.ir. J.L.G. Dietz (TUD). Promotion: 26 September 2005.

2005-18

Danielle Sent (UU). *Test-selection strategies for probabilistic networks.* Promotor: Prof.dr.ir L. C. van der Gaag (UU). Promotion:17 October 2005.

2005-19

Michel van Dartel (UM). *Situated Representation.* Promotores:prof.dr. E.O. Postma (UM), prof.dr. H.J. van den Herik (UM). Promotion: 1 December 2005.

2005-20

Cristina Coteanu (UL). *Cyber Consumer Law, State of the Art and Perspectives.*

Promotores: prof.dr. H.J. van den Herik (UM), prof.dr. G. Howells (Sheffield). Promotion: 20 December 2005.

2005-21

Wijnand Derks (UT). *Improving Concurrency and Recovery in Database Systems by Exploiting Application Semantics*. Promotor: Prof.dr. W. Jonker (UT). Promotion:16 November 2005.

The current list of new Ph.D. defences, officially ranging from December 2005 up to the future in 2006, is given below.

In this list we have included the Ph.D. defence by Wijnand Derks (SIKS-21) which has escaped us so far. Moreover, we have repeated the Ph.D. announcement of Katrin Franke, since in the October 2005 issue we listed her with the Dutch translation of her thesis. Although the translation was correct we would like to be as precise as possible. We congratulate both doctores wholeheartedly with the new title. Finally we wish the other Ph.D. candidates much strength when defending their thesis.

Wijnand Derks (November 16, 2005). *Improving Concurrency and Recovery in Database Systems by Exploiting Application Semantics*. Universiteit Twente. Promotor: Prof.dr. W. Jonker.

Katrin Franke (November 18, 2005). *The influence of Physical and Biomechanical Processes on the Ink Trace. Methodological foundations for the forensic analysis of signatures.* Rijks Universiteit Groningen. Promotor: Prof.dr. L.R.B. Schomaker.

Michel van Dartel (December 1, 2005). *Situated Representation*. Universiteit Maastricht. Promotores: Prof.dr. E.O. Postma, Prof.dr. H.J. van den Herik.

Martin Reynaert (December 2, 2005). *Text Induced Spelling Correction*. Universiteit van Tilburg. Promotores: Prof.dr. W.P.M. Daelemans, Prof.dr. H.C. Bunt. Assistant promotor: Dr. A.P.J. van den Bosch.

Mark McDonald (December 7, 2005). *Architecting the Enterprise, an approach for designing performance, integration, consistency and flexibility*. Delft University of Technology. Promotor: Prof.dr. H.G. Sol.

Jeroen Valk (December 12, 2005). *Coordination among Autonomous Planners*. Delft University of Technology. Promotor: Prof.dr.ir. H.J. Sips. Assistant promotor: Dr. C. Witteveen.

Rutger ter Borg (December 14, 2005). *Electricity Load Modelling using Computational Intelligence*. Delft University of Technology. Promotor: Prof.dr. H. Koppelaar, Assistant Promotor: Dr. L. Rothkranz.

Tamrat Tewoldeberhan (December 15, 2005). *Gaining Insight into Business Networks.* Delft University of Technology. Promotores:prof.dr. H.G. Sol and Prof.dr.ir. A. Verbraeck.

Ielka van der Sluis (December 19, 2005). *Multimodal Reference Studies in Automatic Generation of Multimodal Referring Expressions*. Universiteit van Tilburg. Promotor: Prof.dr. H.C. Bunt, Assistant promotor: dr. E.J. Krahmer.

Cristina Coteanu (December 20, 2005). *Cyber Consumer Law. State of the Art and Perspectives*. Universiteit Leiden. Promotores: Prof.dr. H.J. van den Herik, Prof.dr. G. Howells (University of Lancaster). Reviewer: Prof.dr. E. Hondius (Universiteit Utrecht).

Roman van der Krogt (December 21, 2005). *Plan Repair in Single-Agent and Multi-Agent Systems*. Delft University of Technology. Promotor: Prof.dr.ir. H.J. Sips. Assistant promotor: Dr. C. Witteveen.

ANNOUNCEMENTS

Call for Speakers
BNAIS 2006: AImotion

June 2, 2006
Radboud University Nijmegen

On the 2nd of June 2006 the Belgian Dutch AI Symposium will be held at the Radboud University Nijmegen. The BNAIS tries to show current research development in AI to students. You are invited to contribute to the BNAIS by presenting research of interest. To stress the student viewpoint we also invite students who have just graduated or will do so in the coming months to present their Master's Thesis on the BNAIS 2006. We would like to ask thesis advisers to convey the invitation to the students who might not read this newsletter. Please submit abstracts before March 17th, 2006.

More information: http://www.ru.nl/bnais
Contact: cognac@ai.ru.nl

Call for Papers

Sixth European Symposium on Adaptive and Learning Agents and Multi-Agent Systems (ALAMAS 2006)

April 3-4, 2006
Vrije Universiteit Brussel

Adaptive Learning Agents and Multi-Agent Systems (ALAMAS) is an emerging multi-disciplinary area encompassing Computer Science, Software Engineering, Biology, as well as Cognitive and Social Sciences. The goal of this symposium is to increase awareness and interest in adaptive agent research, encourage collaboration between ML experts and agent-system experts, and give a representative overview of current research in the area of adaptive agents. The symposium will serve as an inclusive forum for the discussion on ongoing or completed work in both theoretical and practical issues.

The proposed symposium is the **sixth** in a series of symposia that have taken place annually since 2001. After these five successful symposia, ALAMAS will be held at the **Vrije Universiteit Brussel** on **Monday the 3rd and Tuesday the 4th of April 2006**. The organization is in hands of the Computational Modeling Lab.

All accepted papers are published in Symposia proceedings. The best papers from the previous AAMAS Symposia have been published in **two Springer LNAI books**, and we plan to publish a follow-up volume including papers from the fifth AAMAS and sixth ALAMAS Symposium.

The workshop topic is situated at the intersection of two areas, namely, Adaptation/Learning and Agents/Multi-Agent Systems. The workshop will focus on (but is not necessarily limited to) the following topics:

- Learning of Co-ordination
- Distributed Learning
- Game-Theoretical and Analytical Approaches to Adaptive Multi-Agent Systems
- Emergent Organisation/Behaviour and Studies of Complexity in Multi-Agent Systems with Learning and Adaptation
- Evolutionary Agents
- Evolution of Individual Learning in Multi-Agent Systems
- Logic-Based Learning
- Learning in Reactive Agents
- Adaptive Mobile Agents
- Software engineering techniques and tools to support development of Adaptive and Learning Agents and Multi-Agent Systems
- Biological inspired Multi-Agent Systems
- Industrial and Large-Scale Applications of Learning Agents

Program Chair: **Ann Nowe**
Local organisers: **Maarten Peeters** and **Katja Verbeeck**

IMPORTANT DATES

Submission deadline:	January 30, 2006
Notification of acceptance:	February 24, 2006
Deadline for camera-ready:	March 24, 2006
Symposium:	April 3 and 4, 2006

All information can be fount at:
http://como.vub.ac.be/alamas2006

Call for Papers

ANTS 2006
Fifth International Workshop on Ant Colony Optimization and Swarm Intelligence

September 4-7, 2006
Brussels, Belgium

SCOPE OF THE WORKSHOP

Swarm intelligence is a relatively new discipline that deals with the study of self-organizing processes both in nature and in artificial systems. Researchers in ethology and animal behavior have proposed many models to explain interesting aspects of social insect behavior such as self-organization and shape-formation. Recently, algorithms inspired by these models have been proposed to solve difficult computational problems.

An example of a particularly successful research direction in swarm intelligence is ant colony optimization, the main focus of which is on discrete optimization problems. Ant colony optimization has been applied successfully to a large number of difficult discrete optimization problems including the traveling salesman problem, the quadratic assignment problem, scheduling, vehicle routing, etc., as well as to routing in telecommunication networks. Another interesting approach is that of particle swarm optimization, that focuses on continuous optimization problems. Also in this case, a number of successful applications can be found in the recent literature. Another interesting research

direction is swarm robotics, where the focus is on applying swarm-intelligence techniques to the control of large groups of cooperating autonomous robots.

The ANTS 2006 workshop will give researchers in swarm intelligence the opportunity to meet, to present their latest research, and to discuss current developments and applications. The four-day workshop will be held in Brussels, Belgium, on September 4-7, 2006. September 4 will be devoted to tutorials.

RELEVANT RESEARCH AREAS

ANTS 2006 solicits contributions dealing with any aspect of swarm intelligence. Typical, but not exclusive, topics of interest are:

- Behavioral models of social insects or other animal societies that can stimulate new algorithmic approaches.
- Empirical and theoretical research in swarm intelligence.
- Application of swarm intelligence methods, such as ant colony optimization or particle swarm optimization, to real-world problems.
- Theoretical and experimental research in swarm robotics systems.

PUBLICATION DETAILS

Workshop proceedings will be published by Springer in the LNCS series.

BEST PAPER AWARD

A best paper award will be presented at the workshop.

FURTHER INFORMATION

Up-to-date information will be published on the web site http://iridia.ulb.ac.be/ants2006/. For information about local arrangements, registration forms, etc., please refer to the above-mentioned web site or contact the local organizers at the address below.

WORKSHOP ADDRESS

ANTS 2006 workshop
IRIDIA, CP 194/6
Université Libre de Bruxelles
Av. F. D. Roosevelt 50, 1050 Bruxelles, Belgium
Tel +32-2-6502729
Fax +32-2-6502715
http://iridia.ulb.ac.be/ants2006
email: ants@iridia.ulb.ac.be

WORKSHOP LOCATION

Université Libre de Bruxelles, Brussels, Belgium.

IMPORTANT DATES

Title and abstract deadline	Mar 12, 2006
Submission deadline	Mar 19, 2006
Notification of acceptance	May 21, 2006
Camera-ready copy	June 4, 2006
Tutorials	September 4, 2006
Workshop	September 5-7, 2006

ANTS 2006 WORKSHOP COMMITTEE

General Chairs: **Marco Dorigo**, IRIDIA, ULB, Brussels, Belgium, and **Luca M. Gambardella**, IDSIA, USI-SUPSI, Manno, Switzerland.

Technical Program Chairs: **Alcherio Martinoli**, EPFL, Lausanne, Switzerland, **Riccardo Poli**, University of Essex, UK, and **Thomas Stuetzle**, IRIDIA, ULB, Brussels, Belgium.

Publication Chair: **Mauro Birattari**, IRIDIA, ULB, Brussels, Belgium.

Call for Papers

Special Session on "Multi-objective Machine Learning"

2006 International Joint Conference on Neural Networks

July 16-21, 2006
Vancouver, Canada

Organized by: Yaochu Jin (yaochu.jin@honda-ri.de)
More information: http://www.soft-computing.de/CFP_SS_MOML.html

MOTIVATION AND SCOPE

Machine learning usually has to achieve multiple targets, which are often conflicting with each other. For example in feature selection, minimizing the number of features and the maximizing feature quality are two conflicting objectives. It is also well realized that model selection has to deal with the trade-off between model complexity and approximation or classification accuracy. Traditional learning algorithms attempt to deal with multiple objectives by combining them into a scalar cost function so that multi-objective machine-learning problems are reduced to single-objective problems.

Recently, increasing interest has been shown in applying Pareto-based multi-objective optimization to machine learning, particularly inspired by the successful developments in evolutionary multi-objective optimization. It has been shown that the multi-objective approach to machine learning is

particularly successful in 1) improving the performance of the traditional single-objective machine-learning methods, 2) generating highly diverse multiple Pareto-optimal models for constructing ensembles, and 3) in achieving a desired trade-off between accuracy and interpretability of neural networks or fuzzy systems.

This proposed special session intends to further promote research interests in multi-objective machine learning by presenting the most recent research results and discussing the main challenges in this area. Topics include but are not limited to:

- multi-objective clustering, feature extraction and feature selection
- multi-objective model selection to improve the performance of learning models, such as neural networks, support vector machines, decision trees, and fuzzy systems
- multi-objective model selection to improve the interpretability of learning models, e.g., to extract symbolic rules from neural networks, or to improve the interpretability of fuzzy systems
- multi-objective generation of learning ensembles
- multi-objective learning to deal with tradeoffs between plasticity and stability, long-term and short-term memories, specialization and generalization
- multi-objective machine learning applications

SUBMISSION

All special session papers must be submitted no later than January 31, 2005 through the conference webpage. Please notice me by sending me an email if you are interested in submitting a paper to the Special Session.

CONFERENCES, SYMPOSIA WORKSHOPS

Below, the reader finds a list of conferences, symposia and workshops, and websites or addresses for further information.

MARCH 20-24, 2006
2nd Conference on Interoperability for Enterprise Software and Applications (I-ESA 2006). Bordeaux, France.
http://www.i-esa.org

MARCH 27-28, 2006
The First Pacific Rim International Workshop on Electronic Commerce (PRIWEC 2006). National Center of Sciences Building, Tokyo, Japan.
http://www-toralab.ics.nitech.ac.jp/PRIWEC2006/

MAY 8-11, 2006
International Conference on Computational Science and its Applications (ICCSA'2006). Glasgow, UK.
http://www.iccsa.org/

MAY 8-12, 2006
Fifth International Joint Conference on Autonomous Agents and Multiagent Systems (AAMAS-06). Future University, Hakodate, Japan.
http://www.fun.ac.jp/aamas2006/

MAY 22-26, 2006
15th World Wide Web Conference (WWW2006). Edinburgh, Scotland.
http://www2006.org

MAY 28-31, 2006
International Conference on Computational Science (ICCS 2006). Reading, UK.
http://www.iccs-meeting.org/iccs2006/

MAY 30-JUNE 1, 2006
First International Conference on Scalable Information Systems (INFOSCALE). Hong Kong.
http://www.infoscale.org/

AUGUST 17-20, 2006
22nd International Conference on Logic Programming. Seattle, Washington, USA.
http://www.cs.uky.edu/iclp06/

AUGUST 21-23, 2006
The 6th International Conference on Intelligent Virtual Agents (IVA'06). Marina del Rey, CA, USA.
http://iva2006.ict.usc.edu/

SEPTEMBER 13-15, 2006
10th European Conference on Logics in Artificial Intelligence (JELIA'06).Liverpool, UK.
http://www.csc.liv.ac.uk/~jelia

OCTOBER 9-10, 2006
BNAIC'2006. University of Namur, Belgium.

ADRESSES
BOARD MEMBERS BNVKI

Prof.dr.ir. J.A. La Poutré (chair)
Centrum voor Wiskunde en Informatica
P.O. Box 94079
1090 GB Amsterdam
Tel.: + 31 20 592 9333. E-mail: Han.La.Poutre@cwi.nl

Dr. A. van den Bosch (secretary)
Universiteit van Tilburg, Faculteit der Letteren
Taal en Informatica, Postbus 90153, 5000 LE Tilburg
Tel.: + 31 13 4663117. E-mail: Antal.vdnBosch@uvt.nl

Dr. C. Witteveen (treasurer)
TU Delft, ITS
P.O. Box 5031, 2600 GA Delft
Tel.: + 31 15 2782521. Email: c.witteveen@its.tudelft.nl

Prof.dr. M. Denecker
Katholieke Universiteit Leuven
Dept. of Computer Science, Celestijnenlaan 200A
3001 Heverlee, België
Tel.: + 32 16327544. E-mail: marcd@cs.kuleuven.ac.be

Prof.dr. C. Jonker
Radboud Universiteit Nijmegen, Division Cognitive Engineering
Nijmegen Institute for Cognition and Information
Spinoza Building, Montessorilaan 3, 6525 HR Nijmegen
The NetherlandsTel.: +31 24 3612646.
E-mail: C.Jonker@nici.kun.nl

Dr. J.W.H.M. Uiterwijk
Universiteit Maastricht, IKAT
Postbus 616, 6200 MD Maastricht
Tel: + 31 43 3883490. E-mail: uiterwijk@cs.unimaas.nl

Dr. E.D. de Jong
Universiteit Utrecht, Inst. for Information & Computing Science
P.O. Box 80089, 3508 TB Utrecht
Tel.: + 31 30 253.9049. E-mail: dejong@cs.uu.nl

Dr. M.F. Moens
KU Leuven, Interdisciplinair Centrum voor Recht & Informatica
Tiensestraat 41, 3000 Leuven, België
Tel.: + 32 16 325383
E-mail: marie-france.moens@law.kuleuven.ac.be

EDITORS BNVKI NEWSLETTER

Dr. J.W.H.M. Uiterwijk (editor-in-chief)
Address details: see above.

Prof.dr. E.O. Postma
Universiteit Maastricht, IKAT
Postbus 616, 6200 MD Maastricht
Tel: + 31 43 3883493. E-mail: postma@cs.unimaas.nl

Prof. dr. H.J. van den Herik
Universiteit Maastricht, IKAT
Postbus 616, 6200 MD Maastricht
Tel.: + 31 43 3883485. E-mail: herik@cs.unimaas.nl

M. van Otterlo, M.Sc.
University of Twente, Dept. of Computer Science
P.O. Box 217, 7500 AE Enschede
Tel.: + 31 53 4894111. E-mail: otterlo@cs.utwente.nl

Dr. M.F. Moens (section editor)
Address details: see above.

Dr. K. Verbeeck (editor Belgium)
Vrije Universiteit Brussel, Computational Modeling Lab
Pleinlaan 2, 1050 Brussel, Belgium
Tel.: + 32 26293724. E-mail: kaverbee@vub.ac.be

Dr. R.J.C.M. Starmans (section editor)
Manager Research school SIKS, P.O. Box 80089
3508 TB Utrecht
Tel.: + 31 30 2534083/1454. E-mail: office@siks.nl

Ir. E.M. van de Vrie (section editor)
Open Universiteit Nederland, Opleiding Informatica
Postbus 2960
6401 DL Heerlen
Tel: + 31 45 5762366. Email: Evert.vandeVrie@ou.nl

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COPY

The editorial board welcomes product announcements, book reviews, product reviews, overviews of AI education, AI research in business, and interviews. Contributions stating controversial opinions or otherwise stimulating discussions are highly encouraged. Please send your submission by E-mail (MS Word or text) to newsletter@cs.unimaas.nl.

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The BNVKI/AIABN Newsletter is sent from Maastricht. The BNVKI/AIABN board has decided that the BNVKI/AIABN membership administration takes place at the editorial office of the Newsletter. Therefore, please send address changes to:

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Universiteit Maastricht, Tons van den Bosch,
Dept. Computer Science, P.O. Box 616, 6200 MD
Maastricht, The Netherlands
E-mail: newsletter@cs.unimaas.nl
http://www.cs.unimaas.nl/~bnvk