BNVKI
AIABN

NEWSLETTER

Situated Models of Perception and Memory

The European Conference on Complex Systems 2007

A Memorable Day

*News from the Belgium-Netherlands Association for Artificial Intelligence*

HJ := 60

Editor-in-chief

The title of this editorial is "borrowed" from Birna van Riemsdijk, who used the title "JJ := 50" in her report on the symposium organized for the occasion of professor John-Jules Meyer's 50th birthday (see the December 2004 issue of this Newsletter, pp. 132-133). So I'm glad to present in this issue a report on the 60th birthday of professor H.J. (Jaap) van den Herik, former chairman and honourable member of the BNVKI. And who could do this better than his colleague and friend JJ himself! At pages 109-110 you find his report on the symposium "Intelligent Systems" organised in honour of Jaap, featuring 8 excellent presentations by close colleagues and friends of Jaap.

The laureate himself, thanking the speakers at the symposium.

Moreover, in this issue there is much attention for Ph.D. thesis abstracts. The last months were successful months in this respect, and though we were not able to obtain all abstracts of the fresh doctors who obtained their degree in these months, we still have received 6 abstracts. They show a large variety of subjects, varying from applications of AI in medicine, business organizations, psychology and even sexuology. The latter thesis, by Scottish chess master David Levy, entitled "Intimate Relations with Artificial Partners", had a lot of media attention. Although not all AI researchers consider this hard science, it surely is on the edge of AI. His thesis is also very provocative and puts AI and robotics in the spotlight. When the commercial edition of his thesis will appear on the market in a few weeks (with the even more direct and appealing title "Love and Sex with Robots"), I'm sure another wave of media attention will be his share.
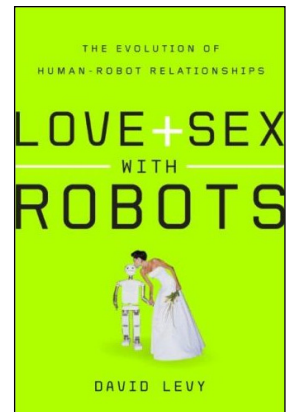
Finally, when this issue falls on your table, you perhaps are just back from Utrecht where you were participant of the BNAIC 2007 conference. As it looks now we will witness a very successful edition of the BNAIC. And if prospects don't lie, maybe the BNAIC 2007 edition will be the largest one, considering number of participants and presentations, in the whole history of the BNAIC. In the next issue we will of course extensively report on the BNAIC 2007.

Appeal for a New BNVKI Board Member

As prof.dr. Cees Witteveen will step down as BNVKI board member at the next General Assembly, to be held during the upcoming BNAIC 2007 (November 5-6, 2007 in Utrecht), the Board of the BNVKI invites members of the BNVKI to make themselves known as a candidate for the new board-member position.

If interested, please contact the Chair of the Board, Dr. Antal van den Bosch, email Antal.vdnBosch@uvt.nl .

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The photographs in this issue are by courtesy of Steven de Jong (p. 108) and Eric Postma (all others).

Front cover: according to David Levy, around 2050 marriages with robots will be legalized.

The deadline for the next issue is: **December 1, 2007**.

BNVKI-Board News

Antal van den Bosch

As I write this, preparations for BNAIC 2007 are at their peak. The co-chairs, Mehdi Dastani and Edwin de Jong, have compiled a wonderful program with invited speakers Pedro Domingos, Michael Thielscher, and special guest Nada Lavrac. The local organization team composed of Arne Koopman, Johan Kwisthout, Matthijs van Leeuwen, Christian Mol, Bas Steunebrink, Nieske Vergunst, and Jilles Vreeken have done a great job as well; among many other organisational feats they managed to arrange a wonderful set of sponsors, both industrial and academic. Thanks to the sponsors for their support of our dear event – and a big applause to Edwin, Mehdi, and their team!

At the coming BNAIC, at the General Assembly meeting (in the lunch break of the second day), we, the board, will present our yearly report on how 2007 went for the BNVKI, and how we intend to continue – both content-wise and financially. As for the latter, the financial report will be delivered for the last time by board member and treasurer prof. Cees Witteveen, who will subsequently step down, marking the end of his five-year term. I speak for the whole board when I express my heartfelt thanks to Cees; he was not only a great, honest and sincere fellow board member but also an admirably trustworthy and thus exemplary treasurer. Thanks Cees!

As we will detail in the remainder of our report to the General Assembly, we can inform you that we indeed have attained the goal we set a year ago to sponsor and endorse more workshops related to AI than before – we intend to follow this path in 2008. To help us, you can proactively suggest workshops to endorse – sponsorship requests included.

If you allow me the liberty of making a suggestion for Sinterklaas presents – buy AI related toys and gadgets! There are new generations to be conquered.

BNVKI/AIABN General Assembly
November 6, 2007

During the lunch break of the 2nd day of BNAIC 2007 (i.e., from 13.15-14.15) the BNVKI/AIABN general assembly will be held. The agenda reads:

0. Opening
1. Minutes meeting general assembly Friday October 6, 2006 (see the October 2006 issue of the BNVKI Newsletter, pp. 96-97)
2. Announcements
3. Financial Report 2006
4. Auditing committee 2007
5. Progress report 2007 and plans for 2008
6. BNAIC 2008
7. New board member
8. End of meeting

Situated Models of Perception and Memory

SIKS-MICC workshop
September 19, 2007
Universiteit Maastricht

Laurens van der Maaten
MICC-IKAT, Universiteit Maastricht

In honor of the Ph.D. defense of Joyca Lacroix, SIKS and the MICC group of Maastricht University organized a symposium entitled 'Situated Models of Perception and Memory' on September 19th 2007. The workshop was funded by NWO and SIKS. The invited speakers at the symposium were prof.dr. Gary Cottrell (University of California at San Diego), prof.dr. Justus Piater (University of Liège), dr. Valerie Goffaux (University of Louvain / Maastricht University), and drs. Joyca Lacroix (now at Leiden University). The symposium was chaired by prof.dr. Eric Postma (Maastricht University).

Unfortunately, professor Cottrell's flight was delayed, and as a result, his presentation was rescheduled. Drs. Guido de Croon (Maastricht University) was willing to fill the gap in the program with a talk on his work. Below, the content of the five talks is discussed in detail.

Prof.dr. Justus Piater – *RLVC and RLJC: Closed-Loop Learning of Visual Control Policies*
In order to develop successful (embodied) cognitive systems, such as robots that can grasp objects, it is necessary that such systems learn while they perform their tasks. Embodied cognitive systems should exploit information that is obtained from percepts that arise from their actions, or adapt to changes in the environment. Traditional computational symbol-manipulation approaches to cognition suffer from problems such as the symbol-grounding problem and, therefore, are not successful in allowing cognitive systems to learn from their perceived consequences of their actions. A more fruitful approach would be to directly link the percepts to the system's actions. In reinforcement learning a direct link between percepts (i.e., states) and actions is learned. In his talk, Piater presents an approach based on reinforcement learning that

allows for a direct perception-action link called Reinforcement Learning of Visual Classes (RLVC).

A visual reinforcement learner may define its state in terms of the image that is perceived. Reinforcement learning cannot be applied directly on such images for two main reasons: (1) the reinforcement learner takes states, rather than visual images, as input, and (2) the size of the state space (i.e., the perceptual space) is too large. The first problem is addressed by the identification of keypoints and the extraction of local-appearance descriptors at these keypoints. The second problem is addressed by means of a greedy algorithm that incrementally refines the state space by splitting up states to reduce perceptual aliasing. The splitting is performed by means of selecting a feature that discriminates between the two states from a codebook of candidate features.

The approach is shown to work successfully on a visual navigation task. The main advantages of the approach are that vision is linked directly to action, and that the huge perceptual space is discretized in an adaptive way.
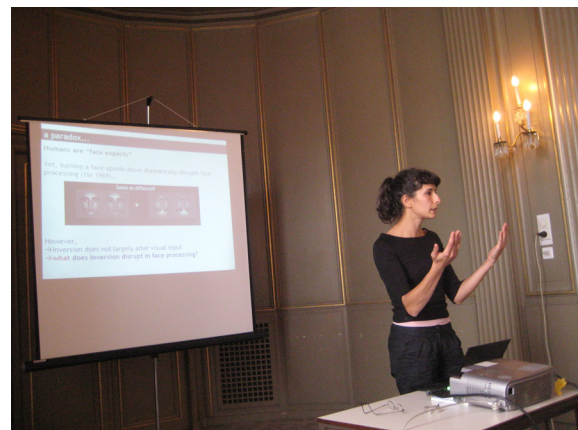

Justus Piater.

Dr. Valerie Goffaux – *Contribution of vertical and horizontal cues to face perception*
Humans are face recognition experts but have considerable difficulty with recognizing an upside-down face. It is generally assumed that for upright faces humans can use expert features that characterize mainly spatial relations in the face. This can easily be demonstrated by means of artificial faces constituted of identical features (such as nose, mouth, etc.) in various spatial configurations. Perceptually, the faces look strikingly different, but when the faces are inverted, all perceptual differences seem to disappear. A wide range of studies has shown that this phenomenon is specific to faces (i.e., the expert hypothesis is likely not to apply here). In the work by Goffaux, spatial relations in faces are divided coarsely into horizontal and vertical spatial relations. Goffaux's experiments with human subjects have shown that face inversion does not affect both types of relations similarly. In fact, there seems to be a special role of vertical spatial relations in face recognition. Experiments with human subjects using brain imaging (fMRI) support this claim (although the fMRI experiments also reveal that local featural information is important as well). Additional experiments in which human subjects are presented with images of faces in which either all horizontal or all vertical energy is retained corroborate the results of the earlier studies.

An obvious explanation for the importance of vertical spatial relations in face recognition is that faces are more vertically than horizontally elongated. Furthermore, the vertical organization of a face can be observed under many different viewpoints, whereas the horizontal organization of the face cannot be observed under most viewpoints. More specifically, when a face turns away from the viewer, the perceived distance between the tip of the nose and the chin does not change, whereas the perceived distance between both eyes is shortened.

Valerie Goffaux.

Drs. Joyca Lacroix – *Modelling Natural Visual Cognition in the Real World*
Similar to Justus Piater, Joyca Lacroix starts her talk with the observation that traditional computational models towards cognitive science suffer from fundamental problems such as the symbol-grounding and the transduction problem. Neurobiology and psychology may provide insights into how to overcome these problems. The Natural Input Memory (NIM) model that was developed by Lacroix was inspired by such insights. The NIM model consists of a simple human memory model (the back-end) that is combined with a perceptual model (the front-end). The development of the perceptual model was inspired by three important characteristics of the human visual system: (1) the fixation-based perception in the human visual

system, (2) the multi-scale sampling that is employed in the human visual system, and (3) the measurement of the presence of oriented edges that is performed in the human primal visual cortex. NIM's perceptual front-end extracts oriented edges at multiple scales using steerable pyramids. Subsequently, it uses a saliency-based mechanism to find possibly interesting fixation points and performs a memory-based recognition. In an extension of the basic NIM model, classification of each fixation is performed using a nearest-neighbor classifier that contributes to a 'belief' histogram. This histogram may be used for object classification, and was successfully tested on a face recognition task.

Future extensions of the model focus on the integration of various top-down processes with the bottom-up process. These processes should be based on human top-down processes related to, e.g., the goals and plans of viewer, local input selection by coarse global image processing, stored long-term knowledge, and short-term episodic memory.

Joyca Lacroix.

Drs. Guido de Croon – *Gaze Control for Object Detection*
Similar to Joyca Lacroix, Guido de Croon attempts to employ human gaze control in computer vision tasks. Human gaze control has been measured using so-called gaze trackers, which led to the observation that humans make approximately three fixations per second. Many current techniques in computer vision (such as the well-known Viola & Jones classifier) perform passive scanning and do not employ the information from the image patches that they are processing. The information in these patches can be employed by incorporating gaze control in object detection (even in still images). In this way, spatial context in the images is incorporated in the object detection process. In de Croon's model, the gaze control is performed by a neural-network controller that is trained using evolutionary learning. The features that are extracted from the patches consist

of a number of so-called integral image features (as proposed by Viola & Jones) that are evolved as well. In the scanning process, the agent is put at a random spatial location on the image. The controller determines the gaze shift, the gaze is shifted, and the process is iterated for a fixed number of iterations. As a result, the gaze is shifted towards possible locations of the object given the context. The object classification is performed by a Support Vector Machine (SVM). De Croon's method is shown to exhibit a promising performance in the detection of mugs and faces in relatively stable real-world environments. Analysis of the neural-network controller indicates that the controller learned the spatial relation between the context and the object fairly well.

Guido de Croon.

Prof. Gary Cottrell – *NIMBLE: A Kernel Density Model of Saccade-Based Visual Memory*
Despite his flight delay and jet lag, professor Cottrell was willing to present a lecture. The focus of his lecture was on NIMBLE, an extension of the NIM model developed by Joyca Lacroix. NIMBLE is a Bayesian version of the NIM model. Cottrell conceives of the memorized preprocessed image fragments as samples from image class distributions. In NIMBLE these distributions are odelled using kernel-density estimation. Subsequently, class-conditional probabilities of new image fragments are derived and integrated for classification in a Bayesian framework. The model is validated by demonstrating human levels of performance on a face recognition memory task and high accuracy on multi-category face and object identification. The results presented showed that NIMBLE is a useful extension and formalization of the original NIM model.

In addition to NIMBLE, professor Cottrell addressed several related lines of his research on psychologically and biologically motivated face-recognition models. In a historical overview he reviewed his work on non-linear dimensionality-

reduction techniques that successfully extracted relevant facial features. In addition, he discussed his work to model and explain results of fMRI studies pertaining to the "fusiform face area", the brain area known to be pivotal in the human processing and recognition of faces. Finally, professor Cottrell pointed at some promising lines of future research.

The workshop revealed the potential of interdisciplinary approaches to Artificial Intelligence in which the development of cognitive vision models is inspired by new insights from (neuro)cognitive studies. Undoubtedly, situated and embodied approaches to AI will benefit from progress in the cognitive (neuro)sciences.

Gary Cottrell.

The European Conference on Complex Systems 2007

October 1-6, 2007
Dresden, Germany

Steven de Jong
MICC-IKAT, Universiteit Maastricht

The European Conference on Complex Systems (ECCS) is an interdisciplinary conference, organized by the Complex Systems Society. Topics vary from biology and physics to artificial intelligence and social sciences, focussing on the complexity associated with problems in these fields. This year, the fourth annual conference was hosted by the Technische Universität Dresden. The first three days consisted of keynote talks, invited talks,

oral presentations and posters. The second three days of the conference consisted of satellite workshops in a broad range of interesting topics. In this small contribution, we will focus on only a small portion of the rich palette of information offered during the conference and associated events.

MAIN CONFERENCE
The conference opened with a short welcome talk by one of the organisers, Dirk Helbing, after which Jörgen Jost directed attention toward a call for socially intelligent ICT within Framework 7. The call closes in April 2008. Research proposals are strongly encouraged.

The first three days had a busy, fixed planning, to which everyone fortunately adhered punctually, leading to only minimal delays. Every morning, the audience was treated with a surprisingly large number of keynote and invited talks, each of which was exciting as well as inspiring. Afternoons were filled with short and long presentations in parallel sessions, including Biological Systems, Bioinspired Modelling, Complex Systems Methods, Cognition, Information Technology Modelling, Networks, and Social Systems. Meanwhile, there was also a poster session on various topics. Presentations were often of very high quality, and questions from the audience regularly lead to lively discussions, within the available strict time frame.

SELECTION OF KEYNOTE TALKS
Dario Floreano presented a talk entitled "Science, Technology and Applications of Swarm Robotics". His group is trying to incorporate principles observed in biology to physical robots. This starts with individual robots and progresses to groups of robots. Groups of lower animals such as insects or fish are able to display coordinated behavior (e.g., swarming); groups of more complex animals (such as apes or humans) can display behavior that is explicitly beneficial for the group as a whole. Floreano addressed the issue of genetic relatedness using evolutionary robotics and showed that groups of individuals that are genetically related, can learn to solve problems that unrelated individuals cannot solve. Applications were illustrated with a wide array of interesting film clips.

Bernardo Huberman talked about social dynamics in cyberspace. He stressed that currently, due to the web, people are generating more content than people are actually willing to read. Huberman observed a shift from the economy revolving around information to it revolving around attention; information used to be scarce, but is now so abundant that all we want is to be noticed. A relevant idea here is viral marketing (word of mouth), which is employed on various websites,

varying from Amazon to Digg. Developments such as these, or Wikipedia or Facebook give researchers the opportunity to study the emergence of a massive system of collective intelligence, collective norms and communication patterns.

Neil Johnson talked about complexity in human activity, addressing his research in group formation: how do groups compete (or even fight) for resources, how do they form or disband? The same principles seem to apply to different groups, from the financial market to crime and online game gangs, especially when there is a small group trying to disrupt the majority (e.g., guerilla). It seems that conflicts are (similarly) power-law distributed with respect to the number of casualties.

Stephan Mertens talked about the complexity of computation. The speaker stressed that more advanced computers, most notably quantum computers, would not be sufficient to bridge the gap between the problem classes P and NP. As always, this will require fundamental insights. Moreover, many people believe that the implications of P=NP would be so grotesque that the opposite seems to be some kind of physical law. The P=NP problem is a problem about mathematics and provability itself. Mertens argued that typical case complexity might be more useful.

Mark Newman gave an introduction to the structure and function of complex networks, deliberately starting with the basics of network theory, and later discussing implications for relevant problems such as virus prevention (both in nature as on the Internet). Most notably, he introduced the notion of the 'ridiculogram', implying (a depiction of) a network that is 1) visually stunning, 2) scientifically worthless and 3) published in Science or Nature.

Stephen Smale presented a challenging keynote talk on the mathematics of emergence and flocking. He focussed on issues such as the emergence of bird flocks or language and the convergence to consensus in decentralized systems, using learning theory and mathematical modelling.

Karl Sigmund talked about the emergence of cooperation – why do humans choose to cooperate, and how can we obtain such cooperation? Sigmund argued that the current state of the art already answers why people choose to cooperate (namely, because of altruistic punishment); we should now answer the question why people choose to perform altruistic punishment in the first place, even though this is costly. Various ideas have been proposed, including the effects of reputation, network topology (such as small-world networks) and

volunteering to participate in interactions. Also, Sigmund showed that it matters whether we consider the population to be infinite or not. Many presentations related to this keynote lecture could be attended during the rest of the conference.

SATELLITE WORKSHOPS

In addition to the main conference on Monday to Wednesday, participants were also invited to the satellite workshops held from Thursday to Saturday. For the sake of brevity, we will just list some of the topics of these workshops here. They included complex networks and dynamics, multi-agent systems and multi-agent learning, emergent systems, systems biology, social interactions and social websites, and evolution and game theory. The organisers of these workshops were sponsored by the Complex Systems Society in order to support invited speakers, wave conference fees, and support young scientists, with a focus on new EU member countries and female scientists. The conference concluded on Saturday with a showcase of European complexity science projects, which included a workshop, poster presentations and project presentations.

In conclusion, ECCS is a rewarding conference for those interested in interdisciplinary research, which fortunately is receiving more and more attention in the artificial intelligence community. The conference actively supports organisers of satellite events and welcomes contributions in diverse fields. Additionally, the FP7 call for socially intelligent ICT is something to keep in mind.

The proceedings are available electronically on http://vwitme011.vkw.tu-dresden.de/TrafficForum/ dresden/ECCS_booklet.pdf.

The organ of the Frauenkirche in Dresden, which was left in ruins for over 45 years before being rebuilt. The building opened again in 2005, with tenthousands of people celebrating.

A Memorable Day

John-Jules Meyer
Utrecht University

I was asked to write something for this newsletter about my impression of the "Intelligent Systems" Symposium held in Maastricht, October 12th, 2007 on the occasion of the 60th birthday of Prof. Jaap van den Herik. I do this with great pleasure, also since this gives me the opportunity to congratulate Jaap publicly with reaching this milestone, marking the beginning of the second half of his career, as I think Tom Mitchell put it in the introduction of his lecture. Jaap and I go back a long time and we have become very good friends as well as colleagues. I admire Jaap for his great skills and drive, and particularly his efforts to foster AI research in The Netherlands. Jaap, my sincerest congratulations with your 60th!

The program was very attractive indeed: a number of excellent speakers gave very interesting talks on topics related to Jaap's expertise and interests, which spans a wide variety of topics, interspersed with personal memories of interactions with Jaap.

First, my colleague from Utrecht Henk van der Vorst gave an excellent talk on mathematical tricks you can play with images, as an example reducing (a picture of) Jaap, and only at the end you realized that he mixed fact and fiction, truth and fabrication in a truly magistral fashion. In the process we learned that Henk has wonderful artistic skills as well!

Henk van der Vorst.

Hiroyuki Iida talked about the four seasons of game study, connecting the (Japanese! – which are quite different, as Jaap learned...) colors of seasons with aspects of games, and in particular the three(!) aspects of mastering a game: winning, playing and understanding.

Jonathan Schaeffer gave a truly fascinating talk about his quest to 'solve' games, which on one occasion took him something like 18 years of continued computation on multiple computers in parallel, where (rare but on this scale inevitable) disk copy errors meant roll backs of computations of several years. This calls for a kind of scientific intrepidity, patience and perseverance I lack myself completely: I already abhor having to repeat writing a small MS document after something has gone wrong...

Jonathan Schaeffer.

Johan van Benthem's talk was brilliant as always, taking a God's eye (i.e. logician's) view relating logic with games, Amsterdam with Maastricht and himself with Jaap. The moment of (logical) truth was at the end when Johan asked Jaap in a rather direct manner whether he (Jaap) actually had employed some logicians in Maastricht himself, which fortunately, after some thinking, Jaap could answer positively...

Johan van Benthem.

Then Corien Prins (now Tilburg) came on and told in a really both touching and informative talk about the Leyden side of Jaap, while at the same time getting back at Jaap's claims about the superiority of machine/computer over man by introducing genetically enhanced humans: there is still hope for humanity...

Then Jaap's closest Maastricht colleague, Eric Postma, told about the amazing things they have done using AI for identifying artists of paintings, followed by an authoritative account of Maastricht's Debeye Award laureate of a couple of years ago, Tom Mitchell from Carnegie Mellon, on his discipline, the science of machine learning.

Tom Mitchell.

The scientific program was ended with a very nice talk by Jan van Zanten, the mathematical conscience of Jaap's group in Maastricht, who in its own unequalled style talked about the wonderful relations between combinatorial games and algebraic codes.

The day was finished by the presentation of a Liber Amicorum to Jaap, which unfortunately I missed since I was waiting for it in what appeared to be the wrong side of the (rather large) building, the beautiful castle Vaeshartelt ;-(Then the real party started which was great, with lots of people, drinks and food, distributed over the whole castle. It was impossible, even for me, to miss out on that...! After having established for myself that Jaap himself was also really pleased with the whole event, I left for home. Truly a memorable day!
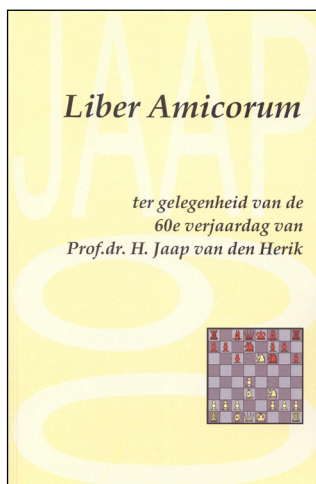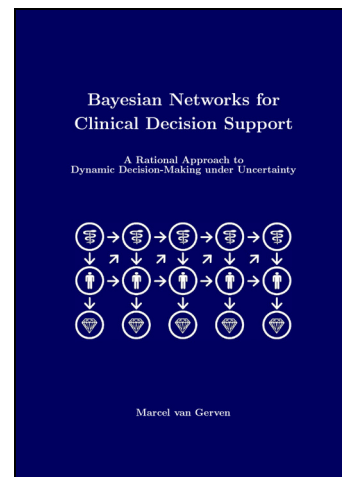

PH.D. THESIS ABSTRACTS

Bayesian Networks for Clinical Decision Support: A rational approach to dynamic decision-making under uncertainty

Ph.D. thesis abstract
Marcel van Gerven

Promotor: Prof.dr.ir. Th.P. van der Weide (RUN)
Co-promotor: Dr. P.J.F. Lucas (RUN)
Date of defense: September 5, 2007

Clinical practice is characterized by complex tasks such as diagnosis, treatment, and prognosis, where the physician needs to make the correct decision at each point in time in uncertain situations. Due to the growing complexity of contemporary medicine and the striving for goal-directed and efficient medical practice, there is a need for systems that support the physician in decision-making.

In the past decennia, advanced techniques have become available that may form a basis for decision-support systems. In this thesis, I will focus on Bayesian networks; graphical models which are based on probability theory and allow reasoning under uncertainty. It is well-known that optimal models can be learned, given sufficient time and data. Clinical practice, however, is characterized by a limited availability of data. This implies that learning optimal models is often impossible. On the other hand, physicians possess large amounts of expert knowledge that can be used to construct

Bayesian networks manually. In this thesis, various techniques are developed that allow the use of Bayesian networks for decision-support in clinical practice. Using these techniques, models can be built from available medical knowledge or learned from a limited amount of data.

After describing the medical and mathematical concepts that are of importance, we start by describing medical decision-support in terms of abstract problem solving in Chapter 3. A clear definition of the medical problem, in combination with the specification of restrictions on the model, already give insight into the structure of the Bayesian network that is to be constructed. Subsequently, we present some advise on how to build Bayesian networks in practice based on our modelling experience.

In Chapter 4, we develop a technique that represents medical knowledge in terms of particular Bayesian network structures. The idea is that the qualitative specification of causal relations and the use of a number of reasonable assumptions, leads to a theory which enables the automatic identification of models that obey the qualitative specification. This offers a way to simplify the development of Bayesian networks based on expert knowledge.

Chapter 5 deals with a different problem, namely learning an optimal treatment model when we possess a model of the underlying disease. This is a complex problem since treatment requires optimal decision-making at each point in time. A formalism is described with which such problems can be represented and a number of techniques are developed that allow the learning of (approximately) optimal treatment models. The usefulness of the technique is demonstrated by means of a model of high-grade carcinoid tumors.

In Chapter 6, we describe the development of a model of low-grade carcinoid tumors where both the disease and its treatment are captured. With 218 variables and 74,342 probability estimates, this dynamic Bayesian network is one of the largest of its kind. The usefulness of the model is demonstrated by means of a number of case studies.

Chapters 3 to 6 have mostly dealt with treatment and make use of available clinical expertise. In Chapter 7, we focus on diagnosis and prognosis, where models are learned from limited amounts of data. We demonstrate the performance of the maximum mutual information algorithm, decomposed tensor classifiers, and noisy-threshold classifiers.

Chapter 8 reflects on the developed techniques. We conclude that the techniques form a solid basis for decision support in clinical practice.
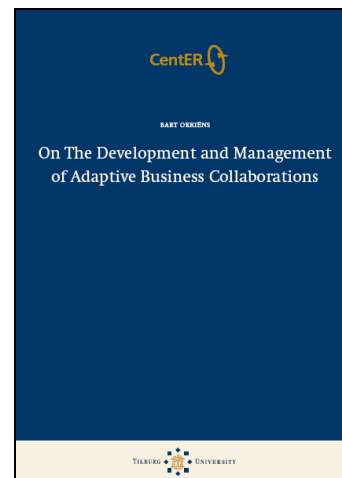
On the Development and Management of Adaptive Business Collaborations

Ph.D. thesis abstract
Bart Orriëns

Promotor: Prof.dr.ir. M.P. Papazoglou (UvT)
Co-promotor: Dr. J. Yang (UvT)
Date of defense: September 12, 2007

Today's business climate demands a high rate of change with which Information Technology (IT)-minded organizations are required to cope. Organizations face rapidly changing market conditions, new competitive pressures, new regulatory fiats that demand compliance, and new competitive threats. All of these situations and more drive the need for the IT infrastructure of an organization to respond quickly in support of new business models and requirements. Only in this way can an organization gear towards the world of semi-automated, complex electronic transactions. Business collaboration is about cooperation between organizations by linking their business processes and exchanging messages. Taking the example of ordering goods, it involves checking price, sending order, billing, shipping, etc. among a customer, a manufacturing company, and a shipping company. Building and managing such collaborations that cross independent organizational boundaries and their systems is challenging as it requires linking the elements of individual businesses together into a cohesive whole.

Particularly, in order to realize the vision of developing business collaborations in a dynamic

fashion while adhering to the requirements imposed by the business environment, the specifics of business collaborations must be properly captured, modelled and managed. Business-collaboration design needs to apply software development principles and at the same time incorporate the special requirements of modern business-collaboration development, i.e, support for high (abstract) level specification and adaptive to market changes. This requires modelling languages, methodologies, techniques and tools that allow designers to rapidly develop and deliver business-collaboration designs based on proven and tested models. Furthermore, new designs must be verifiable to determine if the modelled collaborations are in accordance with current market conditions, government regulations, industry guidelines, internal policies and so on. Similarly, modifications to existing designs must be assessable to check that resulting collaborations remain compliant. This requires the modelling languages to facilitate the specification of both business and technical demands for business collaboration, as well as dependencies among them.

A technology for realizing dynamic-business collaborations that is becoming more and more popular is service-oriented computing (SOC)-based middleware. SOC enables the standardized integration of heterogeneous systems and applications possibly belonging to different organizations. Moreover, SOC promises the realization of business collaborations in the most optimal manner by selecting and combining the most suitable and economical services, where these services may be self maintained or offered by other organizations. A business-collaboration develop-ment in the context of SOC normally involves: (1) the development of private business processes using service orchestration languages such as BPEL4WS; (2) the development of the business protocols to interact with other business partners (the protocol is also often called the public behaviour of a business or abstract business model); (3) finally the development of business agreements for the business collaboration via usage of service choreography. The challenge during such development is how to ensure and maintain consistency for each partner in the collaboration as well as consistency for the collaboration as a whole in the presence of changes as analyzed above. Consistency in this regard can informally be thought of as the lack of contradictions in the behaviour of each individual partner as well as the lack of contradictions between the behaviours of the different partners.

To address this challenge we developed an environment in which the people who develop and manage business collaborations in organizations can do so in a way that is as independent of specific SOC implementation technologies as possible, where they can take business requirements into consideration, and in which they can respond to any changes as effectively as possible. Concretely, we defined a rule-based approach for business-collaboration development and management. The idea behind the approach is to make the business-collaboration requirements of organizations explicit in the form of rules, and to then use these rules to drive and constrain the development and management of business-collaboration designs. Concretely, design becomes a runtime activity where the business-collaboration design shapes itself to its specific circumstances by application of the appropriate rules. As such, business-collaboration designs are generated on-the-fly rather than being pre-defined. This makes business collaboration dynamic in two ways: 1) design of business collaborations is governed by explicitly defined and thus manageable rules, which furthermore can be chained and used for making complex decisions and diagnoses; and 2) business collaborations can be readily changed during design time and runtime by adding new rules and/or re-defining existing rules that handle the change. Simultaneously, rules are also applied to ensure that the generated business-collaboration designs are and remain consistent.

Designing Invisible Handcuffs: Formal investigations in institutions and organizations for multi-agent systems
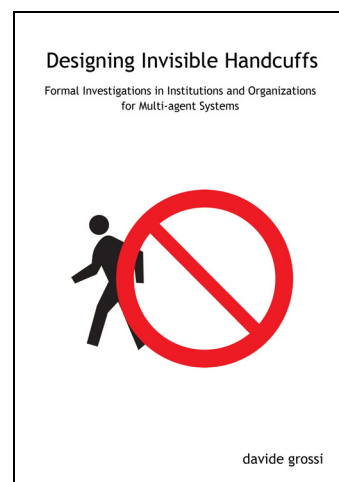
Ph.D. thesis abstract
Davide Grossi

Promotor: Prof.dr. J.-J.Ch. Meyer (UU)
Co-promotor: Dr. F. Dignum (UU)
Date of defense: September 17, 2007

The work presented in this thesis suggestively moves from the consideration that what makes social notions difficult to grasp lies probably in their intrinsic "invisibility". Like Smith's notorious "invisible hand", institutions and organizations are something which just cannot be pointed at by simply looking at the outside world. Still, they are there and they are almost ubiquitous. The prime research question of the work is therefore foundational. If we aim at a science of such things as institutions and organizations, how should we think of them? What concepts and conceptual apparatuses should we use to represent and reason about institutions and organizations? Or, to carry on the metaphor, how can we make those things somehow "visible"?

Interestingly, recent developments in the field of multi-agent systems (MAS) have clearly pointed at the need for an answer to such question. In MAS a number of autonomous pieces of software – the agents – interact in order to execute complex tasks. In such systems the crux of the matter is to design agents' interaction in such a way that, on the one hand, agents remain autonomous and, on the other hand, that the system exhibits global desirable properties. In human societies, institutions and organizations have developed as means for pursuing this exact aim. They set invisible boundaries – "handcuffs" – for the activities of the individuals in the society. If such "handcuffs" need to be designed in order to coordinate software agents, then a formal theory of institutions and organizations needs to be found which can ground the design process. Essentially, aim of the present work is to advance precise proposals for the development of such a formal theory.

From a methodological point of view, the work proceeds by first committing to precise views of institutions and organizations which can be found in the literature on social and legal sciences. Such views are then formalized and the resulting formal theory is finally discussed in its formal aspects as well as in the theoretical implications it bears for the notions of institution and organization thus analyzed.

The work presented conceives of institutions as systems of constitutive rules. Following Searle, constitutive rules are statements of the type "X counts as Y in context C" – the so-called counts-as statements – and they underlie the whole construction of institutional reality. It is our thesis that by means of these statements institutional qualifications are *imposed* on the to-be-regulated domain which provide norms for agents' conduct. A typical example taken from the game of football could be the rule "the off-side situation counts as a violation of the rules of the game". Institutions can therefore be viewed as the imposition of complex conceptualizations specified in terms of counts-as statements. From a formal point of view, this suggests to represent institutions as description logic terminologies or taxonomical boxes (TBoxes). Taxonomical boxes are sets of subsumption statements describing the relations considered by the institutions to hold between the concepts it uses to conceptualize the to-be-regulated domain. The subsumption statement corresponding to the aforementioned counts-as statement would be the following one: "`offside ⊑ violation`".

Of course, many different institutions coexist which might disagree on the way they look at the same domain. This motivates the formal analysis of the notion of context and the related one of contextual terminology which, from the point of view of the formal machinery deployed in our analysis, underpins the whole work presented here. Subsumptions are therefore studied as pertaining to a specific context: "`Football: offside ⊑ violation`". In a nutshell, institutions can be thought of contextual terminologies, and counts-as statements as their basic building blocks.

As to organizations, the thesis focuses on their structural dimension. The notion of organization presupposes a notion of organizational structure, i.e., the structure specifying how the roles of the organization are related to one another (e.g., whether an authority relation holds between role *r* and *s*). On the grounds of foundational literature on the theory of organizations, the work presented stresses two essential aspects of organizational structures which are then both addressed from a formal point of view.

First, the structure of an organization is always multiple. That is to say, roles are connected by a number of different relations (who obeys whom? who communicates to whom? etc.), and not by just one as it is usually the case in network-based or chart-based representations of organizations. Such structures display, therefore, several different types of connections which we represent and study as multi-graphs, i.e., graphs containing links, or edges, of several different types. Second, the structure of an organization has a precise impact on the activities that the agents taking part in the organization can engage in. In other words, the graph-theoretical dimension of an organizational structure has, so to say, a meaning in terms of the agents' activities it makes possible. It is shown that the formal machinery introduced for the analysis of institutions, constitutes also a viable formal tool for representing

this semantic dimension of organizational structures. This combined perspective allows us to provide both quantitative methods based on graph-theory to compare different organizations from a structural point of view, and qualitative ones based on logic to address the types of interaction which different organizations put in place.

Finally, on the grounds of these results, a comparison of the two notions of institution and organization is provided, which makes explicit the different aspects that each of these two notions stresses in the conceptualization of social interaction between agents.

NIM: A Situated Computational Memory Model

Ph.D. thesis abstract
Joyca Lacroix

Promotores: Prof.dr. J.M.J. Murre (UM/UvA),
Prof.dr. E.O. Postma (UM), Prof.dr.
H.J. van den Herik (UM)
Date of defense: September 20, 2007

NIM: A Situated Computational Memory Model
Joyca Lacroix
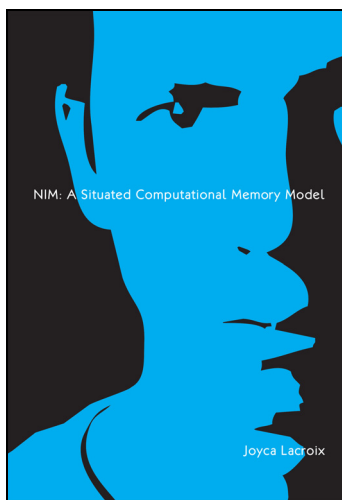
Traditionally, models of natural cognition consider cognitive mechanisms as processes of symbol manipulation operating independently of the environment. The symbol-manipulation models suffer from two interrelated problems: the symbol grounding problem and the transduction problem. Both problems address the lack of a connection between representations in a cognitive system and the entities that they refer to in the real world. The relatively new situated approach to cognition deals with the two problems by viewing cognitive mechanisms as emerging from the interaction with the natural environment. The focus of this thesis is to address the symbol grounding and transduction
problems for computational memory models by realizing a situated computational memory model. The situated model operates directly on the natural environment.

Chapter 1 starts with a historical overview of the development of computational memory modelling. The chapter identifies the lack of a direct connection with the real world as the main limitation of the existing computational memory models. Rather than deriving representations directly from the real world, these models rely on various types of abstract representation spaces that are only indirectly related to the real world. By assuming an abstract representation space, these models suffer from the symbol grounding problem and the transduction problem. In order to deal with these problems we phrase the following problem statement: "How can computational memory models be extended to solve the grounding and transduction problems?" The problem statement is addressed by defining a perceptual front-end that transforms natural visual input into memory representations. We propose a combination of the perceptual front-end with a computational memory back-end to obtain a situated computational memory model. To validate the situated computational memory model, three research questions are formulated: (1) to what extent can a situated model produce human responses to individual natural visual stimuli? (2) to what extent can a situated model produce recognition-memory effects on the basis of natural visual stimuli? and (3) to what extent can a situated model classify natural visual stimuli? The research methodology is presented; it consists of two steps: model construction and model validation.

Chapter 2 provides an overview of the types of abstract representation spaces used in the existing memory models. It illustrates that the representations are not derived directly from the physical features of the individual stimuli that they refer to in the real world, i.e., they are not grounded in the real world. Subsequently, two sources of inspiration for constructing veridical representations directly from visual natural input are discussed. The first source consists of the insights taken from four influential approaches belonging to the domain of computer vision to map visual input onto representations. The second source consists of relevant knowledge about the main characteristics of the human visual system. Based on these two sources of inspiration, the chapter proceeds with the formulation of three guiding principles for grounding memory representations in the real visual world. Finally, it provides ways to fulfil the guiding principles to obtain a perceptual front-end for a situated computational memory model.

Chapter 3 introduces the situated computational memory model. The model operates on natural images and it is called: the Natural Input Memory model (NIM). NIM combines a perceptual front-end with a computational memory back-end. NIM's perceptual front-end employs a biologically informed method that selects local image samples (i.e., eye fixations) from natural images and translates these into feature-vector representations. Each feature vector contains information on oriented edges at multiple scales extracted from a small image area surrounding the fixation location. The feature-vector representations form the input to the computational memory back-end, which is an exemplar-based model that makes recognition-memory decisions on the basis of a comparison between stored and incoming similarity-space representations.

Chapter 4 validates NIM by assessing to what extent NIM can produce human similarity ratings and recognition rates for individual natural stimuli. The model is tested on a similarity-rating task and a face-recognition task using the same stimuli and tasks as those used in behavioural experiments. The NIM similarity ratings and recognition rates are compared with the behaviourally obtained human similarity ratings and recognition rates. The results demonstrate that NIM quite accurately produces the human similarity ratings and the human recognition rates for the individual natural stimuli.

Chapter 5 examines NIM's natural input recognition properties in terms of *general* recognition-memory effects. Many studies have demonstrated the success of REM (a well-established model of memory) in replicating a wide range of human recognition-memory effects. The chapter introduces a NIM variant called NIM-REM that realizes a natural input version of REM by combining NIM's perceptual front-end with a REM-based memory back-end. The remainder of the chapter focuses on validating NIM-REM by assessing its ability to explain behavioural results on four recognition-memory effects that are often studied in behavioural recognition-memory experiments: the list-strength effect, the list-length effect, the item-strength effect, and the false-memory effect. For each effect, the pattern of NIM-REM recognition results are compared with the human pattern of results obtained in behavioural experiments. The results on the four recognition-memory effects indicate that NIM-REM produces rather adequately the findings from behavioural experiments.

Chapter 6 studies NIM's ability to classify natural input. In order to test the classification ability, the chapter introduces a NIM variant called NIM-CLASS that combines NIM's perceptual front-end with a

new memory back-end that is suitable for classification. The classification performance of NIM-CLASS is evaluated on a face-classification task that entails the identification of a natural image of a frontal face with variations in facial expression, illumination, and occlusion, on the basis of a single encounter with the face. The classification results demonstrate that NIM-CLASS is able to classify natural images of frontal faces correctly under a variety of unfavourable conditions, provided that a sufficient number of fixations are made during a single encounter with the face. Subsequently, the chapter investigates to what extent the classification performance can be improved by extending NIM-CLASS with top-down fixation selection to select relevant fixation locations on the basis of stored knowledge. The chapter introduces two NIM-CLASS variants: NIM-CLASS A and NIM-CLASS B. NIM-CLASS A employs a top-down fixation-selection mechanism during the classification of a face that relies on short-term episodic knowledge about previously encountered faces. From the NIM-CLASS A classification results we may conclude that the short-term episodic-knowledge-based top-down fixation selection improves performance on the classification task compared to the NIM-CLASS performance. This is particularly so when a limited number of fixations is made during classification. NIM-CLASS B adopts the top-down fixation-selection mechanism of NIM-CLASS A during the classification of a face and, in addition, employs a top-down fixation-selection mechanism during the storage of a face that relies on long-term stored knowledge about the relevance of different face parts. The NIM-CLASS B classification results demonstrate that the top-down fixation-selection mechanism employed during storage improves the performance on the classification task compared to the NIM-CLASS A performance. The results obtained with the NIM-CLASS A and B variants demonstrate the beneficial effect of active top-down processes that rely on various types of stored knowledge for the classification of natural visual input.

Chapter 7 provides a discussion of our proposed situated computational memory model. First, it relates our approach to influential existing computational models of object recognition. Second, it identifies several model extensions for the improvement of the model's psychological and biological realism as a model of natural cognition. Based on psychological and biological insights, five extensions are discussed: (1) a feature-based attentional mechanism, (2) a spatial attentional mechanism, (3) a neural implementation of the similarity space, (4) the representation of spatial knowledge, and (5) the incorporation of separate episodic and semantic representation spaces. Third, the chapter places our approach in the context of the

global developments in the domain of cognitive modelling. It shows that our approach departs from the traditional computational memory models and adheres to the new 'situated' approach by focussing on the interaction with a realistic environment.

Chapter 8 answers the three research questions formulated in chapter 1 and provides the thesis conclusion of the problem statement. For the first research question, the answer is that the situated model is able to produce human responses to individual natural stimuli quite reliably. For the second research question, it is stated that the situated model is able to produce the four recognition-memory effects successfully directly on the basis of natural visual input. For the third research question, we state that our situated model is able to classify natural images correctly under a variety of potentially unfavourable conditions provided that a sufficient amount of visual input is selected. Moreover, we see that the use of active top-down processes that rely on stored knowledge to select visual input enhances classification performance, in particular when classification is based on a limited amount of visual input. Finally, the chapter elaborates on the conclusion that the situated computational memory model presented in this thesis provides a viable solution to the symbol grounding and transduction problems by relating a representation to its real-world referent in a transparent and non-trivial manner that is neurobiologically informed.

Goal-oriented Design of Value and Process Models from Patterns

Ph.D. thesis abstract
Zlatko Zlatev

Promotor: Prof.dr. R.J. Wieringa (UT)
Date of defense: October 4, 2007
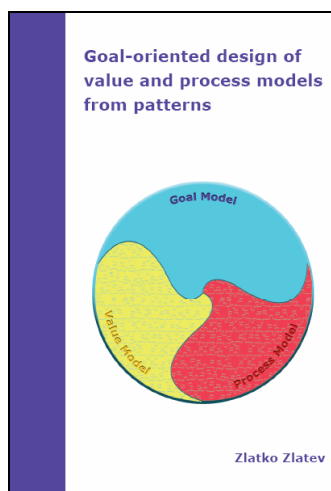
This thesis defines a design framework and a method for modelling networked businesses. The intended application domain is electronic businesses that extensively use information and communication technology to coordinate work. The key property of the proposed approach is the reuse of design knowledge in the form of design patterns.

Design patterns are extracted from models of existing electronic intermediaries considered successful. These businesses have been reverse-engineered to two types of models: economic value exchange models and business process models. The identified patterns comprise two libraries of value exchange and business process patterns, respectively. Patterns are catalogued with, among others, their context, solved problem, and proposed solution. Most importantly, they are annotated with a machine-readable capability model used as a search key in the library.

Capability models are part of the goal-modelling technique for business requirements proposed here. Our goal-modelling technique operationalizes each business goal with a variable and an evaluation function: the evaluation function determines when a measured variable value satisfies the goal. A goal model represents requirements if goals are assigned evaluation functions but the variable values are unknown. In such a case, the goal model specifies what is desired to happen. If, on the other hand, variable values are known, the goal model documents the capabilities of a pattern.

The proposed design framework structures the development process into: (1) available design knowledge in libraries of value and process patterns, (2) business requirements captured in a goal model, and (3) economic value and business process perspectives to look at a business system. The design method prescribes steps to transform patterns and requirements into a system specification. These include: (i) identification of relevant pattern based on matching capability and requirements goal models; (ii) synthesis of value and process patterns into value and process models, respectively; and (iii) consistency check procedure for value and process model.
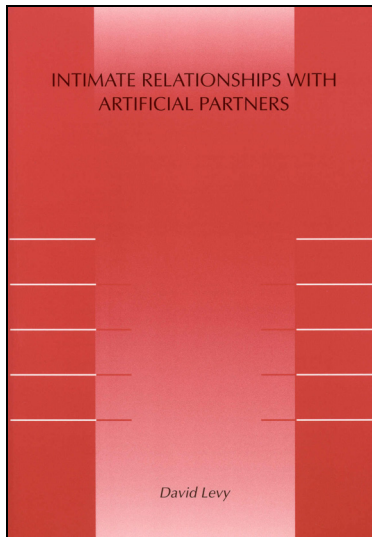
The usefulness of the approach is demonstrated in a real-life example, which shows that the framework and method exhibit a predefined set of desired properties.

Intimate Relationships with Artificial Partners

Ph.D. thesis abstract
David Levy

Promotores: Prof.dr. M.J.H. Meijer (UM), Prof.dr. H.J. van den Herik
Date of defense: October 11, 2007

The thesis investigates the past and present development of our relationships with computers. Emphasis is put on the question how these relationships are continuing to progress towards intimacy, culminating in the prospect of robots becoming our artificial partners. It is a fascinating area which, only fifty years ago, was completely within the realm of science fiction, but which is now moving towards becoming a reality. The study consists of four parts.

The goal of my research is to answer a twofold problem statement (PS) concerning the types of relationship between human beings and some kind of robot that will be created during the coming decades. The structure of the research is described in Part One, consisting of Chapters 1 and 2. The two strands of the problem statement are as follows.

PS1:   *To what extent will the emotions that humans feel for other humans, for pet animals, for virtual pets, and even for less animal-like artefacts – namely computers – be extended to embrace the robots of the future?*

In order to answer PS1 it is necessary to examine the reasons (1) why humans develop strong emotional feelings of attraction (leading to attachment or love) to other humans, (2) why humans develop strong emotional attachments to pet animals and to virtual pets, and (3) why humans develop emotional attachments to computers. We can then consider how these reasons might also apply to human-robot relationships.

PS2:   *To what extent will the normal bounds of human sexuality be extended with respect to the robots of the future?*

In order to answer PS2 it is necessary to examine, largely from a psychological perspective, (1) the reasons why humans enjoy sex, (2) why humans desire sex, and (3) whether love as we know it, love from our chosen sex object, is an essential factor for our sexual enjoyment and gratification. Having sufficient knowledge of these topics we can then consider how and to what extent their normal bounds will be extended to human-robot relationships.

My research objectives are therefore twofold, namely to investigate: (1) whether humans will develop strong emotional feelings of attraction (leading to attachment or love) to robots as (what will be regarded as) "normal" extensions of our feelings (attachment or love) towards other humans — this is investigated in Part Two (Chapters 3 to 6); and (2) whether making love with robots will be as normal as making love with humans — this is investigated in Part Three (Chapters 7 to 10). Part Four (Chapter 11) contains conclusions.

In order to achieve these objectives I have formulated eight research questions (RQs).

Chapter 1 starts with a brief introduction to Artificial Intelligence and Robotics, then formulates my twofold problem statement, and lists my research objectives and research questions. There follows a description of my research methodology and an overview of the structure of the thesis.

Chapter 2 provides the relevant historical background to the thesis – a brief overview of the successes achieved in creating mechanical artefacts, robots, and sociable computers, over a period of more than two thousand years. This historical overview starts with artefacts that were purely mechanical in their functioning; then it continues with early thinking and socially interesting artefacts (tea-carrying dolls, for example), progressing eventually to the early goals and achievements of the new science of Artificial Intelligence, of which Robotics is a branch.

In chapter 3 I address the first of my research questions: is it possible to trace what (precisely) causes people to develop strong emotional feelings of attraction (leading to attachment or love)? I begin by investigating the connection between the psychological phenomena of attachment, which starts in infancy, and romantic love. In an attempt to obtain some insight into the question: "Why do people fall in love?", I examine ten principal causes of falling in love that have been identified by research psychologists. I then compare these factors with the phenomenon of falling in love on the Internet. Later in the thesis I use these ten causes as benchmarks for my investigation into the relationships that will develop during the coming decades between humans and robots.

In chapter 4 I investigate my second research question: what characterizes the affective relationship between humans and pets? It is a topic that has been well researched during the past twenty years. This topic is relevant to my own research, partly because it demonstrates that many people develop quite strong emotional attachments to these non-humans, thereby proving that it is not essential to *be* human in order to be the focus of love *from* a human.

The question: "Why do people love their pets?" is discussed, and the answers and the strength of the love that people exhibit for their pets also informs our understanding of why many humans form strong emotional attachments, including love, for virtual pets such as the TAMAGOTCHI and Sony's robotic dog AIBO.

The subject of my research in chapter 5 is love for virtual pets. My third research question reads: what is the attractive power of a virtual pet? My research here provides us with much insight into the social relationships between human beings and computers. It is highly relevant because computers, in one form or another, form the core, the brain, of virtual pets and robots. The main conclusion of that chapter is that humans do indeed develop emotional feelings for virtual pets.

In chapter 6, the principal subject is the nature of the emotional relationships that many people develop with some sort of computer-driven artefact, and specifically the relationships that we will develop with the humanoid robots of the future. Here I investigate my fourth research question: what is the attraction of a humanoid robot for a human being? I start the chapter with an investigation of people's attitudes to relationships in general, followed by a discussion on why many people actually prefer interacting with computers to interacting with other people. This leads to ideas on

robotic psychology and behaviour, and in turn to the differences between emotions in humans and emotions in robots. I then investigate the extent to which robots might recognize human emotions, and how the recognition process contributes to the falling-in-love process. I also discuss robot personalities and their influence on robots' relationships with humans. My examination of the process of designing robot personalities includes an introduction to the concept of robot chromosomes – a recent development. I apply the ten factors discussed in chapter 3 (the factors that cause humans to fall in love with humans) to human-robot relationships, in order to investigate what this comparison proves. For a deeper understanding of the topic of human-robot relationships I subsequently investigate more concepts directly related to love, namely: robot fidelity, passion, and the intensity of robot love, all of which are closely related to the mood and desires of one of the partners. The logical culmination of the investigations in this chapter, and indeed of Part Two of this thesis, is a discussion on "Marrying a Robot".

Chapters 7 to 10 present what I believe compelling arguments to show that sex with robots will become a norm rather than being an oddity. I start by examining sexual relationships between humans.

I commence this analysis in chapter 7, where I investigate my fifth research question: why do people enjoy sex? I consider only those aspects of this question that are likely to be relevant when extending the question to robots. The most direct evidence on this topic is presented in tables 7.1 to 7.3, which list the most commonly stated reasons for having sex (with a human) – reasons that mostly appear to apply equally to the concept of sex with a robot. This evidence is employed to help support my argument, in chapter 8, on the inevitability that many people will also enjoy sex with robots.

The main thrust of chapter 8, is to investigate my sixth research question: why do people pay for sex? Two of the most frequently stated reasons, from both men and women clients, are the desire to experience variety, both in the choice of sex partner and in the sexual experiences themselves; and to be able to enjoy sex without the complications and restraints of a relationship. Many of the women who pay for sex are also seeking some emotional closeness, but this is considerably less true of male clients. I explore this question because sex with a prostitute and sex with a robot are both experiences that come without any genuine love from the sex provider. Whatever passes for love in these encounters is pure acting (in the case of the human sex worker) or pure programming (in the case of a

robot), which are not dissimilar in their lack of genuineness. My thinking here is to demonstrate this and other parallels that apply both to sex with a prostitute and sex with a robot.

Chapter 9 explores the engineering and technologies of various types of sexual artefacts, some of which date back more than a century, and thereby this chapter answers my seventh research question: what technologies are available to be used as sex technologies? From the history of dolls as lover substitutes, through the earliest vibrators and other sex machines designed for the pleasure of women, I trace the evolution of sex devices to the much more sophisticated products of today, including expensive silicone dolls that can satisfy some people's sexual desires and do so sufficiently well to generate income for the recently launched business of doll "escort" services in Japan and South Korea. I also examine the technologies of virtual sex and the Internet, an astounding mixture of sexual technologies including the relatively new domains of Virtual Reality and Teledildonics. By considering the development of these technologies during recent decades, the reader should be able to understand at least some of the sexual possibilities of the robots of a few decades from now, given the inevitable advances in Artificial Intelligence research.

Having explained the reasons why humans will desire sex with robots, and having demonstrated advances in the technologies of sexual artefacts that are leading very much in the direction of robot sex, I discuss in chapter 10 the changes in thinking, in attitudes, and in sexual mores, that have occurred in the past in relation to sex. These changes provide the answer to my eighth and final research question: what mental obstacles exist to prevent the final step towards the second objective? My argument here is rather straightforward. It is that the change in attitudes to homosexuality, oral sex, fornication, and masturbation, changes that our world has witnessed during the past two centuries and especially during the last fifty years, have been no less dramatic than the changes in attitude that will be required to accept the concept and practice of sex with robots as being natural extensions of human sexual relationships.

Chapter 11 summarizes my conclusions to research questions RQ1, RQ2, RQ3, and RQ4, leading to the overall conclusion for PS1, that the emotions that humans feel for other humans, for pet animals, for virtual pets, and even for less animal-like artefacts — namely computers — will be fully extended to embrace the robots of the future. In chapter 11 I also summarize my conclusions to research questions RQ5, RQ6, RQ7, and RQ8, leading to the overall conclusion for PS2, namely that the normal bounds of human sexuality will be fully extended to embrace the robots of the future. On these two overall conclusions I rest my case, namely that love and sex with robots are inevitable as extensions to our ideas, feelings, and practices in the realm of relationships. The question is not if, but when, all this will happen. It is my belief that the answer is "much sooner than you might think". Finally, I provide four recommendations for further research.

FIVE and 100,000

Jaap van den Herik
MICC-IKAT, Maastricht

The relation between quality and quantity has fascinated mankind for centuries. Counting is important, in particular when the result is "many". But is not being "the best" better than having achieved many 'events'? This question can be prompted in a variety of domains and does seldom result in a definitive answer. Of course, one gold medal is better than five or ten silver medals (see the lists of won Olympic medals in the daily papers). Still, there are severe comments possible on these statements. Whatever the case, I would like to leave this discussion to the reader and concentrate on three other issues, namely (1) the length of the title of a Ph.D. thesis, (2) the number of words of a Ph.D. thesis (i.e., its size or the number of pages), and (3) the number of promoti.

The title
In earlier contributions I emphasized that small (i.e., short) is beautiful. A title of five words is perfect, it is the optimality *pur sang*, although I have to admit that I personally was kept by the finding modeling modeling. It was in the American language (i.e., one *l* in modeling), but it was fine, as no other Englishman could improve upon this title. I only remember the farewell-speech title by Professor Carel Scheffer (Delft University of Technology) which read: Tijd (in English it would be 'Time', but Latin is probably more appropriate in this case by 'Hora'). Three titles in the list below are in my opinion too long. It is better to give the reader the opportunity to use his own ideas on what the title would imply. It makes the reader "hungry" for reading "food" and so a large amount of readers may be attracted. A good title is half of the work.

The contents
The other half is a good content. For this requirement the former Vice-Chancellor of the Leiden University, Professor Douwe Breimer, has introduced the so-called Breimer norm for theses in

all disciplines: the contents should never exceed the number of 100,000 words. Depending on the spacing, lettertype, and width it leads to some 175 to 225 pages.

This requirement serves three purposes, viz. (1) it protects the promovendus by restricting him/her to produce a quality thesis of middle-sized proportion and not the work of her/his life ("levenswerk"); (2) it protects the members of the assessment committee (usually the promovendus has no idea what an effort is required from the members to read the manuscript from cover to cover, and then comment upon the contents), and (3) a middle-sized book may attract more readers than books that considerably exceed the Breimer norm. So, quality is in the contents and in the size.

The number of promoti
Some disciplines are well-known for their number of promoti; for instance, physics and chemics have a good reputation in this respect. On average, I estimate that they produce twice or three times more promoti per supervisor than professors at the law faculty. To provide you with some "hand-waven" figures: physics 60 to 90 per career and law 20 to 30 per career. How about computer sciences and information systems? This is a difficult question. Moreover, it is a matter of jealousy, since the question: is this really science? may pop up rather fast. Whatever the critiques, whatever the length of the titles, and whatever the much critised contents (as Henk Sol confessed in a meeting in Utrecht to me), in my opinion quantity is sometimes a factor to be respected. Therefore I would like to congratulate Professor Henk Sol (Delft University of Technology and the University of Groningen) with the completion of his 60th promovendus. Henk, well done. Of course, the Editorial Board of the BNVKI Newsletter congratulates also all promoti with the milestone they have reached. We wish you much success in your further career.

Simaati M. Muniafu (October 1, 2007). *Developing ICT-enabled Services in Transition Countries*. Delft University of Technology. Promotor: Prof.dr. H.G. Sol (TUD).

Zlatko Zlatev (October 4, 2007). *Goal-oriented Design of Value and Process Models from Patterns*. University of Twente. Promotor: Prof.dr. R.J. Wieringa (UT).

Slinger Jansen (October 8, 2007). *Customer Configuration Updating in a Software Supply Network*. Utrecht University. Promotores: Prof.dr. S. Brinkkemper (UU), Prof.dr. P. Klint (CWI).

Niek Bergboer (October 10, 2007). *Context-based Image Analysis*. Universiteit Maastricht. Promotores: Prof.dr. H.J. van den Herik (UM), Prof.dr. E.O. Postma (UM).

David Levy (October 11, 2007). *Intimate Relationships with Artificial Partners*. Universiteit Maastricht. Promotores: Prof.dr. M.J.H. Meijer (UM), Prof.dr. H.J. van den Herik (UM).

Peter Barna (October 30, 2007). *Specification of Application Logic in Web Information Systems*. Eindhoven University of Technology. Promotores: Prof.dr. P. De Bra (TU/e), Prof.dr G.-J. Houben (VUB/TU/e).

Georgina Ramírez Camps (November 2, 2007). *Structural Features in XML Retrieval*. University of Amsterdam. Promotor: Prof.dr. M.L. Kersten (CWI / UVA). Co-promotor: Dr. A.P. de Vries (CWI/ TUD).

Stijn-Pieter van Houten (November 6, 2007). *A Suite for Developing and Using Business Games; Supporting supply chain business games in a distributed context*. Delft University of Technology. Promotores: Prof.dr. H.G. Sol (TUD), Prof.dr.ir. A. Verbraeck (TUD).

Roy Chin (November 12, 2007). *Mainport Planning Suite; Software services to support mainport planning*. Delft University of Technology. Promotores: Prof.dr. H.G. Sol (TUD), Prof.dr.ir. A. Verbraeck (TUD).

Karianne Vermaas (November 26, 2007). *Fast Diffusion and Broadening Use: A research on residential adoption and usage of broadband internet in the Netherlands between 2001 and 2005*. Utrecht University. Promotor: Prof. dr. S. Brinkkemper (UU). Co-promotor: Dr. L. van de Wijngaert (UU).

Joost Schalken (December 17). *Empirical Investigations in Software Process Improvement*. Vrije Universiteit. Promotores: Prof.dr. J.C. van Vliet (VU), Prof.dr. S. Brinkkemper (UU).

Information Retrieval Workshop
at CWI
November 1, 2007

On November 1, 2007 an Information Retrieval workshop will be organised at CWI (room M279) from 14.00-17.00. All SIKS-members are cordially invited to participate.

Invited speaker is Nick Belkin from Rutgers University, who will talk about "Personalizing the Digital Library Experience". Nick Belkin visits Amsterdam as a committee member in Georgina Ramirez' Ph.D. defense (on Structural Features in XML Retrieval). SIKS-Ph.D. students working in the field of Information Retrieval or on the SIKS-focus "Datamanagement, Storage and Retrieval" are strongly encouraged to participate.

Additional speakers include:
- Jaap Kamps (UvA) on The Importance of Link Evidence in Wikipedia
- Thijs Westerveld (Teezir) on Expert Finding in Practice
- Henning Rode (UT) on Entity Retrieval
- Martin Kersten (CWI) on Database Summarization
- Maarten de Rijke (UvA) on Question Answering at INEX

Local organisation: Dr. Arjen P. de Vries. Please, RSVP (mailto:arjen@acm.org) if you plan to attend the workshop, and help us estimate the required catering.

SIKS Basic Course "Research Methods and Methodology for IKS"
November 14-16, 2007

On November 14-16, 2007, the School for Information and Knowledge Systems (SIKS) organizes the annual three-day course "Research Methods and Methodology for IKS". The location will be Landgoed Huize Bergen in Vught. The course will be given in English and is part of the educational program for SIKS-Ph.D. students. Although the course is primarily intended for SIKS-Ph.D. students, other participants are not excluded. However, their number of passes will be restricted and depends on the number of SIKS-Ph.D. students taking the course.

"Research Methods and Methodology for IKS" is relevant for all SIKS-Ph.D. students (whether working in computer science or in information science). The primary goal of this hands-on course is to enable these Ph.D. students to make a good research design for their own research project. To this end, it provides an interactive training in various elements of research design, such as the conceptual design and the research planning. But the course also contains a general introduction to the philosophy of science (and particularly to the philosophy of mathematics, computer science and AI). And, it addresses such divergent topics as "the case-study method", "elementary research methodology for the empirical sciences" and "empirical methods for computer science".

"Research Methods and Methodology for IKS" is an intense and interactive course. First, all students enrolling for this course are asked to read some pre-course reading material, comprising some papers that address key problems in IKS-methodology. These papers will be sent to the participants after registration. Secondly, all participants are expected to give a brief characterization of their own research project/proposal, by answering a set of questions, formulated by the course directors, and based on the aforementioned literature.

COURSE COORDINATORS
Hans Weigand (UvT), Roel Wieringa (UT), John-Jules Meyer (UU), Hans Akkermans (VU) and Richard Starmans (UU)

PROVISIONARY PROGRAM
Wednesday, November 14

Time	Activity
9.30	Coffee
10.00 - 10.30	Opening (dr. Richard Starmans)
10.30 - 12.00	Introduction (dr. Hans Weigand)
12.00	Lunch
13.00 - 13.45	Dr. Joyca Lacroix (UM/RUL): NIM: A Situated Computational Memory Model (example research project)
13.45 - 14.00	Break
14.00 - 17.15	Research Design (prof.dr. Roel Wieringa) (including assignment)

Thursday, November 15

9.00 - 10.30	Philosophy of formal sciences (prof.dr. J.-J. Meyer)
10.30 - 11.00	break
11.00 - 12.30	Philosophy of empirical sciences (dr. Richard Starmans)
12.30	Lunch
13.30 - 14.15	Customer configuration updating in a software supply network (example research project; dr. Slinger Jansen, UU)
14.15 - 14.30	Break
14.30 - 17.15	Research methods (including assignment; prof.dr. Hans Akkermans)

Friday, November 16

9.00 - 10.00	Conceptual design () (including assignment; dr. Hans Weigand)
10.00 - 10.30	Break
10.30 - 12.00	Simulation as a research method (prof.dr. Jack Kleijnen)
12.00	Lunch
13.00 - 14.15	Research methods in IR (dr. Djoerd Hiemstra)
14.15 - 14.30	Break
14.30 - 15.00	Assignment
15.00 - 16.30	Research methods in MAS (prof.dr. Catholijn Jonker)

REGISTRATION

To register you are requested to send an email to: corinej@cs.uu.nl. Please mention

- whether you take arrangement 1 (single room, all meals and course material included) or
- arrangement 2 (lunch, dinner and course material included)
- whether you are a fully registered SIKS-Ph.D. student or
- a Ph.D. student of ASCI or a different research school

Dutch-Belgian Database Day 2007
November 29, 2007

The Dutch Belgian Database Day (DBDBD) is a yearly one-day workshop organized in a Belgian or Dutch university, whose general topic is database research. DBDBD invites submissions (1 page abstract) on a broad range of database and database-related topics, including but not limited to data storage and management, theoretical database issues, database performance, data mining, information retrieval, data semantics, querying, ontologies etc. Based on the submissions, the workshop will be organized in different sessions each covering a particular topic.

At the DBDBD junior researchers from the Netherlands and Belgium can present their recent results. It is an excellent opportunity to meet up with your Belgian/Dutch colleagues, and to get informed about the (recent) database-related research performed in Belgian/Dutch universities. The workshop is also open to non-Belgian/Dutch participants (presentations are in English).

CALL FOR PARTICIPATION

DBDBD is organized under auspices of SIKS, the Dutch research school for information and knowledge systems. This year, DBDBD will be organized in "Het Academisch Genootschap" in Eindhoven, on Thursday November 29th, 2007.

Registration is necessary and is possible by sending an email on or before the 19th of November with subject "registration" to dbdbd07@gmail.com with your name and affiliation (and whether or not you are a SIKS Ph.D. student). Registration costs will be 30 euro to be paid on site (CASH only!). This includes lunch, drinks and coffee, and a reception. Registration for a fixed number of SIKS-Ph.D. students is free, i.e., will be covered by SIKS (first come, first served).

IMPORTANT DATES

- Submission deadline (1 page abstract): November 5th, 2007
- Notification: November 12th, 2007
- Program online: November 16th, 2007
- Registration deadline: November 19th, 2007
- Dutch-Belgian Database Day: November 29th, 2007

SUBMISSIONS

Submissions should contain:
- the name of the author,
- his/her university and research group with his/her position,
- the title,
- a one-page abstract, and,
- if applicable: reference(s) to papers covered by the proposed presentation.

The submission should be sent as a pdf-file to dbdbd07@gmail.com. Abstracts and presentations will be published on the workshop's website. More information can be found on the DBDBD website: http://www.win.tue.nl/~tcalders/dbdbd07.htm.

SIKS Basic Course "Agent Systems"
December 10-11, 2007

INTRODUCTION

On December 10-11, 2007, the School for Information and Knowledge Systems (SIKS) and the Netherlands Research School on Transport, Infrastructure and Logistics (TRAIL) organize the course "Agent Systems". The location will be Landgoed Huize Bergen in Vught. The course will be given in English. Although the course is primarily intended for TRAIL and SIKS-Ph.D. students, other participants are not excluded. However, their number of passes will be restricted and depends on the number of SIKS and TRAIL students taking the course.

SCIENTIFIC DIRECTORS

Prof.dr. C.M. Jonker (TUD), Prof.dr. J.-J.Ch. Meyer (UU), Prof.dr. B. De Schutter (TUD), Prof.dr. C. Witteveen (TUD).

PRELIMINARY PROGRAM

Monday, December 10

10.00 - 12.00	General Introduction MAS and Architectures (prof.dr. J-J. Ch. Meyer, UU)
12.00 - 13.00	Agent Logics (dr. J. Broerse, UU)
13.00 - 14.00	*lunch*
14.00 - 17.00	Agent Programming Languages + practical assignment (dr. M. Dastani, UU)

Tuesday, December 11

09.00 - 10.00	Multi-agent Planning Systems and Technology (dr. M.M. de Weerdt, TUD)
10.00 - 11.00	Cognitive Agent Models (prof.dr. J. Treur, VU, and/or ir. K. van de Bosch, TNO)
11.00 - 13.00	Negotiation (+ assignments) (prof. C.M. Jonker and dr. K. Hindriks, TUD)
13.00 - 14.00	*lunch*
14.00 - 17.00	Design of multi-agent systems (+ practical assignments) (prof.dr. F. Brazier, VU)

REGISTRATION

For registration you are kindly requested to fill in the registration form at the SIKS-site.

SIKS Advanced Course "Multi Agent Systems: Theory, Technology and Applications"
December 12-13, 2007

INTRODUCTION

On December 12-13, 2007, the School for Information and Knowledge Systems (SIKS) and the Netherlands Research School on Transport, Infrastructure and Logistics (TRAIL) organize the advanced course "Multi Agent Systems: Theory, Technology and Applications". The location will be Landgoed Huize Bergen in Vught. The course will be given in English. Although the course is primarily intended for TRAIL and SIKS-Ph.D. students, other participants are not excluded. However, their number of passes will be restricted and depends on the number of SIKS and TRAIL students taking the course.

SCIENTIFIC DIRECTORS

Prof.dr. C.M. Jonker (TUD), Prof.dr. J.-J.Ch. Meyer (UU), Prof.dr. B. De Schutter (TUD), Prof.dr. C. Witteveen (TUD).

PROGRAM

Wednesday, December 12

9.00 - 9.30	Introduction TRAIL themes (prof.dr. H. van Zuylen)
9.30 - 12.30	Game Theory: an introduction (prof.dr.ir. G.J. Olsder)
12.30 - 13.30	*lunch*
13.30 - 15.00	MAS in traffic networks (dr. B. Immers, TNO)
15.30 - 17.00	Demo traffic control (drs. R. van Katwijk, TNO)

Thursday, December 13

9.00 - 10.30	Swarm intelligence + applications (prof.dr.ir. R. Babuska, TUD)
11.00 - 12.30	AGV lab demo (ir. M. Duinkerken, TUD)
13.30 - 15.00	Route choice behaviour (dr.ir. H. van Lint and/or drs. E. Bogers, TUD)
15.30 - 17.00	Agent-based models and simulation of pedestrian flows (prof.dr.ir. S. Hoogendoorn, TUD)
17.00 - 17.15	Closing

REGISTRATION

For registration you are kindly requested to fill in the registration form at the SIKS-site.