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INSTITUTE FOR LOGIC, LANGUAGE AND COMPUTATION

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LANGUAGE AND COMPUTATION

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Chapter 1 GENERAL INFORMATION

Scientific mission

Many broad flows of information drive the modern technological world. It is a challenge for contemporary science to provide a deeper understanding of this phenomenon and where possible, enhance existing practices in dealing with it. Indeed, in the course of this century, information has become a crucial theme for scientific studies across many disciplines. Encoding, transmission and comprehension of information are the central topics of research at the Institute for Logic, Language and Computation (ILLC) of the Universiteit van Amsterdam. The broader context in which ILLC sees itself is that of an upcoming information science or 'informatics', which is concerned with information flow in natural and formal languages, as well as many other means of communication, including music and images of various kinds. Research at ILLC aims at developing logical systems that can handle this rich variety of information, making use of insights across such disciplines as linguistics, computer science, cognitive science and artificial intelligence. Additional methods are actively pursued as well, whenever relevant, ranging from statistics to argumentation theory. In addition to its specific research goals, ILLC aims at overcoming traditional borderlines between faculties and disciplines and serves as a rallying point for information scientists across computer science, linguistics, philosophy, and the social sciences. Moreover, the institute propagates exact logical standards of semantic clarity, algorithmic perspicuity and increasingly also efficient computability. The resulting view of information science transcends the boundaries of the university. ILLC is also committed to dissemination of its results into the broader world of general education, vocational training and industrial research.

Research projects

ILLC's research program is divided into projects oriented toward a particular subject matter. This division also reflects the way research is actually carried out. Projects cut across the various groups which make up ILLC. The 2000 project reports can be found in chapter 4.

1. Theory of Interpretation
2. Cognitive Systems
3. Information Processing
4. Mathematical Logic
5. Computation and Complexity Theory

6. Reasoning with Uncertainty
7. Applied Logic
8. Computational Logic
9. Logic in Communication
10. Education and Dissemination of Logic

As of 2001 ILLC's research is organized in the following projects:

1. Theory of Interpretation
2. Cognitive Systems and Information Processing
3. Constructive and Intensional Logic
4. Computational and Applied Logic
5. Algorithmics and Complexity Theory

More information about the new project division can be found in chapter 3.

Participants in ILLC in 2000

Participating Departments

Faculty of Science: Department of Computer Science

Faculty of Humanities: Department of Philosophy

Faculty of Humanities: Department of Linguistics

Faculty of Social Sciences: Department of Sociology

Scientific Advisory Board

Soloman Feferman (Stanford), Wilfrid Hodges (London), Hans Kamp (Stuttgart), Gordon Plotkin (Edinburgh), Joerg Siekmann (Saarbrücken)

Scientific director

Martin Stokhof

Deputy scientific director

Dick de Jongh

Managing director

Peter Blok

Management assistants

Ingrid van Loon, Marjan Veldhuisen, Marco de Vries

Graduate Program in Logic

Dick de Jongh (director), Ingrid van Loon (program manager)



Chapter 2 SCIENTIFIC STAFF, STUDENTS, GUESTS

Department of Computer Science

Senior Staff:

Pieter Adriaans, Krzysztof Apt, Johan van Benthem, Kees Doets, Jan van Eijck, Peter van Emde Boas, Theo Janssen, Dick de Jongh, Anne Kaldeway, Michiel van Lambalgen, Maarten de Rijke, Leen Torenvliet, Anne Troelstra, Yde Venema, Paul Vitányi.

Postdocs:

Alexandru Baltag, Lex Hendriks, Frans Voorbraak, Domenico Zambella.

Associated Researchers:

Harry Buhrman

PhD Students:

Marco Aiello, Carlos Areces, Annette Bleeker, Sebastian Brand, Boudewijn de Bruin, Wim van Dam, Juan Heguiabehere, Willem-Jan van Hove, Eva Hoogland, Rosalie Iemhoff, Nikos Massios, Christof Monz, Marc Pauly, Jon Ragetli, Paul van Ulsen, Marco Vervoort, Ronald de Wolf.

Department of Philosophy

Senior Staff:

Renate Bartsch, Jeroen Groenendijk, Herman Hendriks, Karen Kwast, Martin Stokhof, Frank Veltman.

Postdocs:

Paul Dekker, Jaap Maat, Robert van Rooy, Harry Stein, Sjoerd Zwart.

PhD Students:

Maria Aloni, Elsbeth Brouwer, Balder ten Cate, Rosella Gennari, Gwen Kerdiles, Allard Tamminga.

Department of Linguistics

Senior Staff:

Remko Scha, Henk Zeevat.

Postdocs:

Rens Bod, Khalil Sima'an

PhD Students:

Remko Bonnema, Noor van Leusen, Louis Nagtegaal

Department of Sociology*Senior Staff:*

Michael Masuch, Breannán Ó Nualláin

Postdocs:

Maarten Marx, Jaap Kamps

Associated Researchers:

Rob Mokken.

PhD Students:

Ivar Vermeulen.

Graduate Program in Logic Students 1999-2000*MSc students:*

Catarina Dutilh-Novaes (Brazil), Shai Berger (Israel), Levan Khavtasi (Georgia), Farid Ahmed (Bangladesh), Alexander Bergo (Norway), Agus Hasan Budiyo (Indonesia), Michael Gavrilovich (Russia), Mariana Haim (Uruguay), Jason Mattausch (USA), Iouri Netchitailov (Russia), Marie Nilsenova (Czechia), Rasa Paulekaite (Lithuania), Shimon Tanaka (Japan, 98/99 student), Sjaak Verbeek (Netherlands), Patrick Yancey (USA), Sophia Velissaritou (Greece, 98/99 student).

Exchange students:

Alexandru Anghelescu (Romania), Benjamin Rodenhäuser (Germany), Fabian Neuhaus (Germany), Clemens Kupke (Germany), Chiara Panizza (Italy), Dimitris Stathopoulos (Greece).

Contract students:

Darrin Hindsill (USA), Marta Garcia-Matos (Spain), Vidya Lakshmiathy (USA), Alessandra Palmigiano (Italy).

Students 2000-2001

MSc students:

Dirk Buschbom (Germany), John Duda (USA), David Gabelaia (Georgia), Andreas Giannakouloupoulos (Greece), Mehmet Giritli (Turkey/Cyprus), Nicole Hausen (USA), Darrin Hindsill (USA), Özkan Kahramanogullari (Turkey), Troy Lee (USA), Fabrice Nauze (France), Ben Rodenhäuser (Germany), Börkur Sigurbjörnsson (Iceland), Fadillah Tala (Indonesia), Marcello Vavassori (Italy), Mathieu Vidal (France).

Exchange students:

Mika Cohen (Sweden), Chris McCaw (Australia), Luca Spada (Italy), Vincenzo Salipante (Italy), Massimo Panzarella (Italy), Giacomo Paleardi (Italy).

Contract students:

Tapio Janasik (Finland), Misa Keinanen (Finland).

Guests

Ramon Jansana (Spain), Valentin Goranko (South Africa), Joachim Niehren (Germany), Elena Lissaniouk (Russian Federation), Rob Goldblatt (New Seeland), Mai Gehrke (United States), Rohit Parikh (United States), Urszula Wybraniec (Poland), Guram Bezhanishvili (Georgia), Michael Morreau (United States), Carla Piazza (Italy), Massimo Franceshet (Italy), Patrick Blackburn (France), Yuri Gurevich (United States), Hans Kamp (Germany), Natasha Alechina (Great Britain), Neil Jones (Denmark), Samson Abramsky (Great Britain), Enrico Franconi (Great Britain)



Chapter 3 A CHANGE OF PLANS, PLANS FOR CHANGE

Martin Stokhof
scientific director

Research

The formulation of the long term research program 2001-2004, which was already announced in last year's annual report, was completed in 2000. After several rounds of consultations and internal discussions a pre-final version was drawn up, which was discussed with ILLC's Scientific Board in a two day meeting in September. On the whole the program got a favorable response from the Board members, but at several points their insightful comments led to adjustments and changes, among others in the grouping together of the old projects in new ones.

The result is that as of 2001 ILLC's research is organized in the following five core projects:

- Theory of Interpretation
- Cognitive Systems and Information Processing
- Constructive and Intensional Logic
- Computational and Applied Logic
- Algorithmics and Complexity Theory

These core projects organize the majority of ILLC's research activities: they reflect the actual collaborations between individual researchers and they serve as the 'home' for the various activities which embody this collaboration, such as regular staff meetings, joint funding proposals, supervision of PhD projects, informal workshops, and so on. Moreover, they also play a role in ILLC's internal administrative procedures. More on that below, in the section 'Administration'.

Specific common interests which span various research projects and which have a distinct profile are organized as *themes*, of which there are three: Games, Learning, and Dissemination. The themes present more loosely organized trends in research, which have the potential to grow into distinct projects.

But ILLC's 2001-2004 research program is not confined to a re-arrangement of existing research, of course. It also defines a specific set of goals that ILLC wants to achieve within the next couple of years. Two areas have been identified in which major new developments are expected and to which more resources need to be allocated. One area is that of computational logic, the other is that of cognitive science.

Computational logic is a rapidly developing research line which promises not only connections with applied research, e.g., in the area of document retrieval, but which also leads to new theoretical insights, for example concerning the relation between the complexity of algorithms and the expressive power of representation formalisms. The contributions of Breannán Ó Nualláin and Krzysztof Apt which you find elsewhere in this annual report give a good impression of some of the current themes here. ILLC wants to strengthen its position in this area in the years to come and has set itself as a 'milestone' that a fully staffed group, consisting of a full professor and associated staff, be formed by the end of the planning period. In the fall of 2000 an application for funding from the university central research budget was made for additional means to finance this chair and the associated group.

ILLC also needs to investigate the possibilities of building links with research in the cognitive sciences, both cognitive psychology and neurobiology. With the advent of sophisticated neuro-imaging techniques, this field has changed dramatically, bringing many questions which hitherto have withstood experimental testing within reach of experimental research. Many of the issues and problems that ILLC's research is also concerned with deal with cognitive processes, structures and abilities. The broad definition of ILLC's 'core business', viz., information and information processing, indicates this. For reasons having to do with the origins of the modern phase of its tradition, the logical way of doing things has kept its distance from more empirical oriented research. But in view of recent developments the time has come to reconsider this separation and to investigate the possibilities of a new rapprochement. Within the context of the Universiteit van Amsterdam ILLC has initiated contacts with the cognitive psychologists of the Research Institute of Psychology and the neurobiologists in the Swammerdam Institute of the Life Sciences. A common initiative to found a 'Cognitive Science Center Amsterdam', which is to coordinate and stimulate interdisciplinary research in this area, is currently underway.

A third goal that ILLC has set itself is to realize a better proportion between its regular, 'first stream', i.e., university funding, and the funding obtained from non-university institutions, such as NWO (the Dutch science foundation) and the KNAW (the Royal Dutch Academy of Sciences), a.k.a. 'second stream funding', and various dedicated funding programs such as the EU Fifth Framework, and industrial cooperations, collectively referred to as 'third stream funding'. In 2000 the proportion between the various streams was 55:40:5. The goal is to change that to 45:45:10 in 2004. The concern behind this

is that there is a real possibility that first stream funding will be insufficient to maintain a healthy level of research activities, in particular PhD projects. The recently announced plans of the University Administration for a new system of PhD research, if implemented as announced, will result in a significant reduction of the number of positions available in the first stream funding.

The 2001-2004 program also discusses various other aspects of ILLC's future, such as housing and various budgetary matters. The interested reader can download the full version from the ILLC web site or write to the ILLC bureau to obtain a copy.

Results of ILLC's research activities carried out in 2000 were good. The number of publications has dropped somewhat, but this is probably due to the fact that the number of staff employed by ILLC was lower. (See chapter 6 for details.) Five candidates successfully defended their PhD theses. That ILLC's researchers continue to play an important role in their various fields is also witnessed by the success of their attempts to obtain additional, second and third stream funding: four new postdocs, among which a KNAW fellowship for Robert van Rooy, six PhD positions, and a scientific programmer.

Two ILLC researchers, Rens Bod and Paul Dekker, obtained a 'Vernieuwingsimpuls' grant from NWO. The Vernieuwingsimpuls program aims at talented young researchers who can be expected to initiate and explore new directions in research. It allows the laureates to conduct a 5 year research program of their own, with sufficient means to employ a number of postdocs and/or PhD students. The universities that have supported the applicants have committed themselves to offering them a permanent position afterwards.

Finally, ILLC had the pleasure of welcoming on board Harry Buhrman, who was appointed as a part time professor in algorithmics and complexity theory, in particular of physical computation systems. With this appointment ILLC's theoretical computer science group is significantly strengthened.

Teaching

As ILLC's 'home' faculty, the FNWI (Faculty of Science), progresses in setting up the research institutes as its primary administrative units, with a large budgetary autonomy, the involvement in teaching grows as well. Unlike other faculties, the FNWI has implemented the UvA's new administrative model in such a way that the research institute is also the primary locus where teaching

of staff members is planned and coordinated. In the other participating faculties, the FGW (Faculty of Humanities) and the FMGW (Faculty of Social and Behavioral Sciences), this is the 'afdeling' (department). This means that ILLC as an institute is also responsible for the activities of its FNWI members in various curricula, primarily mathematics, computer science and artificial intelligence. But since ILLC's FGW and FMGW members also contribute to (some of) these curricula, this means that these issues need to be addressed at the level of the institute as a whole, i.e., across faculties and hence across different administrative structures.

An important development is the upcoming new BA-MA structure of Dutch university curricula. Although the implications for the various curricula in which ILLC participates - beside those already mentioned these include philosophy and linguistics - are different, in each case there is an opportunity and a necessity for change. Here a coordinated effort to employ *all* of ILLC's capacities as efficiently as possible is called for. This becomes more important also because it is to be expected that at least part of the budget which is intended for teaching will be allocated on the basis of the number of credits realized. Here choices have to be made. On the one hand ILLC's specific expertise must be visible in the various curricula. On the other hand teaching efforts should be more or less 'self sufficient'. Finding the proper balance between these two requirements is one of the main challenges for the coming years.

The new BA-MA structure also calls for a reconsideration of the position of ILLC's own Master of Logic program. The major question here is whether to continue the MoL-program as an independent program, or to incorporate it into one of the new MA-programs. One reason for tighter integration is the relative scarcity of resources: ILLC partakes in quite a number of different curricula, with a relatively small permanent staff. On the other hand, the MoL program continues to attract a growing number of students from all over the world. Together with other foreign students, who come to Amsterdam on exchange programs, they form a thriving community, which in general mixes well with the Dutch student population. There is obviously a market for a dedicated, 'ILLC-style' logic program at the Masters level. Also talented MoL-students broaden the pool of candidates for PhD projects. Actually, quite a number of international students have already continued their careers as PhD students at ILLC. This discussion is still in progress.

In the area of PhD teaching activities, a number of PhD students of ILLC attended the annual summer school organized by FoLLI. They also took part in yet another successful school week organized by the Dutch Graduate School in Logic OZSL, which took place in the fall.

The continuation of OZSL as an ‘onderzoekschool’ in the original sense of the word was subject of a debate with all participants in the fall. The general feeling was that as an organization which facilitates and organizes teaching for PhD students in logic on a national scale, the OZSL continues to serve an important goal. Other functions that ‘onderzoekschole’ originally were intended to fulfill, such as coordination of research, have never played an important role. The board of the OZSL therefore has decided to investigate whether the KNAW is willing to recognize the OZSL for another five year period on these terms.

Irrespective of the outcome of this ILLC remains committed to the idea of PhD training in close cooperation with other members of the Dutch logic community.

Administration

The implementation of the UvA’s new administrative model, with its division into research institutes, teaching institutes and ‘afdelingen’ (departments), continued in 2000, but in different paces and slightly different directions in the various faculties which participate in ILLC. This makes the day to day running of an interfaculty institute such as ILLC sometimes rather tiresome and it certainly does not make for great transparency for the members of the institute.

There are a number of discrepancies between the internal administrative structures and procedures of the participating faculties which negatively affect the efficiency of the institute’s administration. The lack of a uniform funding system makes it difficult to use the institute’s budget in an efficient manner. The difference in outlook with regard to relationship between research institutes, teaching institutes and ‘afdelingen’ results in quite heterogeneous procedures concerning planning of teaching. The different roles of the ‘afdelingen’ also makes it difficult to deal with vacancies and other matters concerning human resource management. Another issue of constant concern is to maintain an adequate and reasonably uniform level of computing facilities.

In 2000 these issues have been discussed with the deans of the participating faculties. There was consensus concerning the need for more transparency in various administrative procedures across faculties. The main task for 2001 is to see that this consensus results in such changes as are needed to actually realize such a transparent situation.

Internally the UvA's new administrative structures also have led to a number of changes. Many of the responsibilities that in the old situation resided with the board of a research institute are now relegated to the scientific director. In order to make sure that the scientific director is able to fulfill these responsibilities in accordance with the institute's concerns and needs a new internal administrative structure had to be set up. With the new organization of research projects a board of project leaders ('projectleidersoverleg') has been formed which meets at least once a month and which discusses all affairs concerning the institute. Specifically, the board of project leaders advises on the institute's annual budget, vacancies and appointments, research planning and the annual report, the distribution of teaching and administrative tasks. The various projects are allocated their own budget for additional costs. The project leaders also serve as a liaison between the scientific director and the individual members of the institute.

Conclusion: Planning for Change

To an outsider, a research institute such as ILLC might appear as an oasis in the midst of the desert of 'real life', one of the few places where people can pursue their interests in tranquillity, without having to respond to a constantly changing environment. This is the picture of the theoretical scientist as a monk in monastery, undisturbed by the turmoil of every day life, quietly investigating solid and permanent truths. We know better.

First of all, in the administrative environment, primarily the university, there are continuous cycles of planning and change. Some of these are determined by developments on a political level, others by its own internal administrative logic. Not all of these changes and planning cycles are equally transparent, at least not from the perspective of the working scientist. There seems to be at least some truth in the saying that politicians and administrators want to be remembered for what they have changed, not for what they have kept in place. But in so far as these changes in administrative structure, financial planning cycles, teaching programs, and so on, are motivated by a concern to meet the challenges of a changing society, they are for the better. At least they should be and it is also up to us to see to it that they are. ILLC, as any university institution, has a responsibility of its own here.

But there is a second, far more important source of change: the scientific environment in which we do our research. This environment is not fixed and stable, but rather is in a state of permanent flux. It changes constantly and it sometimes does so in unpredictable ways. Here we are both agent and patient. Some of these changes happen because we play an active part in initiating them. Others first occur elsewhere, but we need to react and adapt to those as well. One of the major challenges that a research community such as ILLC faces, is to plan for these changes as much as possible. Of course, it is difficult to predict scientific developments over a longer period of time, yet one has to try to anticipate and prepare for them.

But, one might ask, what is the actual value of such an exercise, if scientific developments are so hard to predict? A final answer must wait until we reach the end of the planning period, of course. But there is another reason why drawing up a long term research program is a worthwhile undertaking. It forces us to take a step away from the actual projects we are engaged in on a daily basis and to think in a more disinterested fashion about how our field is developing, how we want it to develop and what part we can play in that. Such instances of collective reflection are very valuable by themselves, and their importance does not depend on what the actual outcome of future developments turns out to be.



Feeling the Mood: Meaning and Use

Robert van Rooy

In the traditional theory of interpretation a division of labor is made between the study of *meaning*, semantics, and the study of the way these meanings are *used* in conversation, pragmatics. This view presupposes that meaning can be determined independently of use. Slowly but surely, it has become clear that this assumption is problematic: what is said by a sentence is normally *underspecified* by its conventional meaning, and depends to a large degree on how it is used. I have always been very interested in pragmatics, and also my interest has developed from learning how meaning is used, to learning how meaning depends on use. I try to answer this question by first investigating why and how we use language at all.

So, why do we talk? What is the purpose of our use of language? It is obvious that language is used for more than one purpose. Sometimes we use language with an *expressive* purpose: guess what my roommate just did when his computer crashed again. Sometimes language is being used to *strengthen relationships* between people: my colleagues gossip a lot during lunch. I have to admit, however, that I normally use language just to influence the behavior of others. And to be honest, I think you are exactly like me. Indeed, although language is a multi-purpose instrument, the purpose to *influence* other's *behavior* seems to be basic.

Now, why do we want to influence other's behavior, and how are we going to analyze this? Well, let me again speak for myself: I want to influence one's behavior by my use of language because I believe that one's changing behavior would be profitable for *me*. So, I consider one communicative act better than another, when I expect the former to have a more profitable effect than the latter. In my work I try to measure this intuitive notion of profitability of a communicative act in terms of a *quantitative* notion of *relevance* by using theories of rational behavior.

I have used decision (Savage) and information (Shannon) theory to determine a quantitative notion of *relevance* of assertions and questions, in terms of *decision problems* that agents face in cooperative question-answer dialogues. An agent facing a decision problem is an agent wondering which action to perform. More information, however, might resolve this decision problem, or might at least allow her to make a better informed decision. This means that information becomes valuable, and that the value/relevance of the information given by what is *asserted* by other agents, can be determined in terms of the reduction of

uncertainty about which action is the best to perform. Similarly, the relevance of a *question* can be determined in terms of the expected value of the potential answers to the question, especially when we assume Groenendijk and Stokhof's analysis of questions. These values of answers/assertions and questions can be used to determine what is actually expressed by uses of natural language expressions, and for giving a formal account of *conversational implicatures*, based on the assumption that speakers want to *maximize* the relevance of their communicative acts.

I apply game theory, the theory of interactive behavior of rational agents, to extend these investigations on how meaning depends on use. There are two reasons for this. First, this theory can be used to model also conversational settings in which the agents are not fully cooperative, as was assumed in the decision theoretic account. In such situations, what becomes *common ground* between agents, so important for choice of action and in particular for production and interpretation of language, can be thought of as the result of a *bargaining* game between interactive agents. It is also the natural setting to analyze the use of communicative actions like commands, promises and acknowledgements.

Second, to determine the actual interpretation of a sentence not only the *maximization* of *relevance* plays a role, but also the fact that agents want to do this by *minimizing* their effort (by using short pronouns to refer to salient objects, for example). Together with Paul Dekker I have shown recently that this balance can be analyzed in proper game theoretical terms, by describing optimal interpretation in terms of equilibria of optimization games. It turns out that these latter games can be used not only to determine interpretation in *particular* conversational settings, but also to explain the rise of more stable *conventional* meanings.

Wittgenstein once famously declared that meaning depends on use, and the metaphor of 'language games' played an important role to support this idea. In my work I try to formalize Wittgenstein's metaphor and see how useful this is for the analysis of meaning.

Chapter 4 FUNDAMENTAL RESEARCH

4.1 Theory of Interpretation

Characterization

The project investigates the logical and philosophical foundations of formal theories of interpretation. Its main goal is the development of tools for adequate interpretation of natural language, testing these against both empirical data as well as methodological and philosophical constraints.

Main Themes

The three main themes in the project are: interpretation in conversation, concept formation, philosophical backgrounds.

Research on interpretation in conversation focuses on interpretation as a dynamic process in actual conversation. It builds on earlier research on the dynamics of interpretation at sentence level, applying the results of that research to phenomena which play a key role in the structuring of discourse, in particular of conversations. To this end the scope of existing formalisms needs to be extended to cover multi-speaker exchanges. Relevant empirical phenomena that are studied here include question-answering and anaphoric uptake across speech participants. Increasingly the research in this theme makes use of decision and game theory in the analysis of the procedures which are used by rational communicative agents in both production and interpretation. This research has strong links with research in the project Logic in Communication and with work on dynamic logic in the project Mathematical Logic. Computational feasibility of the resulting theories is a topic of investigation in the project Computational Logic.

The work on concept formation is devoted to the development of a formal model of the way in which concepts arise from (relatively) unstructured data. This research is closely connected with the data-oriented approach towards information processing which is being developed in the project Information Processing. One important topic here is the role of consciousness vis-à-vis the possibility of language in general and semantics in particular. This issue is investigated against the background of both connectionistic, neural network based models of learning as well as more traditional approaches in terms of rules and representations. Another central topic within this theme is the study of metaphor, which raises important questions concerning the origins and transfer of meaning, its dependence on context and background, and its relation to general cognitive processes of analogy and imagery.

Research on philosophical backgrounds involves coming to grips with the presuppositions and limitations of the kind of theories developed in the first two themes. Historical and philosophical analyses of various key notions used there also bring out connections with different paradigms. Topics addressed within this theme include the historical origins and subsequent development and employment of the notion of an ideal language; the historical backgrounds of modern intensional semantics, in particular that of the central principle of compositionality; the relevance of Wittgenstein's rule-following considerations for linguistics, in particular the role of normativity in interpretation and its connection with epistemology and the role of formal languages in semantics.

Researchers

Renate Bartsch, Jeroen Groenendijk, Herman Hendriks, Theo Janssen, Jaap Maat, Robert van Rooy, Harry Stein, Martin Stokhof.

PhD Students

Maria Aloni, Elsbeth Brouwer, Balder ten Cate.

External Cooperation

There is close cooperation with researchers in Utrecht (Visser) and Tilburg (Muskens) in the NWO-funded program 'Sources and Streams of Information: Towards a Logical Analysis of the Dynamics of Discourse'. Further cooperation involves researchers in Berlin, Frankfurt, Oxford and Stuttgart.

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Research in the theme interpretation in conversation saw several interesting developments. First of all, a coherent formal model of the meaning of, update with and support for first order information has finally been completed. The model integrates and extends the main insights and tools of discourse representation theory and dynamic semantics with key concepts from the tradition of philosophical pragmatics. Also, parallels between dynamic semantics and game theoretical semantics have been used to provide an explanation of some prima facie puzzling effects of negation, questions, and conditional sentences on anaphoric structure. Secondly, work on the role of optimization techniques in interpretation and their formulation in game-theoretical terms, was continued. Optimality of interpretation can be characterized in terms of games in which one agent chooses an optimal formulation from a set of candidate utterances in order to express his intentions and another agent chooses an optimal interpretation from a set of candidates in order to retrieve the intended meaning. Given such a view on linguistic

interaction as a coordination game, felicitous exchange can be characterized by means of a game-theoretical solution concept, viz., that of a Nash-equilibrium. Possible areas of application include the interpretation of anaphoric and temporal structure and rhetorical relations in discourse. Game theory and decision theory also proved to be a promising starting point for the analysis of several open problems in the semantics and pragmatics of question-answering. They enable one to give a pragmatic analysis which is based on the assumption that questions are being asked in order to resolve decision problems. This view also gives an explanation of the fact that certain types of responses can intuitively resolve a question, although the standard semantic approaches predict that they can not.

Maria Aloni completed her thesis on conceptualizations in discourse. In her thesis she shows that conceptualization can be used to solve a number of puzzles in dynamic semantics, in the semantics of questions and in that of attitude reports.

Within the second theme, concept formation, research on the role of consciousness in natural language understanding has continued. An important issue here is the clarification of the notion of representation. A book length manuscript with the title "Consciousness at the Cutting Edge Between World and Brain" is almost completed. It is concerned with the relationship between consciousness, perception, imagination, language and thought.

With regard to the relationship between concept formation and lexical semantics, an investigation has been made of the role and the limitations of compositionality in the lexicon, and of the function of polysemy and its origins in metaphor and metonymy.

Work on metaphorical interpretation has concentrated on the role of imagery in the creation and understanding of metaphor, in particular poetical metaphor. In contrast with other approaches to metaphor the goal here is to characterize the nature and function of the poetical in the metaphorical use of language.

In the third theme, philosophical backgrounds, work on philosophical languages in the seventeenth century resulted in the completion of an annotated edition and translation of Dalgarno's linguistic work, which includes the first artificial language to be produced in the early modern period. (This is joint work with David Cram, Oxford.)

An extensive study was made of the occurrence and the role of the principle of compositionality and the context principle in Frege's published and unpublished work against the background of the views of other 19th century philosophers.

A new project was started on a hitherto relatively underdeveloped problem, viz., the role of testimony and trust in the acquisition of meaning and knowledge. The mechanism of trust is an ubiquitous one, which nevertheless has received relatively little attention. This project focuses on the philosophical backgrounds and presuppositions of this phenomenon, in particular on its relationship with foundational and non-foundational approaches in the theory of knowledge. Also the opposite phenomenon (lack of testimony, lack of information) plays a role in natural language interpretation, and therefore the properties of informational independence will be investigated.

2001

Within the first theme, interpretation in conversation, research on the philosophical foundations and the logical formalization of game-theoretic concepts and the application of game theory in the analysis of conversation will be continued. On the empirical side, the focus will be on the explanation of the dynamics of conceptualization shifts in terms of optimization techniques. Integration of dynamic semantics and theories of question-answering and topic/focus remains high on the agenda. Here the aim is to develop a framework for the representation of discourse topics which combines dynamics of domain restrictions and a dynamic theory of presupposition and accommodation. Finally, special attention will be given to the role of (Gricean) communicative intentions in the structuring of discourse.

In the second theme, concept formation, the focus will be on a closer investigation of the role of consciousness within a multi-layered neuronal model of language acquisition and linguistic understanding. Characteristic for this model is the use of interaction between the layers by resonance circuits, which provide the means to model constituent structure in perception, imagination and linguistic understanding. In the field of concept formation, the fluid boundary between metaphor and metonymy will be investigated and explained on the basis of the operations involved in production and interpretation. In the work on poetic metaphor research will concentrate on the compatibility of the traditional notion of imagery with modern cognitive models of metaphor.

In the third theme, philosophical backgrounds, work on the ideal language movement will proceed. A new project will focus on Leibniz's project of a rational grammar and on its relevance for modern philosophy of language. The investigation of the historical backgrounds of compositionality and contextuality will be continued. Next to that of Frege, the position on these

issues of other 19th century philosophers will be analyzed. The project on testimony, trust and informational independence will be continued. In a later stage of this project it will be investigated whether the results here could be relevant for more practical work in multi-agent logics for communicative interactions and transactions, and vice versa.

4.2 Cognitive Systems

Characterization

Research in this project is oriented toward the logical study of cognitive processes, such as informational update, belief revision and kinematics of preference. Its main goal is to design logical theories of cognition that have a certain psychological plausibility and computational feasibility.

Main Themes

One guiding topic is the study of hypothetical and default reasoning. In recent years, this stream has merged with the much wider research field of non-monotonic logic in artificial intelligence. Research on this theme has both foundational unifying aims and practical ones, including the description of actual reasoning practices and design of more efficient reasoning tools for artificial intelligence. A related theme is the study of belief revision as a form of theory update, in the Alchourrón, Gärdenfors and Makinson postulational style. One of our objectives here is to tailor this theory so as to make it applicable to real life situations. The project will also pursue theoretical implications for the broader philosophical work on rationality. A final theme is provided by the dynamic notion of logical validity. This notion of validity lacks the structural properties of the classical notion. That is why it is interesting to study the notion of inference in this setting. The usefulness of an adapted theory of dynamic predicate logic for the modeling of incomplete knowledge in relational database theory serves as a more practical testing ground for this theme. All these projects have links with the project ‘Theory of Interpretation’, the dynamic logic part of the project ‘Mathematical Logic’ and the project ‘Computation and Complexity Theory’.

Researchers

Karen Kwast, Frank Veltman, Sjoerd Zwart.

PhD Students

Gwen Kerdiles, Allard Tamminga.

External Cooperation

The participants have a tradition of close co-operation with colleagues in Edinburgh (Centre for Cognitive Science, Human Communication Research Centre), Regensburg (Institut für Philosophie) and Lund (Lund Cognitive Science Centre).

2000

Further work has been done on a dynamic analysis of counterfactual conditionals, which solves some notorious puzzles left open by the standard theories and which can be extended to a theory that explains the use of the subjunctive mood in other contexts. The results in the field of belief revision have been twofold. There is a study of mechanisms of belief revision using paraconsistent logic, and an investigation of the relation between belief revision (the Kuhnian AGM-paradigm of theory change) and the notion of verisimilitude (Popper's idea of an improved theory being more similar to the truth). The question here is: how and under what conditions and definition of verisimilitude will revision of our beliefs lead us to theories that are closer to the language relative truth? Further work has been done on the interface between reasoning based on graphical representation and logic-based reasoning, as well as constraint-based reasoning with and about temporal information. These latter topics provide an important practical testing ground for the more general themes concerning the dynamics of information in general.

2001

Starting in 2001, the research in this project will be subsumed under the heading 'Cognitive Systems and Information Processing'. Our new challenge will be to build bridges to other communities in cognitive science, in particular psycholinguistics and cognitive neuroscience. We believe that logic can make an important contribution to the construction of models for the actual processing of language. Our plans include a study of vague adjectives and quantifiers, built on the idea that vagueness is not so much a matter of laziness, but a consequence of the fact that often our senses do not inform us more precisely than they do.

4.3 Information Processing

Characterization

This project is concerned with the design of algorithms which interpret and/or generate messages expressed in various natural 'languages'. It construes the notion of 'language' somewhat more broadly than most of the other projects,

including, for instance, conventions for graphical representation or styles of musical composition. The methods employed in this project build on formal theories of linguistic syntax and logical semantics, but often extend these with statistical or complexity-theoretical techniques which are inspired by theories of human Gestalt perception. The project aims at computational methods which are cognitively plausible as well as practically useful. Work on pilot-applications investigates the viability of the algorithms for real-world tasks.

Main Themes

A central theme in this project is the development of a performance model of natural-language processing, called data-oriented parsing (DOP). This model de-emphasizes the problem of delimiting the class of 'grammatical' sentences; instead, it assumes an overgenerating competence-grammar and focuses on the problem of statistical disambiguation. A data-oriented parsing system employs a large corpus of annotated utterances as a representation of its 'past language experience', and makes its disambiguation decisions on the basis of statistics about arbitrarily large and complex subtrees from this corpus. (The corpus-annotations themselves are based on logic-oriented theories of grammar and semantics.) The DOP model has been tested as a language model for speech recognition, outperforming the Hidden Markov Model (HMM) technique on the OVIS domain. In collaboration with the University of Leeds and the Max Planck Institute, a number of psycholinguistic experiments have been carried out, suggesting that frequently occurring sentences are stored in memory even if they are non-idiosyncratic and semantically transparent.

Computational models of discourse and context constitute another long-standing theme within this project. The research on this topic is carried out in close cooperation with the work on discourse dynamics in the project Theory of Interpretation. It complements this work in that it focuses more on linguistic issues and empirical coverage. The models developed here articulate the structural properties of discourse by means of unification grammars, and employ type theory and dynamic logic to represent semantic interpretations and their context-dependence. As the interest in empirical issues in discourse increases, closer collaboration with the DOP theme emerges.

A third related theme is concerned with graphical representations. Realistic language processing applications often involve additional media, such as graphical information displays. We therefore want to address the design of multimedia interfaces and automatic information visualization systems. To create a theoretical basis for building algorithms of this sort, we are developing mathematical and computational models of visual Gestalt perception and

diagram interpretation. This work is carried out in close cooperation with the project Computation and Complexity Theory.

Researchers

Rens Bod, Remko Scha, Khalil Sima'an, Henk Zeevat.

PhD Students

Remko Bonnema, Noor van Leusen, Louis Nagtegaal.

External Cooperation

Much of the initial work on data-oriented parsing was funded by the now terminated NWO Priority Program 'Language and Speech-Technology', an application-driven research project which builds on technology developed at Philips Forschungslabor Aachen. In this program there existed a close cooperation with the computational linguistics research at the University of Groningen, the work on dialogue management and speech generation at the Institute for Perception Research (IPO) in Eindhoven, and the work on speech recognition at the University of Nijmegen. The research on DOP is also coordinated with the work on memory-based language processing at the University of Tilburg, work on statistical language processing by Itai and Winter at the Technion in Haifa, and work on data-oriented lexical-functional grammar at Xerox Parc (Palo Alto). Other important research contacts are Carnegie Mellon University (automatic visualization), the Psychology Department of the University of Nijmegen (Gestalt perception), FX PAL (Fuji Xerox, Palo Alto) (discourse models), the Humboldt University in Berlin, Potsdam University (Germany) and Stockholm University (discourse processing and optimality theory).

2000

In the area of DOP, emphasis shifted from traditional annotation models based on PSG to dependency grammar based Tree-Gram. This approach is more suitable for speech output and for languages with a freer word order than English such as Hebrew or Dutch. A lexicalised version of Tree-Gram DOP was developed to repair the insensitivity of the existing DOP model for lexical influences. In addition, in cooperation with Technion, work was carried out on the development of the Hebrew tree bank at Technion, which is based on the Tree-Gram model.

The classical DOP model was further explored by investigating its properties on the Wall Street Journal corpus. A simpler variation of DOP was developed

where the role of probabilities is diminished by only comparing the probabilities on the shortest derivations of a given structure. An important breakthrough is the improvement of the calculations of the probabilities inside DOP. This work has been applied to the OVIS corpus.

Contact has been clearly established between the fields of discourse and optimality theoretic treatments of pragmatics. Blutner's and Zeevat's OT theory of presupposition has been supplemented by treatments of pronominal anaphora and an initial study of tense and discourse relations. High on the agenda are now the typology of these phenomena and the investigation of other pragmatic phenomena, as well as the problem of efficient computational implementation of these and other OT treatments, as well as probabilistic interpretations of OT principles.

Rens Bod won a Vernieuwingsimpuls on a proposal to apply the DOP techniques to music and graphics and Khalil Sima'an won the FoLLI Outstanding Dissertation Award as well as the best paper prize at BNAIC.

2001

Khalil Sima'an continues this year on a prolongation grant from the otherwise finished NWO Priority Program 'Language and Speech Technology'. Work is foreseen to apply the Tree-Gram methods to the OVIS corpus to improve the performance of the DOP-model on that spoken language corpus. The semantics of Tree-Gram model is an open problem and will be addressed this year.

Rens Vernieuwingsimpuls Theoretical work will start on an integrated computational model of perceptual cognition, which encompasses language processing as well as visual and musical perception.

The investigation of the possibilities of optimality theory for the study of semantics and pragmatics is high on the agenda. Pilot studies on the treatment of discourse particles have been successfully presented at a number of conferences and workshops and will lead to publication this year. The PhD thesis of Remko Bonnema is nearing completion.

In the area of optimality theoretic discourse studies, a large cooperative project is being prepared involving German and Swedish partners.

4.4 Mathematical Logic

Characterization

This project continues the long-standing Amsterdam tradition in mathematical logic and the foundations of mathematics. Over the years, the original core theme of constructivism has widened to become general proof theory and provability logic, and on the other hand modal and dynamic logic. Thus, the two main ‘trademarks’ of mathematical logic at Amsterdam fit together in their efforts to create a general framework for reasoning and information flow.

Main Themes

One core theme is concerned with the foundations of constructivism and more general proof theories emanating from that tradition. Current interests here include intuitionistic logic, type theories, linear logic and other substructural resource logics. Semantic foundations of these theories, in terms of Kripke models or categorical models, are also actively investigated. The eventual aim is a general formulation of the constructivist program as a practical general-purpose tool for the working mathematician, computer scientist, and computational linguist.

Another theme is provability and interpretability logic of classical and intuitionistic arithmetic, with its current ramifications into recursion theory and complexity theory, as well as ‘weak arithmetics’. Topics here include interpolation properties, axiomatic completeness, and modal-style formalizations of further proof-theoretic notions. This research has close ties with the projects Algorithmics and Information Processing and Computational and Applied Logic. It also serves as a test-bed for more discriminating notions of complexity that may increase our theoretical understanding of the actual workings of automated deduction on large-scale input sets.

The third theme is modal and dynamic logic. Modal logics are designed to combine reasonable expressive power with a decidable notion of validity. Special emphasis is given to dynamic logics, i.e., modal logics of action inspired by the analysis of computation and information flow. Our overall goal is a modally inspired mathematical framework for information flow, pursued in analogy with classical logic. The following key topics can be identified. One concerns large decidable ‘guarded fragments’ of first-order logic, which generalize modal logics. Modal process theory on labeled transition systems is studied with a wide spectrum of process equivalences: semantic invariance and syntactic definability for process languages, expressive completeness of process repertoires with regards to bisimulation. Another topic is the use of modal techniques to reduce the complexity of logical systems by decomposing their

standard semantics into a decidable logical core plus mathematical extras. The modal analysis of games as a dynamic many-agent model for communication and interaction is explored, as are modal structures in visual information. The mathematical side of modal logic, and in particular, its algebraic theory, is also an object of investigation. Finally, the project also covers research on logical learning theory, model theory, as well as various connections with algebraic logic.

Researchers.

Johan van Benthem, Kees Doets, Dick de Jongh, Anne Troelstra, Domenico Zambella.

PhD students:

Marco Aiello, Boudewijn de Bruin, Eva Hoogland, Rosalie Iemhoff.

External cooperation

The group maintains close connections with logic groups at the universities of Aachen (informatics), Bloomington, Edinburgh, Groningen, London (Imperial college, King's College), Moscow (Steklov Institute for Mathematics), München, Münster, Prague, Rochester, Siena (Logic Graduate School), Stanford (CSLI, CS), Udine, and the Hungarian Academy of Sciences in Budapest (mathematics).

2000

Within the first theme, the scientific legacy of A. Heyting and A.S. Troelstra was organized, indexed and put into the archives of the Rijksarchief in Haarlem. Troelstra completed, together with his co-author Schwichtenberg, the second edition of their book "Basic Proof Theory". Research concentrated on intuitionistic logic; a perspicuous enumeration of the projective formulas in two variables was given. Also, earlier developed techniques for automated calculations in fragments of intuitionistic logic were extended to stronger and weaker versions of intuitionistic logic. We also found completeness results for certain extensions of the intuitionistic propositional calculus IPC using rules which define new connectives.

On the interface of the first and the second theme, we continued our search for the 'right' interpretability logic for constructive theories; a first step on this road was made by proving a modal completeness theorem for preservativity logic. Preservativity logic turned out to have a direct relationship with the admissible rules of IPC and intuitionistic arithmetic HA, enabling us to give a surprisingly perspicuous axiomatization of those rules.

With respect to the third theme of modal and dynamic logic, we investigated public update systems in terms of classical model-theoretic issues. The results obtained concerned the notions of bisimulation and definability, preservation and a relativisation calculus. Concerning the topic of logic and games, we further developed our general epistemic-dynamic framework for imperfect information games, operating at different levels of description in a ‘simulation hierarchy’; we analyzed basic representation theorems, expressive power, game algebras and the complexity of determining the players’ powers. We elaborated on the topic of modal logics of space in various directions: first, we worked on completeness theorems, e.g., for logics over the real numbers; second, we established strong connections between mathematical morphology on the one hand, and linear logic and arrow logic on the other; and third, we worked on applications of this and earlier work in the fields of computer vision and document image analysis; much of this work was done in collaboration with the Institute for Informatics. We continued our study of guarded fragments of first-order logic and proved that both the guarded fragment and the packed fragment do have the Beth definability property and a modalized version of interpolation, but not the interpolation property as such.

Research in model theory yielded a uniform proof method, which exploits back-and-forth characteristics to give short proofs for classical results. In the area of abstract algebraic logic, we generalized the characterization of Beth definability as the surjectiveness of certain epimorphisms to equivalential logics; this result was the fruit of joint research with colleagues from Chicago. In computability theory we gave a forcing-style solution to Post’s problem by defining a new notion of forcing and proving the existence of computably enumerable generic sets, which may have incomplete Turing degree.

Finally, two dissertations were completed in 2000. Paul van Ulsen finished his study of the logical work of E.W. Beth; this work culminated in the dissertation “E.W. Beth als logicus”. Hans van Ditmarsch, who was based in Groningen but co-supervised in Amsterdam, completed his investigations into knowledge games, and reported on his research in a PhD thesis entitled “Knowledge Games”.

2001

Concerning the first theme, we will try and give perspicuous presentations of the projective formulas using a fixed, finite number of propositional variables. We will also investigate the applicability of intuitionistic and intermediate logics in the semantics of logic programs, concentrating on the stable semantics.

Within the second theme we will study completeness problems in classical and constructive provability logic; here we plan to cooperate with colleagues from Utrecht.

Concerning the third theme of modal and dynamic logic, van Benthem plans to complete a new monograph ‘Logic and Games’, providing a general perspective on the interfaces between logic and game theory; we also want to develop a logical formalism in which assumptions concerning knowledge and rationality can be formulated adequately. We plan to continue the research on modal logic of spatial patterns, both from a theoretical and from a more applied angle. Finally, we intend to explore contacts between logic and experimental cognitive science, with a view toward testing the ‘realistic’ value of dynamic-logic models of communication and cognition.

With respect to learnability theory, we intend to give a categorization of the rigid languages on two letters, and to study the complexity of the learning problem in this simplest case (together with colleagues from Utrecht).

4.5 Computation and Complexity Theory

Characterization

The main themes of the project are algorithmic methods and complexity analysis. Specific subjects are quantum information processing, computational learning and cognition and AI, network algorithmics, computational complexity theory and descriptive complexity and its applications.

Main themes

Quantum coherent computation is a new field of research that has attracted an increasing number of computer scientists and physicists over the last 10 years. In the last years evidence has arisen that the proposed coherent quantum computers may be (and for some tasks are) intrinsically much faster than classical computing devices, thus making their technological development of great economic interest. Coherent quantum computers have also a theoretical interest, as their study has contributed open problems and may contribute to solving standing open problems in computation theory. Exploring the possibilities of a quantum computer is anticipated to shed new light on aspects of quantum mechanics, thus increasing our understanding of quantum phenomena.

A central theme in the project Machine Learning is the so-called ‘Minimum Description Length Principle.’ The fundamental idea behind the MDL principle is that any regularity in any given set of data can be used to compress

the data, i.e., to describe it using fewer symbols than needed to describe the data literally. The more regularities there are in the data, the more we can compress it. A more concrete project based on such data compression ideas involves the learning of Context Free Grammars from positive examples.

The project Algorithms and Complexity, Advanced Systems Research has two distinct subprojects: Distributed and Network Computing and Algorithms and Complexity. The project Distributed and Network Computing has focused on algorithms for mutual search and naming conventions. In the subproject Algorithms and Complexity we study a varying collection of old and new algorithmic problems. A main tool in the study of algorithms (as in other parts of the project) is Kolmogorov Complexity.

Researchers

Pieter Adriaans, Harry Buhrman, Peter van Emde Boas, Leen Torenvliet, Paul Vitányi.

PhD Students.

Wim van Dam, Ronald de Wolf.

External Cooperation

The cooperation with CWI is at the core of this project. Furthermore the coordination of the 5th European framework project Quantum Algorithms and Information processing is centered at CWI (Buhrman). This framework involves eight European, three Canadian and one American partners. Vitányi is site manager in the EU Network of Excellence QUIPROCONe which includes 35 sites. Finally, there are many long term research relations with numerous institutes.

2000

(1) *Quantum Computing.* On January 3d the fifth framework project Quantum Algorithms and Information Processing (QAIP) of which Buhrman is the coordinator officially started with a kickoff meeting at CWI. The Quantum Information Processing conference (QIP) was held in January 2001 in Amsterdam, organized by Buhrman, de Wolf and Roehrig. Several projects in this field were carried out by Buhrman, de Wolf, van Dam and Vitányi, cooperating with Ambainis, Mosca, Tapp, Cleve, Watrous, Dür, Heiligman, Hoyer, Magniez, Santha and Hallgren, resulting in 9 refereed publications and several other submissions.

(2) Machine Learning. The focal theme in this project during 2000 was the connection between Data Compression and Learning. The relations between the existing theories for the Bayesian approach, Kolmogorov Complexity and the Minimal Length Description principle were established by Vitányi, together with others including Ming Li. The insights were applied to concrete examples in model selection, handwriting recognition, and cognitive psychology. Vitányi is co-chair of the 2001 edition of the COLT conference organised by CWI in Amsterdam.

A prominent example of applied Learning theory was Pieter Adriaans' Robosail project, which proved that an automatically controlled sailing yacht can outperform human controlled competitors. The used software was produced in part by a team of students from the UvA AI program. In 2000 new versions of the Emile language learning program were developed by Marco Vervoort, based in part on recent theoretical developments in papers by Pieter Adriaans.

(3) Algorithms and Complexity, and Advanced System Research.

The research activities in the project Algorithms and complexity in 2000 consisted of ten different small projects all in cooperation with foreign visitors/colleagues, and other groups within ILLC and UvA, and all resulting in papers including one STOC and one JACM paper. The projects ranged from highly practical (static membership, lowerbound for shellsort) to more theoretical (enumerations of the Kolmogorov function). In 2000 our group was also represented in program committees and steering committees of several important conferences like ICALP200, CCC and IFIP (Buhrman, Vitányi).

2001

The projects of the ILLC were partially reordered starting with the year 2001. The proposal that 'Algorithms and Complexity' be merged into the larger theme of 'Information Processing' was frowned upon by the evaluation committee that visited ILLC. So it once more became a project on its own. New is the startup of the EU 5th framework project Quantum Algorithms and Information Processing (QAIP), the Network of Excellence QUIPROQUONE, the European Science Foundation Programme on Quantum Information Processing, the NWO project on Quantum Algorithms and Computational Complexity and NWO PhD project in 'Average-Case Complexity of Algorithms'. Wim van Dam and Ronald de Wolf will defend their PhD theses in 2001. Presently a project application on the theme of imperfect information games, semantics and complexity is under review with NWO. The two proposals submitted to NWO in 2000 were not granted, but in

the mean time alternative funding has been obtained for the UMEEPI project with W. Vree. We expect to fill one of the remaining open positions in the joint ILLC-CWI Quantum Computing project by this summer.

4.6 Reasoning with Uncertainty

Characterization

The main aim of this project is the analysis of reasoning with uncertainty in various settings, ranging from human cognition to artificial systems that can perceive and act. Technically, the work involves the construction of extension of probability theory and nonmonotonic logic; areas of application include robotics, psychology and linguistics. In the years 1994-1998 this project was funded by NWO in the Pionier-program; it now continues with support from ILLC.

Main Themes

The project studies various aspects of handling uncertain or incomplete information, with a focus on logical notions and techniques. The methods used can be summed up in the following slogan: 'Bringing probability into logic and vice versa'. More precisely, the guiding principle is that by enriching standard logic to include some general probabilistic notions one may hope to bridge the gap between certain and uncertain reasoning. Conversely, we investigate the usefulness of logical techniques, such as nonstandard analysis or generalized quantifiers, for the study of problems in for example probability theory. The program has both a theoretical and a more applied aspect; we hope to test intuitions and theoretical results concerning uncertain reasoning in areas such as robotics, where uncertain information already plays a prominent role, or linguistics, where the role of nonmonotonic reasoning is increasingly recognized. The program consists of four subprojects (1) Mathematical foundations of probability (2) Probabilistic concepts in the semantics of natural language (3) Reasoning about uncertainty in AI, in particular robotics and (4) Probabilistic methods in complexity theory.

Researchers

Michiel van Lambalgen, Frans Voorbraak.

PhD Students

Nikos Massios, Marco Vervoort.

External cooperation

The cooperations of this project include the robotics group IAS at the computer science department of the Universiteit van Amsterdam, as well as the Human Communications Research Centre in Edinburgh and the Seminar für Sprachwissenschaft in Tübingen.

2000

The subproject Mathematical Foundations of Probability is concerned both with infinite games with imperfect information and with reinforced random walks. This project was terminated in September 2000 upon the completion of Vervoort's dissertation. Several new results were obtained concerning the strength of the axiom 'all infinite games with imperfect information are determined'. Vervoort also did work on a grammar-learning algorithm originally proposed by Adriaans, which resulted in a much-improved algorithm; this appeared as Chapter 3 of the dissertation, and was presented at the 2000 SOFSEM conference. In connection with the theme Probabilistic Concepts in the semantics of natural language work has centered on analysing the data obtained in a series of experiments on actual human reasoning with logical constants performed with Keith Stenning at HCRC in Edinburgh. This resulted in a paper shortly to appear in the *Journal of Logic, Language and Information*, in which it is shown that existing explanations, from Bayesian probability to evolutionary psychology, all fail. Jointly with Fritz Hamm (Tübingen) we developed a semantics for nominalisation and the progressive, based on a unification of the event calculus and Feferman's theory of truth. We also continued work on formalisms unifying logic and probability theory, which resulted in a paper shortly to appear in the *Journal of Logic and Computation*.

Reasoning about Uncertainty in AI mainly falls under three headings: Partial Probability Theory, Autonomous Surveillance and Resource-bounded Belief Revision. Partial Probability Theory (PPT) is a formalism for handling uncertainty without requiring that the uncertainty is represented by a single, completely defined probability function. In this context, standard decision theoretic principles such as maximum expected utility fail; we have studied several alternatives, such as the Gamma minimax of robust Bayesian decision analysis, and are currently writing an overview paper which attempts to give a principled way to decide between alternatives. Autonomous Surveillance (research by Massios and Voorbraak performed jointly with the Autonomous Systems Group (IAS)) can be defined as a close monitoring of something or someone with the purpose of detecting the occurrence of some relevant events.

This year's harvest includes results on the effect of the layout of the environment on the complexity of the planning procedures. Last year the subproject Probabilistic Methods in Complexity Theory was redefined as a project on model theory. Zambella's book manuscript is growing and now includes stability theory.

2001

This project has been subsumed under a new project entitled Cognitive Systems and Information Processing, and its emphasis will shift toward the interplay between logic and cognitive science. Van Lambalgen's principal research activities will include the study of reasoning processes by means of physiological data, and the writing of a monograph (jointly with Hamm) on events in the semantics of natural language. Voorbraak will leave the project, and there will be a vacancy for a researcher on reasoning with uncertainty.

4.7 Applied Logic

Characterization

This project is concerned with applied logic in a broad sense. It includes the logical representation of existing scientific theories (mainly theories from sociology and organization theory); the development and use of computational tools that play an important role in realizing substantive applications; the development and use of non-classical logics that resonate closely with natural reasoning patterns, or enjoy properties that make them computationally feasible.

Main Themes

Three main themes are:

(1) Formalization of social science theories in formal logic. Social science discourse is exclusively in ordinary language (except, of course, for the mathematical theories in economics). As a result, the main theories are formulated in essay style articles and much of the discussion can be brought back to differences in their interpretation. To resolve some of these problems, there has been a concerted effort to axiomatize or formalize theories from the social sciences.

(2) A computational methodology of formal theory building. Computational support is instrumental in constructing, investigating and revising the above axiomatizations. There are investigations into the principal ways in which an initial formal rendition of a theory can give feedback for its own revision. This sheds some light on the question how to render an informal description into an

adequate formal representation. This question occurs in many fields, for example, it is one of the fundamental problems in artificial intelligence (think of the classical frame problem which gave rise to the development of nonmonotonic logic).

(3) Development and use of non-classical logics. Parallel to the use of classical logics, there are investigations into the development and use of modern non-classical logics that allow for a natural translation of the informal argumentation patterns. Computational complexity theory is an important tool to assess the adequacy of these translations.

Researchers

Michael Masuch, Rob Mokken, Breannán Ó Nualláin, Maarten Marx, Jaap Kamps.

PhD student

Ivar Vermeulen.

External cooperation

Internationally there is collaboration with UC Berkeley (Haas School of Business), Stanford University (Department of Sociology), Computer Science departments at Imperial and King's College, London, INRIA/LORIA, Nancy, France, University of Saarbrücken (Computational Linguistics), Institute of Cybernetics, Georgian Academy of Sciences and New Mexico State University. National collaborative ties exist with the universities of Rotterdam, Groningen and Twente, and the CWI in Amsterdam.

2000

Various scientific theories from the field of sociology have been formalized in (classical first-order) logic, such as Carroll and Hannan's resource-partitioning theory. The methodology of logical formalization is centered around the use of computational support. Our research strategy is to reuse existing automated reasoning tools that are available for first-order logic: Automated Theorem Provers and Automated Model Generators. In particular, we devised tools for coming to grips with the implicit background knowledge that is presupposed in traditional expositions of scientific theories.

A roadmap of computationally well-behaving non-classical logics, like guarded fragments, description and hybrid logics has been drawn. These logics were subsequently applied to several problem domains.

2001

The social sciences are characterized by a manifold of schools within which its members adhere to specific theoretical paradigms, resulting in incommensurability of theories, for example the use of incompatible concepts to describe the world, or the making of inconsistent claims. Earlier research provided first-order logic renditions of several influential organization theories. These axiomatizations have, so far, been treated independently. Our goal is to move beyond the scope of individual theory fragments, necessitating us to resolve the incommensurabilities by precisely analyzing the concepts and claims of different theories. We will systematically investigate interrelations between formal theories belonging to the same or to different paradigms. The tests we use to evaluate formal theories do not only prove a particular property, but also present specific proofs or models that are available for further inspection. We can use this feedback to repeatedly revise an initial formal rendition of a theory, resulting in a cyclic process in which the formal rendition and the original theory evolve in parallel. As a result, we move beyond the static picture of axiomatization as the ultimate step in a theory's life time. The axiomatization need not end the life of a theory, but rather contribute to its further development. On a broader scale, applying logic allows for evaluating the used logics themselves, both in terms of the reasoning patterns they yield and in terms of their inherent computational complexity. In order to better understand the nature of the hard computational problems, we investigate the structure of the problem spaces to locate critical regions and identify tractable subclasses.

4.8 Computational Logic

Characterization

This project is focused on uses of logic in computer science. Foundational work focuses on the development and implementation of algorithms, heuristics and testing methodologies for expressive, yet decidable logics. Evaluations are carried out from a theoretical angle (in terms of computational complexity, expressive power and descriptive adequacy) and from a more experimental angle, which involves extensive explorations of computational problem spaces, using both artificial laboratory settings and real-world domains such as telecommunications, information retrieval and electronic publishing.

Main Themes

Building on ILLC's traditional strength in modal logic, research within the 'computing with logic' theme is aimed at understanding the balance between

representations of complex domains on the one hand and computational efficiency of associated reasoning tasks on the other hand. The leading strategy is the development and deployment of dedicated ‘variable weight’ methods: methods that allow us to represent information at appropriate levels of detail and analysis, with suitable algorithms to match these representations. Such specialized methods are then combined, in a modular way, to address complex reasoning tasks. There is a major emphasis on ‘evaluating’ algorithms and heuristics, both by means of benchmarks and by means of real-world tests. A second theme, called ‘computing with content,’ aims to bring advances in natural language processing and computational logic to bear on information extraction and retrieval. Research within this theme explores combinations of natural language processing tools and spatial information for understanding the structure and content of electronic documents. There are further activities in the areas of semi structured databases, image retrieval, as well as structuring of and navigation through electronic documents. There are strong links with the projects Computation and Complexity theory and Information Processing. A final theme concerns ‘logic and programming.’ The aim of this theme is to study both foundations and applications of constraint programming. The foundational work concentrates on the design and implementation of an adequate programming environment for constraint programming and the application part concentrates on the use of constraint programming for various optimization problems drawing on integer programming techniques.

Immediate practical aims include: computational support for both logical and semantical modeling; development and analysis of test suits for evaluating reasoning methods; support for developing and maintaining electronic textbooks; setting up and maintaining setting suits; front ends for logic tools. Here there are links with work in the project ‘Applied Logic’.

Researchers

Krzysztof Apt, Carlos Areces, Lex Hendriks, Maarten de Rijke.

PhD Students

Sebastian Brand, Rosella Gennari, Willem Jan van Hove, Christof Monz, Jon Ragetli.

Grants

During 2000, the Computational Logic group received a number of major grants. First, Apt received two grants to continue and expand the Alma project. Second, a proposal, submitted by de Rijke and entitled ‘Simulating and Testing for Feature Interaction,’ was awarded by NWO; this project is aimed at

developing new methods for detecting feature interaction in telecommunication systems, based (in part) on satisfiability testing. Third, De Rijke received a grant to complete - together with Areces - a survey on computational methods for modal logics.

External cooperation

Academic external collaborations involved Alechina (Nottingham), Bernardi (Utrecht), Blackburn (Saarbrücken), Demri (Paris), Fisher (Manchester), Franceschet (Udine), Gabbay (London), Montanari (Udine), de Nivelle (Saarbrücken), Ohlbach (München), de Vries (CWI). Industrial collaborations involved Elsevier Science, KPN Research, Xerox Europe. Members of the group were involved with a large number of international initiatives, organizations and events, including the Association for Computational Linguistics (ACL), Advances in Modal Logic (AiML); the Association of Logic Programming (ALP); the European Association for Logic, Language and Information (FoLLI); the European Conference in Artificial Intelligence (ECAI); the International Federation on Computational Logic (IFCoLog); Computational Logic 2000, and Inference in Computational Semantics (ICoS).

2000

Within the theme ‘Computing with Logic’ theme resolution-based decision methods were developed for a variety of expressive description formalisms, including the (loosely) guarded fragment and modal fragments with assertional information. Novel heuristics based on the so-called tree model property were developed and their impact tested. Areces completed his PhD thesis, in which the relationship between description logics and so-called hybrid logics were studied. The relationship between classes of similar description languages were also studied by Kerdiles and de Rijke, using a variety of computational and logical criteria.

A more direct way of understanding the balance between representations and efficiency is by experimentally comparing the computational properties of different representations. This line is being pursued by Ó Nualláin in the setting of propositional logic and by Areces, Gennari, Heguiabehere and de Rijke in the setting of modal logic, where they exploited important semantic properties to optimize the performance of translation-based theorem provers.

One way of boosting the usability of restricted description languages is by working with combinations of such languages. Franceschet, Montanari, and de

Rijke studied model checking algorithms for combinations of modal and temporal logics.

In collaboration with KPN Research, expressive, yet decidable logics were used for the detection of feature interaction in telecommunication systems, where the main challenge is to represent and compute with, dynamic and possibly conflicting information from different sources in a controlled and efficient way; two complementary lines of attack were set up, one using constraint-based modeling, the other based on satisfiability testing.

The ‘computing with content’ theme saw the start of the second year of the NWO-funded project ‘Derive!’, which is aimed at bringing recent advances in natural language processing and computational logic to bear on information extraction and retrieval; it addresses the problem of finding content in natural language documents. Monz is the principal investigator on this project, and during 2000 he developed an experimental information retrieval workbench called FlexIR.

At the same time, Monz and de Rijke worked on the use of shallow or light-weight natural language processing tools for various goals in computational semantics. Aiello, Monz and Todoran explored combinations of natural language processing tools and spatial information for understanding the structure and content of scanned documents. In the area of semi-structured data, a modal logic perspective on the underlying data models was exploited to obtain significantly lower complexity bounds as well as improved algorithms. In collaboration with Chidlovskii (Xerox), Ragetli and de Rijke worked on automatically generating information extractors for identifying relevant content in result pages of web-based search engines. As part of the Logic and Language Links project funded by Elsevier Science, Ragetli and de Rijke studied the use of glossary-based navigation tools for exploring and organizing the contents of electronic handbooks; this led to a prototype implementation of a glossary based browser for the *Handbook of Logic and Language* developed by de Rijke. Further work here concerned the detection of content-bearing terms and on the automatic generation of hypertext links. Finally, Areces and Bernardi continued their collaboration on a logical and algorithmic analysis of structural reasoning in categorial grammars.

Within the ‘logic and programming’ theme, work on the Alma project continued; the Alma is aimed at realizing a strongly typed constraint programming language that combines the advantages of logic and imperative programming. At this stage

the first layer, Alma-0, is available. Alma-0 extends a subset of Modula-2 by features that facilitate writing programs that involve search. Gennari studied general frameworks for understanding and comparing algorithms aimed at solving constraint satisfaction problems. Together with van Eijck, Heguiabehera and Ó Nualláin continued their collaborative work on *Dynamo*, a language that implements a process interpretation of dynamic predicate logic.

2001

The balance between representation and algorithm continues to be a driving force in the area of computational and applied logic. Complex modeling tasks require both efficient computational support and a thorough understanding of what exactly turn a problem into a computational hard problem. Applications force us to develop novel ways of coping with reasoning problems near the boundaries of what is computationally feasible or even possible - this is true for our current application domains in logic, computing, sociology and industry as much as for new ones such as dynamic terminologies, question-answering systems and electronic publishing.

More concretely, extensive testing methodologies and environments are being set up to explore both purely propositional and modal problem spaces. Further test beds are being developed for feature interaction and information retrieval purposes and the latter will be linked to various initiatives involving digital libraries. At a more foundational level, different ways of combining reasoning engines will be studied and evaluated.

Further plans for 2001 include a substantial number of research proposals as well as a merger of the Computational Logic group with the Applied Logic Lab (ALL), to reflect existing research collaborations within ILLC.

4.9 Logic in Communication

Characterization

Logic in Communication is an interface project between the faculty of Humanities and the Faculty of Science, which aims at developing a core theory for the emerging science which studies information as such, independently of the boundaries between the traditional disciplines. The project is concerned with the formal study of communication and information flow. The objective is the development and study of formal mathematical tools for the analysis of communication in both natural languages (linguistics) and artificial ones (computation). With the objective of a calculus of information science, the

Amsterdam traditions in dynamic semantics (interpretation) and modal logic (information) and the reviving field of game theory (action) find a point of convergence.

Main themes

One of the essential properties of information is that it can be transferred or communicated from one agent to another. Thus, a central aim of the project is to develop and study formal models of such communication processes. It is clear that even the simplest forms of communication intertwine such diverse notions as knowledge, physical action and information change and that a multi-agent perspective is essential. Many interesting research problems arise from finding out how such features interact, in rich epistemic action logics that combine individual information states with collective ones. An example on the empirical side is our analysis of linguistic presuppositions as preconditions for successful information processing. The Amsterdam tradition in modal logic provides the backdrop to much of the formal modeling in the project, both of information structures and processes. Modal logic is pleasantly robust in its balance between expressive power and computational simplicity, while retaining a nice metalogic. Hence a large part of the group's research is performed within a framework of modal logic and related formalisms like dynamic logic, or the guarded fragment of the predicate calculus. One characteristic of our approach is the development of new systems 'in tandem' between modal logics and more classical languages, with a variety of tools from model theory, universal algebra and other technical sources. Finally, game theory forms an important research area within this project since it provides us with a framework that is on the one hand rich enough to be interesting for a general theory of communication and on the other hand restrictive enough to allow for a rigid and elegant mathematical analysis.

Researchers

Alexandru Baltag, Paul Dekker, Yde Venema.

PhD students

Annette Bleeker.

External cooperation

The group has intensive interaction with the research group of Hans Kamp (IMS, Stuttgart) and with colleagues in London (Imperial College, King's College and University College) and Saarbrücken. There are also strong connections with researchers at the CWI (Amsterdam) and the University of

Nijmegen and with Larry Moss and his colleagues at Indiana University (Bloomington).

2000

In 2000, we have continued to extend the reach of this paradigm, thus further increasing our grip on information flow from all perspectives.

In the area of modal logic proper, Maarten Marx and Yde Venema wrote a state of the art survey on decidability and complexity issues in modal logic. Yde Venema carried out foundational research on applications of game theory to axiomatization problems in modal logic; together with Ian Hodkinson and Szabolcs Mikulás he found a general method to obtain an axiomatization of the class of complex algebras of an arbitrary variety of algebras; in particular, this solves a problem concerning the axiomatization of so-called group relation algebras. Venema also proved that any modal logic in a language with polyadic operators can be simulated by an ordinary modal logic with diamonds; this simulation operator transfers most natural properties of modal logics.

Alexandru Baltag deepened our understanding of the connections between modal logic and co-algebras; by working with natural transformations between categories of co-algebras he drew an interesting landscape of co-algebraic modal logics. He also showed that the neighborhood semantics of non-normal modal logics finds a natural place within the co-algebraic framework.

Concerning the development of logics that formalize the combined notions of action and knowledge, Alexandru Baltag extended his systems to incorporate game theoretic issues. For instance, by adding nondeterminism to his epistemic action logic he managed to express several interesting game theoretic phenomena in his language, such as Nash equilibria in perfect information games, and rationalizability. Also, he can now use his calculus of epistemic processes, which he extended with features like parallelism and communication for game-theoretic applications, such as the derivation of the outcome of a game from a given strategy profile. Within this framework, Annette Bleeker extended her analysis of encrypted message passing. Yde Venema proved that van Benthem's conjectured axiomatization of game algebras is indeed complete. Different from Goranko's earlier proof, Venema shows that every abstract game algebra can be represented as a concrete collection of effectivity functions.

In the area of the theory of interpretation, Dekker, in joint collaboration with van Rooy, studied further issues on the semantics / pragmatics interface, and presented analyses in pragmatic, and game- and optimality theoretic terms. Firstly, a coherent formal model of the meaning of, update with and support for

first order information has eventually been completed. The model integrates and extends the major insights and tools of discourse representation theory and dynamic semantics with key concepts from the philosophical pragmatic tradition. Among other things, the system deals with the resolution of incomplete expressions. We have also given a formal characterization of the circumstances under which information exchange is sound, in the sense that received information, even if transmitted by means of open expressions, is grounded in the speaker's support for the utterances made. Conceiving of the linguistic (semantic/pragmatic) process of information exchange as the execution of a program, this determines the conditions under which the program is (provably) correct.

Secondly, Dekker furthered the study of the parallels between Dynamic Semantics and Game Theoretical Semantics. The outlook upon information exchange in dialogue as a game between interrogating and informing agents, enhances our understanding of some, at the face of it puzzling, facts about the effects of negations, questions, and conditional sentences upon anaphoric structure. Not only does this outlook motivate a kind of information structure which naturally blocks the presence of referential uses of terms figuring in these constructions, it also suggests a natural explanation of the cases in which this type of blocking is absent. Thus, simple systems of dynamic interpretation are naturally extended with functional terms (functional indefinites and functional pronouns), thus yielding an account of the notorious problem of quantificational (and other) subordination.

2001

In the year 2001 we intend to strengthen the above-mentioned research lines. Theoretical issues in the area of modal logic that we hope to address are the properties of modal fixed-point logics, co-algebraic modal logics and the connections between the two. With respect to game theory we plan to extend the philosophical foundations and the logical formalization of game-theoretic notions on the one hand, and the application of game theory in the study of communication processes on the other hand.

4.10 Education and Dissemination of Logic

Characterization

Dissemination of research results in logic (in the broad sense pursued at ILLC) in the form of innovative software-supported textbooks. Two larger aims are to contribute to the core of a new highschool curriculum on information sciences

and to experiment with new electronic media and document structures, in co-operation with surrounding organizations.

Main Themes

Production of pilot textbooks on themes deriving from ILLC research projects: such as Introduction to Logic, Language and Computation, Dynamic Logic and Semantics, Logic and Complexity, Parsing and Deduction. The new techniques here will draw on other ILLC projects, such as ‘Computational Logic’ (automated deduction) and ‘Information Processing’ (visualization techniques). Other research themes include optimal document structures and the establishment of a general-access computational infrastructure for logic textbooks. The first and second year (undergraduate and first year graduate) curriculum at ILLC is undergoing a major overhaul. The new courses put more emphasis on connecting the core topics of logic with computational concerns. From the perspective of ILLC, logic constitutes an integral part of the hard core of computer science and artificial intelligence. Links between theoretical issues and the practical concerns of computer scientists, cognitive scientists and researchers in AI abound. The new courses under development will highlight procedural aspects of logic, such as rule systems for deduction and tableau construction, pay more attention to the connections between logic and programming (logic programming, Prolog, constraint programming) and focus more closely on the use of formal definition in programming and implementation (e.g., in functional programming, or in methods of formal specification).

Plans are underway for a collaboration between Spinoza ‘Dissemination of Logic’ and Amsterdam University Press (Saskia De Vries). Van Eijck, Jaspars, Ketting and Pauly are producing the first of a small series of secondary school course books on various aspects of ‘Information in Context’. These books are intended as supplementary material in the area of information science, independent of existing coursebook methods and more geared towards displaying underlying principles and interconnections between various disciplines. It is the intention to make this booklet series into a collaboration effort of mathematicians, linguists, computer scientists and cognitive scientists and to illustrate by means of the series the idea of the multidisciplinary unity of information science.

Researchers

Jan van Eijck.

PhD students

Juan Heguiabehere, Marc Pauly.

External cooperation

The theme has a link to CWI, where Marc Pauly is involved in a Dynamic Logic and Games project, under the supervision of van Eijck and van Benthem. Other links are to Elsevier, via the Logic and Language Link project. Further ties exist with innovative courseware development enterprises at the university of Groningen, the Free University in Amsterdam, Utrecht University and the Dutch Open University. Cognitive psychological aspects of effective textbook presentation are studied in the context of existing ILLC cooperations with Edinburgh and Stanford. Strengthening of local contacts is foreseen with the Intelligent Systems Lab Amsterdam (document structures, postacademic courses) and with the Training Institute in Computer Science (course development).

2000

An important Dissemination of Logic theme during 2000 has been the integration of dynamic semantics of natural language on one hand and programming and (automated) reasoning with dynamic first order logic on the other. Dynamic first order logic, adopted from computer science more than a decade ago for purposes of natural language analysis, has received a new twist in the study of programming with DFOL. Programming with DFOL holds a promise both for computer science and for natural language analysis. For computer science, it offers a new perspective on programming with logic. For natural language semantics, it offers a new, more computational turn to the process of meaning representation and it suggests that query languages for computation and question answering in natural language can brought still closer together. In 2000, tableau style calculi for DFOL were developed that may serve as an underpinning of dynamic logic programming.

2001

Important aims for 2001 are the production of the first volume of the secondary school book series 'Information in Context' with Amsterdam University Press (a draft version is available from <http://www.cwi.nl/~jve/AUP/crr>; this is now used for trial runs at a number of Dutch secondary schools), and the further restructuring and modernization of the ILLC logic core curriculum.



Krzysztof R. Apt

Feeling the Mood: Some Personal Impressions on Constraint Propagation

I got interested in the subject of constraint processing in late 1996 and gave in 1997 a course on “Programming with Constraints” for students of the third and fourth year. Constraints have been studied in Artificial Intelligence starting from the seventies. The central notion is that of a constraint satisfaction problem (CSP). A CSP consists of a finite set of constraints, which are simply relations over some domains. A solution to a CSP is a sequence of values from the underlying domains that satisfies each constraint after projecting it on the relevant domains. The task of constraint programming consists of formulating the initial problem as a CSP and of solving it by means of general or domain specific methods. “Solving” can mean finding a solution, all solutions or the best solution w.r.t. some cost function.

In the case of CSP’s on finite domains by writing all possibilities in the form of a (decision) tree we end up with a, in general, huge search space. One of the general methods used to reduce the size of this search space is called constraint propagation and the algorithms that achieve such a reduction are called constraint propagation algorithms. So these algorithms attempt to limit the combinatorial explosion. Which type of constraint propagation is used depends on the initial choice of constraints and domains and on the applications. Intuitively, the constraint propagation algorithms aim at achieving some form of “local consistency”. In the literature some two dozens of notions of local consistency were proposed and for each of them one or more algorithms that achieve it.

When studying the constraint propagation algorithms presented in the book “Foundations of Constraint Satisfaction” by E. Tsang it struck me that many of them are suspiciously similar. It slowly dawned upon me that there might be a general framework in which one could explain them.

After a couple of months I found such a general framework that allowed me to deal satisfactorily with the constraint propagation algorithms that aim at the reduction of the variable domains. It involved functions defined on Cartesian products of partial orders. These functions were assumed to satisfy simple properties of monotonicity and inflationarity, and a generic algorithm could be used to schedule them in such a way that their least common fixpoint is computed. By instantiating the partial orders and the functions in an appropriate way we could obtain then specific constraint propagation algorithms.

Then, to my disappointment, I found that most of this was already understood by researchers in Nantes and in Novosibirsk, though, admittedly their papers were pretty recent. But then, after an illuminating correspondence with Rina Dechter, one of the pioneers in the field of constraint processing, I suddenly realised that in my framework I can also explain another form of constraint propagation that involves addition of redundant constraints. Moreover, I found that some notions of local consistency are actually defined in terms of non-idempotent functions whereas the other approaches always assumed idempotence. So in the end I had a more general framework.

Such a general framework has various advantages: it can be used to verify, compare, parallelize, and derive various constraint propagation algorithms. Moreover, it allows to view a number of techniques used in mathematics and computer science, such as Gaussian elimination, unification algorithm, Fourier-Motzkin elimination, resolution principle, the cutting planes technique of integer programming as instances of constraint propagation.

This work led to an article that initially appeared as an invited talk in the proceedings of the ICALP '97 conference. A further research in the library revealed that the search for a common framework for constraint propagation actually can be traced to the beginning of the subject and the work on it has spanned more than twenty years. But nobody seemed to have dealt with all aspects in one framework. In the final version of this paper, published in the Theoretical Computer Science journal in 1999 I spent three pages trying to retrace the search for this uniform framework in a string of papers in which many of the contributions were forgotten, some were done in parallel and some were rediscovered.

While lecturing to students on this subject in 1998 I realized that one fine aspect of the perhaps best known constraint propagation algorithm, called AC-3, is not explained by the general frameworks so far proposed, including mine. This led me to a further study that ended only last year in December when I sent to the publisher the final version of a paper entitled "The Role of Commutativity in Constraint Propagation Algorithms" that will appear in the ACM Transactions on Programming Languages and Systems. In this paper I succeeded to simplify the previous framework and was able to show that the AC-3 algorithm and a number of other constraint propagation algorithms implicitly exploit the commutativity of some of the scheduled functions.

So in the end it took me almost 4 years to properly understand the AC-3 algorithm. But I hope that this generic account of this and other constraint propagation algorithms will be of relevance still 4 years from now on.

Chapter 5 EDUCATION AND COMMUNICATION

Graduate Program in Logic

The Graduate Program in Logic is an international study program organized by ILLC. It includes a PhD program, a MSc program, a Certificate program and the possibility for exchange or contract students to spend a semester/year at ILLC. It offers courses and research in foundations of mathematical and philosophical logic and their applications in computer science, linguistics and cognitive science.

Master of Science program

The MSc program is a full year program, consisting of course work and a Master of Science thesis. The required background is at least a Bachelor's or equivalent degree in computer science, mathematics, philosophy or linguistics. All applicants must have a strong academic record. The amount of time needed to complete the program varies and will depend on previous academic training. Earning a MSc degree will take a student a minimum of twelve months. Sometimes more time is required to complete a Master's. Because the program is interdisciplinary, there is a lot of freedom in a student's choice of courses. The student gets a highly individualized program which is developed in interaction with a personal study advisor. This advisor is always one of the ILLC faculty members.

The Certificate Program.

This program is especially designed for advanced undergraduate students with at least two years of academic training in a relevant field, who would like to earn extra credits abroad. A certificate is awarded after the completion of six courses, the choice of courses is up to the student. A student usually takes two courses per trimester, so that the Certificate is earned in one academic year (ten months). Students may also take courses for a shorter period of time, such as one or two trimesters, without the intention of qualifying for a degree. This option is of special interest to exchange and contract students.

PhD Program.

As in most PhD programs, the work in the ILLC PhD program is divided into two parts. Firstly, the student acquires a fairly broad but rigorous working knowledge in the field of logic and its applications. ILLC organizes this part of the PhD program in cooperation with the Dutch Graduate School in Logic (OZSL, see below). This school offers a national program of courses, colloquia,

workshops and annual PhD conferences (all in English). Secondly, the student carries out original research and writes a dissertation under the guidance of two dissertation supervisors. During the first year of the program, the emphasis is on the first part and from the second year onwards, the emphasis is on dissertation work.

In the 1999/2000 academic year 14 MSc students, 6 exchange students and 4 contract students were enrolled. From the MSc students, 10 received their MSc degree, 3 will graduate in 2001 and 1 student stopped his MSc studies and continued as contract student.

The 2000/2001 the program was attended by 15 MSc students, 6 exchange students and 2 contract students.

In 2000 ILLC had 25 PhD students. The following dissertations were successfully defended:

1. Renata Wasserman, *Resource Bounded Belief Revision*
2. Jaap Kamps, *A Logical Approach to Computational Theory Building (with applications to sociology)*
3. Marco Vervoort, *Games, Walks and Grammars: Problems I've Worked On*
4. Paul van Ulsen, *E. W. Beth als logicus*
5. Carlos Areces, *Logic Engineering. The Case of Description and Hybrid Logics*
6. Hans van Ditmarsch, *Knowledge Games*
7. Egbert L.J. Fortuin, *Polysemy or monosemy: Interpretation of the imperative and the dative-infinitive construction in Russian.*

Information about the Graduate Program in Logic can be found at <http://www.illc.uva.nl/gpil>

PhD training and the OZSL

The PhD training of the ILLC takes place in collaboration with the Dutch Graduate School in Logic (OZSL). The director of the school is Jan van Eijck (Amsterdam/Utrecht). ILLC's managing director, Peter Blok, is the secretary. ILLC researchers are very active in the educational program of OZSL, and ILLC also houses the bureau of the school.

Partners in the Dutch Graduate School in Logic

- the Institute for Logic, Language and Computation (ILLC), Universiteit van Amsterdam

- the Research Institute for Language and Speech, section Computational Linguistics and Logic, of the Faculty of Arts of Utrecht University
- the Institute for Mathematics and Computer science (IWI), incorporating the Faculty of Mathematics and Natural Sciences of the University of Groningen
- the Institute for Behavioral and Cognitive Neurosciences (BCN) incorporating the Faculty of Mathematics and Natural Sciences, Medicine, Arts and Psychology and Philosophy of the University of Groningen,
- the Centre of Language and Cognition Groningen incorporating the Faculty of Arts of the University of Groningen (participation through BCN)
- the Center for Mathematics and Computer Science (CWI), Amsterdam
- the Faculty of Computer Science of the Free University of Amsterdam
- the Faculty of Philosophy and Faculty of Arts of Tilburg University
- individual associates of the University of Leiden and the University of Nijmegen

The Educational Program

The OZSL organizes one or two schoolweeks yearly, and a varying number of masterclasses throughout the year. Also, the OZSL is heavily involved in the European Summer Schools of Logic, Language and Information (ESSLLI). In 2000, ESSLLI (the 12th European Summer School in Logic, Language and Information, organized by FoLLI), took place in Birmingham.

The OZSL Autumn Schoolweek of 2000 took place October 23-27 in Hotel Dennenhoeve in Nunspeet. This event offered a broad range of tutorials and discussion opportunities, up-to-date overviews of the Staff and PhD research carried out within the school (Staff Accolade and Accolade New Style), an occasion for social interaction between PhD students, and an occasion to meet staff. In detail, the following events took place:

- *Staff Accolade*, moderated by Maarten Marx
- *Three Lectures on Coalgebra*, by Bart Jacobs and Jan Rutten.
- *Almost sure validities and 0-1 laws of logical properties on finite structures*, by Valentin Goranko
- *The Use of Logic in Linguistics*, discussion moderated by Albert Visser.
- An afternoon with Samson Abramsky.
- *Games Afternoon* (event organized by Paul Dekker and Yde Venema.
- *PhD Accolade*, moderated by Raffaella Bernardi and Joost Joosten.

Communication and Contacts

Publications

The official publications of the institute encompass a series of research reports, a series of technical reports a series of Master of Logic theses and a dissertation series. At the end of 2000, the ILLC dissertation series, which has been set up in 1993, contained 62 titles. 15 research reports and 4 technical notes appeared in 2000. Research reports are published under the header of PP (Prepublications), technical notes under the heading X. 6 Master of Logic theses were published (code MoL). Coordinating editor of these series is Dick de Jongh. Marco Vervoort is executive editor. All theses and reports can be downloaded from <http://www.illc.uva.nl/Publications/> or ordered from the ILLC Bureau. The Applied Logic Lab has its own series of pre-publications, the ALL/CCSOM Prepublication Series. In 2000, 6 new reports appeared. A list of all reports can be found in appendix 2.

Communication and publicity

For internal and external communication and publicity, we use the following media:

- ILLC-List, an electronic newlist (for internal use only);
- Logic in the Netherlands: the newsletter of the Graduate School in Logic;
- The webpages of ILLC <http://www.illc.uva.nl/>
- ILLC Magazine: a magazine for alumni, appearing twice a year;
- The annual Spinoza report/brochure Logic in Action;
- The annual catalogue Graduate Program in Logic.

Colloquia

Regular meetings at which both ILLC-staff and visitors meet and exchange ideas and results, are one of the back-bones of the scientific activity of the ILLC-community. The following series of colloquia, lectures and workshops, form the core of ILLC's activities in this area. They are complemented by informal meetings on an ad-hoc basis.

- Computational Logic Seminar, weekly;
- Seminar on Games and Logic, bi-weekly;
- Dynamo Workshop, weekly;
- The DIP Colloquium (Discourse Processing), bi-weekly.

Workshops

In 2000, ILLC organized nine workshops and other conferences of which an overview can be found in appendix 3.

International Embedding

FoLLI

ILLC provides coordination for the European Association of Logic, Language and Information (FoLLI). During 2000 FoLLI's activities included:

- Organization of an annual Summer School in Logic, Language and Information. The 12th Summer School was held in Birmingham (England), from 9 to 18 August
- Launch of the FoLLI Newsletter, edited by Alexander Koller (newsletter@folli.org)
- Sponsoring of the Journal of Logic, Language and Information (JoLLI)
- Sponsoring of a series Studies in Logic, Language and Information (SiLLI) of lecture notes and monographs, published by CSLI
- Supporting an electronic news service in the field (Colibri)
- Acting as a Clearing House for scientific information (this function is provided by the logic group at Imperial College, London)
- Sponsoring scientific events such as WoLLIC

In 2000, the Executive Board of FoLLI had the following composition: Paul Gochet (President), Phillipe Blache, John Nerbonne, Jörg Siekmann, Eva Hajicova (chair Standing Committee), Dag Westerståhl (editor-in-chief of the Journal), Maarten de Rijke (managing editor of the book series), Dov Gabbay (coordinator Clearing House).



Breanndán
Ó Nualláin

Feeling the Mood: Empirical Logic

Some weeks ago, while cycling to and from the institute through the streets of Amsterdam, I noticed how the canals almost froze over, only to thaw again. While the temperature remained below zero for several days, the water slowly, but surely, turned to ice. But then the wind veered to the west, the temperature rose above zero and the ice, much to the frustration of skating enthusiasts, could not resist melting back into water.

The fact that water, and indeed other substances, can exist in such distinct states is interesting in its own right, but it is particularly curious that the change from one state to another can be brought about by a tiny change in temperature. Ice will not persist at a fraction of a degree above zero, while liquid water succumbs at just a fraction of a degree below. The change is abrupt; physicists speak of a *phase transition* between the solid phase and the liquid phase.

The physics of phase transitions resisted mathematical description for quite some time. The problem was first considered by Laplace but it was not until Van der Waals' dissertation, *Over de continuïteit van den gas en vloeistofoestand*, that the first model was proposed which permitted a phase transition. Van der Waals later became professor of physics here at the University of Amsterdam and won the Nobel prize for his work in 1910. The model has since been superseded by more quantitatively accurate models, most notably by the Ising model.

Now phase transitions would seem to be purely physical phenomena, so when I happened upon an article several years ago claiming to describe phase transition behaviour in a computational system, I was intrigued.

The computational problem was the satisfiability problem for propositional logic (SAT for short). The investigators had taken a restricted form of SAT, called 3SAT, which consists of instances in clause form, each clause having exactly 3 literals. They randomly generated instances of 3SAT with varying numbers of clauses and variables, and looked at whether the instances were predominantly satisfiable or not.

They found a striking result. When the ratio of clauses to variables was greater than about 4.25, almost every instance was unsatisfiable; when the ratio was lower, almost every instance was satisfiable. This ratio can be varied smoothly as a kind of "temperature," but only when the "temperature" crosses the critical value do the 3SAT instances move from the "satisfiable phase" to the

“unsatisfiable phase.” Moreover, problem instances around the phase transition turn out to be much harder to solve than those away from it.

The phenomenon can be explained by stretching the physics metaphor. Each variable can be regarded as a degree of freedom and each clause as a constraint. When the number of constraints is high relative to the number of degrees of freedom, the problem instance is *overconstrained* and it is very unlikely that a satisfying assignment exists. On the other hand, when there are relatively few constraints, the problem instance is *underconstrained* and it is likely that any assignment will satisfy. In both cases instances can be solved relatively easily. It is the instances from the critical region around the phase transition which are much much harder.

This leads to an interesting line of research. Choose a computational problem and one or more algorithms for solving that problem. Generate instances of the problem from some random ensemble and observe the performance of the algorithms on those instances. Form some hypotheses based on the data and then devise and conduct experiments to test those hypotheses. In short, apply the *empirical method* to the study of computational logic using the computer as laboratory.

Using this approach we can map the space of instances of a problem. This leads to *a priori* methods for estimating how difficult a given problem instance will be to solve. Such a judgement may recommend one algorithm over another for solving the instance or, in general, allow Bayesian methods to be applied to optimize a portfolio of algorithms.

One final point. Since the phase transition phenomenon has been observed in two such different systems (one computational and one physical), one could ask whether there is an underlying mechanism which gives rise to it. And indeed there is. In fact a variant of the Ising model from Statistical Physics can be shown to capture 3SAT.

But the essence of the mechanism is that both systems are composed of a large number of component parts which can combine in many ways. The instances of 3SAT considered consist of several hundred clauses, while the canals of Amsterdam contain some 10^{30} or so water molecules. (This difference in scale leads to a much sharper phase transition for water than for 3SAT.) The statistical properties of the combinatorics of systems of many elements give rise to these emergent phenomena. The combinatorial basis for phase transitions can be found in the existence of threshold functions in the theory of Random Graphs, a field pioneered by Erdhős and Rényi. Computation, viewed as graph exploration, adds a new and interesting dimension.



Chapter 6 FACTS, FIGURES AND THOUGHTS

Input

The year 2000 was a remarkable one for ILLC in some respects. As can be seen from figures 6.1 and 6.3, the total staffing decreased with approximately 20% compared to 1999. There are various reasons for this. Quite a number of PhD and post-doc projects ended in the course of 2000. This was the case in both first and second stream funding. Because of budgetary problems in all participating faculties, the appointment of new PhD students was delayed significantly. Two positions in the permanent staff that became vacant in 2000 had to be left open temporarily due to insufficient first stream funding. Moreover, a vacant assistant professorship in the faculty of Social Sciences can not be occupied during period of the current research program, i.e., until 2004. The effects of the university's yearly 2% cut on research funding will also negatively influence ILLC's first stream funded staff in the next three or four years. The consequences are dire. Not only does the number of permanent staff decline, also the representation of various age classes becomes even more off

Figure 6.1
Human Resource
Input 2000 fte

	<i>Funding</i>	<i>GW/TF</i>	<i>GW/LC</i>	<i>GW/AI</i>	<i>FMG/ALL</i>	<i>NWI/LTI</i>	<i>Total</i>
<i>Full professor</i>	1	1,50		1,00		3,00	5,50
	2						0,00
	3				0,10	0,20	0,30
<i>Associate professor</i>	1	1,00	1,00	1,00	1,00	1,80	5,80
	2						0,00
	3						0,00
<i>Assistant professor</i>	1	0,30	0,70			2,60	3,60
	2					2,00	2,00
	3						0,00
<i>Postdoc</i>	1					1,40	1,40
	2	3,50	0,45	1,50	1,50		6,95
	3						0,00
<i>PhD student</i>	1	1,55	2,00		1,00	4,92	9,47
	2			0,58		3,00	3,58
	3		0,25			0,67	0,92
<i>Other</i>	1				1,00		1,00
<i>Total</i>		7,85	4,40	4,08	4,60	19,58	40,52

Figure 6.1 represents total staff in full time equivalents (human resource input).
A key to the symbols can be found on page 59.

balance than it already is. One main concern for the future therefore is to appoint young people, especially on permanent positions.

But there is good news too. In 2001 one of the vacant positions just mentioned will be filled. And although the number of permanent staff will probably remain at a lower level, ILLC is doing extremely well in finding additional funding for its research. In 2000 there were a number of successful applications: 4 postdocs and 6 PhD positions were granted. Many of these researchers will start in 2001.

Figure 6.2
Resource Input fte

	<i>Funding</i>	<i>GW/TF</i>	<i>GW/LC</i>	<i>GW/AI</i>	<i>FMG/ALL</i>	<i>NWI/LTI</i>	<i>Total</i>
Full professor	1	0,75		0,50		1,50	2,75
	2						0,00
	3				0,10	0,10	0,20
Associate professor	1	0,50	0,50	0,50	0,40	0,90	2,80
	2						0,00
	3						0,00
Assistant professor	1	0,15	0,07			1,25	1,47
	2					1,00	1,00
	3						0,00
Postdoc	1					0,90	0,90
	2	3,50	0,45	1,50	1,50		6,95
	3						0,00
PhD student	1	1,24	1,80		0,80	3,93	7,77
	2			0,58		3,00	3,58
	3		0,20			0,67	0,87
Other	1				1,00		1,00
Total		6,14	3,02	3,08	3,80	13,25	29,29

Figure 6.2 gives the research time in full time equivalents (research input)

The research input (RI) is connected to the human research input (HRI) in the following way. Per default, regular staff spends 50% of its time on research. Some staff may have deviating arrangements, which are of course incorporated in the figures. Temporal staff (mainly postdocs) and PhD-students spend 100% of their time on research. Moreover, with appointments of 0.2 fte or less, all time is supposed to be dedicated to research.

The first column lists the ranks. The second column represents the source of funding ("geldstroom"):

1 = direct funding from university

2 = funding by KNAW or NWO

3 = funding from external sources

The departments are the following:

FGW/TF= Philosophy of Language, Faculty of the Humanities

FGW/LC = Logic and Cognition, Faculty of the Humanities

FGW/AI = Computational Linguistics, Faculty of the Humanities

FMG/ALL = Applied Logic Lab, Faculty of Social and Behavioural Sciences

FNWI/LT = Logic and Theoretical Computer Science, Faculty of Science.

Figure 6.3
Resource Input fte

1998	1999	2000	2001 (expected)
47,5	50,6	40,5	55

Given these developments the total staff of the institute will probably be around 55 full time equivalents (f.t.e.) in 2002. But the composition with respect to age, the ratio permanent – temporary staff and the distribution over the various funding sources will have changed considerably.

Output

As for the scientific output (fig 6.4 and fig 6.5), we see that the absolute number of publications has dropped. However, relative to the number of fte's it has decreased less dramatically, from 2.7 per fte in 1998 and 1999 to 2.4 in 2000. Other scientific activities, such as talks and presentations, remain at a high level and the number of publications is expected to pick up again in 2001–2002, when more staff will be employed.

Figure 6.4 Scientific
Output 2000

Refereed publications	96
Edited volumes	7
Technical Reports and other publications	48
Dissertations	7
Talks	210
Editorships	39
Program Committee Memberships	29
International Functions	34
(International) Events Organized	17

Figure 6.5 Scientific
Output 1998-2000

	1998	1999	2000
Refereed publications and books	132	149	103
Talks	218	172	210
Dissertations	5	4	7

In 2000, five ILLC-PhD students successfully defended their theses. In addition two theses were completed outside the institute under supervision of ILLC staff. The prognosis for 2001 is that eight dissertations will be defended.

Grants and Awards

NWO Sciences:

Krzysztof Apt, *ALMA-0 and New Foundations for Declarative Programming*
 Krzysztof Apt, Farhad Arbab (CWI), E.B.G. Monfroy (CWI), *Coordination-based Parallel Constraint Solving*
 Maarten de Rijke, Krzysztof Apt, *Simulation and Testing for Feature Interaction*
 Paul Vitányi, *Universal Learning*
 Yde Venema, Bart Jacobs (KUN), Jan Rutten (CWI), *Coalgebraic Modal Logic: Theory and Applications*

NWO Humanities:

Johan van Benthem, *De kennis en rationaliteitsaanname van speltheoretische oplossingsconcepten*

KNAW fellowship:

Robert van Rooy, *Games, Relevance, and Meaning*

NWO postdoc position:

Jaap Maat, *Leibniz' opvattingen over formele en natuurlijke talen*

NWO "Vernieuwingsimpuls" (1 senior researcher, 1 postdoc and 1 PhD student or 2 PhD-students; plus extra computer support):

- Paul Dekker, *Formal Language Games*
- Rens Bod, *Towards a Unifying Model for Linguistic, Musical and Visual Processing*

FoLLI Outstanding Dissertation Award:

Jelle Gerbrandy, *Bisimulation on Planet Kripke*
 Khalil Sima'an, *Learning Efficient Disambiguation*



APPENDIX 1 PUBLICATIONS

1 Theory of Interpretation

Refereed publications

- M. Aloni. Conceptual covers in dynamic semantics. In Patrick Blackburn and Jerry Seligman, editors, *Logic, Language and Computation, Vol. III*. CSLI, Stanford, CA, 2000.
- R.I. Bartsch. Generating Polysemy: Metaphor and Metonymy In Regine Eckardt and Klaus Heusinger, editors, Volume I of *Arbeitspapiere*, Universität Konstanz, Fachbereich Sprachwissenschaft, Sonderforschungsbereich 471, 2000.
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- J. Groenendijk and M. Stokhof. Meaning in Motion. In Klaus von Heusinger and Urs Egli, editors, *Reference and Anaphoric relations*, pages 47–76. Kluwer Academic Publishers, 2000.
- H.L.W. Hendriks. Compositionality and Model-Theoretic Interpretation. *Journal of Logic, Language and Information*, 9(4):419–438, 2000.
- T. M.V. Janssen. An algebraic approach to grammatical theories for natural language. In A. Nijholt, D. Heylen and G.S. Scollo, editors, *Algebraic Methods in Language Processing. Proceedings 16th Twente workshop on language technology, Iowa City, USA, May 2000*. Computer Science, Twente University, 2000.
- J. Maat and D. Cram. Universal Language Schemes in the Seventeenth Century. In S. Auroux, K. Koerner, H-J. Niederehe, K. Versteegh, editors, *History of the Language Sciences, An International Handbook on the Evolution of the Study of Language from the Beginnings to the Present*. De Gruyter, Berlin-New York 2000.
- R.A.M. van Rooy. Decision Problems in Pragmatics. In Massimo Poesio and David Traum, editors, *Proceedings GötaLog: Fourth Workshop on the Semantics and Pragmatics of Dialogue*, 2000.

- R.A.M. van Rooy. Permission to Change. *Journal of Semantics*, (1), 2000.
- M.J.B. Stokhof. Ludwig Wittgenstein. In M. Keestra, editor, *Tien Westerse Filosofen*. Nieuwe Zijds Uitgeverij, Amsterdam, 2000.
- M.J.B. Stokhof. *Taal en Betekenis*. Boom, Amsterdam, 2000.

Dissertations

- Egbert L.J. Fortuin *Polysemy or monosemy: Interpretation of the imperative and the dative-infinitive construction in Russian*. PhD thesis, ILLC dissertation series 2000-07, University of Amsterdam, Amsterdam, 2000.

Other publications

- E.C.Brouwer. Voorbij de zweepantenne: Katharsis II. In *Katharsis II/Niek Kemps*. Rijksgebouwendienst, 2000.

2 Cognitive Systems

Refereed publications

- A.M. Tamminga. Finite State Belief Dynamics. In Catherine Pilière, editor, *Proceedings of the ESSLLI-2000 Student Session*, Birmingham University, August 2000.

Other publications

- S.D. Zwart. Geloofsrevisie en waarheidsgelijkenis, <http://www.leidenuniv.nl/philosophy/filosofiedag/acta3.html>

3 Information Processing

Refereed publications

- R. Bod. Context-Sensitive Spoken Dialogue Processing with the DOP Model. *Journal of Natural Language Engineering*, 5(4), 2000.
- R. Bod. Combining Semantic and Syntactic Structure for Language Modeling. *Proceedings International Conference on Spoken Language Processing (ICSLP'2000)*, Beijing, China, 2000.
- R. Bod. An Improved Parser for Data-Oriented Lexical-Functional Analysis. *Proceedings ACL'2000*, Hong Kong, China, 2000.

- R. Bod. Parsing with the Shortest Derivation. *Proceedings COLING'2000*, Saarbrücken, Germany, 2000.
- R. Bod. An Empirical Evaluation of LFG-DOP. *Proceedings COLING'2000*, Saarbrücken, Germany, 2000.
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Dissertations

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Other publications

- D.H.J. de Jongh. Learning and Grammar. In J.F. Quesada, F.J. Salguero, and A. Nepomuceno, editors, *Logic, Language and Information, Proceedings of the First Workshop on Logic and Language*, number 2000-

01 in ILLI-PR, pages 139–146. Instituto de Lógica, Leguaje e Información, Universidad de Sevilla, Editorial Kronos, Sevilla, 2000.

- E. Hoogland and M. Marx. Interpolation in guarded fragments. Technical Report PP-2000-11, Institute for Logic, Language and Computation, University of Amsterdam, 2000. Also project ‘Applied Logic’.
- J.F.A.K. van Benthem. *Explaining language by economic behaviour*, pages 93–107. Cambridge University Press, 2000.
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- P. Gács, J. Tromp, and P.M.B. Vitányi. Towards and algorithmic statistics. In Proceedings ALT 2000, volume 1968 of *Lecture Notes in Artificial Intelligence*, pages 41–55. Springer-Verlag, Berlin, 2000.
- Q. Gao, M. Li, and P.M.B. Vitányi. Applying MDL to learning best model granularity. *Artificial Intelligence*, 121(1-2):1–29, 2000.
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6 Reasoning with Uncertainty

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- F.P.J.M. Voorbraak. Partial probability: theory and applications. *International Journal of Uncertainty and Knowledge-Based Systems*, 8(3):331–345, 2000.

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- R. Wassermann. *Resource Bounded Belief revision*. PhD thesis, ILLC dissertation series 2000-01, University of Amsterdam, Amsterdam, 2000.

Other publications

- M. van Lambalgen and F. Hamm. Event calculus, nominalisation and the progressive. Available at <http://www.semantics.archive.net>. 76 pages. December 2000.
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7 Applied Logic

Refereed publications

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- I.E. Vermeulen and J. Bruggeman. The Logic of Organizational Markets: Thinking Through Resource Partitioning Theory. Technical Report 0B17, Research School Systems, Organisation and Management, 2000.

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8 Computational Logic

Refereed publications

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- K.R. Apt and A. Schaerf, Programming in Alma-0, or Imperative and Declarative Programming Reconciled, in D. M. Gabbay and M. de Rijke, editors, *Frontiers of Combining Systems 2*, Research Studies Press Ltd, pages 1–16, 2000.
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- S. Bistarelli, R. Gennari, and F. Rossi. Constraint Propagation for Soft Constraint Satisfaction Problems: Generalization and Termination Conditions. In *Proceedings of the 6th International Conference on Principles and Practice of Constraint Programming*, volume 1894 of *Lecture Notes in Computer Science*. Springer-Verlag.

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- B. Chidlovskii, J. Ragetli, and M. de Rijke. Automatic wrapper generation for web search engines. In *Proceedings International Conference on Web-Age Information Management (WAIM'00)*, LNCS. Springer, 2000.
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- K.R. Apt, A.C. Kakas, E. Monfroy and F. Rossi, editors.. *New Trends in Constraints, Lecture Notes in Artificial Intelligence 1865*, Springer (2000), x + 339 pages, 2000.

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- C. Monz and M. de Rijke, editors. *Inference in Computational Semantics 1. Special issue of Journal of Language and Computation dedicated to ICoS-1, volume 1, issue 2, 2000, 2000.*
- M. Zakharyashev, K. Segerberg, M. de Rijke, and H. Wansing, editors. *Advances in Modal Logic, Volume 2.* CSLI Publications, 2000.

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Other publications

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- C. Monz and M. de Rijke. Editorial: Inference in computational semantics. *Journal of Language and Computation*, 2:159–165, 2000.
- H. de Nivelle and M. de Rijke. The Boyer-Moore theorem prover. In M. Hazewinkel, editor, *Encyclopedia of Mathematics, Supplement II*, pages 83–84. Kluwer, 2000.
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9 Logic in Communication

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- A. Baltag. A Logic for Suspicious Players. In G. Bonanno, W. van der Hoek, editors, *Proceedings of The Fourth Conference on Logic and the Foundations of the Theory of Games, LOFT 4*, pages 21–23, 2000.
- P.J.E. Dekker. Coreference and representationalism. In Klaus von Heusinger and Urs Egli, editors, *Reference and Anaphorical Relations*. Kluwer, Dordrecht, 2000.
- P.J.E. Dekker. The semantics of dynamic conjunction. In Jerry Seligman and Patrick Blackburn, editors, *Logic, Language and Computation, Vol III*, pages 105–125. CSLI, Stanford, CA, 2000.
- P.J.E. Dekker. Support for update semantics (house version). In Massimo Poesio and David Traum, editors, *Proceedings of GötaLog 2000*, pages 5–12, Göteborg, 2000. Department of Linguistics.

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Other publications

- A. Baltag A logic for suspicious players: epistemic actions and belief-updates in games. CWI Technical Report SEN-R0044, CWI, Amsterdam, December 2000
- A.M. Bleeker and D.J.N. van Eijck. The epistemics of encryption. Technical Report PP-2000-08, ILLC, 2000. Technical Report INS-R0019, CWI, 2000.
- I. Hodkinson, Sz. Mikulás, and Y. Venema. Axiomatizing complex algebras by games. Technical Report PP-2000-1, 2000.
- M. Marx and Y. Venema. Local variations on a loose theme: modal logic and decidability. Technical Report PP-2000-9, Institute for Logic, Language and Computation, University of Amsterdam, 2000. Also project ‘Applied Logic’.
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10 Education and Dissemination of Logic

Refereed publications

- C.E. Areces, R. Gennari, J.M. Heguiabehere, and M. de Rijke. Tree-based heuristics in modal theorem proving. In *ECAI 2000. Proceedings of the 14th European Conference on Artificial Intelligence*. IOS Press, 2000. Also project ‘Computational Logic’.
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- D.J.N. van Eijck, J.M. Heguiabehere, and B. Ó Nualláin. Theorem proving and programming with dynamic first order logic. In María Alpuente, editor, *Functional and Logic Programming: Ninth International Workshop, WFLP’2000, Benicàssim, Spain, September 28–30, 2000*, pages 56–71. Universidad Politéchnica de Valencia, 2000.

- D.J.N. van Eijck. Making things happen. *Studia Logica*, 66:41–58, 2000.
- D.J.N. van Eijck. The proper treatment of context in NL. In Paola Monachesi, editor, *Computational Linguistics in the Netherlands 1999; Selected Papers from the Tenth CLIN Meeting*, pages 41–51. Utrecht Institute of Linguistics OTS, 2000.
- M. Pauly. From Programs to Games: Invariance and Safety for Bisimulation. In Peter Clote and Helmut Schwichtenberg, editors *Computer Science Logic*, Volume 1862, LNCS, Springer, 2000.
- M. Pauly. An Introduction to Game Logic. In M. Faller, S. Kaufmann and M. Pauly, editors *Formalizing the Dynamics of Information*, CSLI, 2000.

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- A.M. Bleeker and D.J.N. van Eijck. The epistemics of encryption. Technical Report PP-2000-08, ILLC, 2000. Technical Report INS-R0019, CWI, 2000.
- D.J.N. van Eijck. Context semantics for NL. Lecture Note, Uil-OTS, November 2000.
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- D.J.N. van Eijck, J.M. Heguiabehere, and B. Ó Nualláin. Theorem proving and programming with dynamic first order logic – full version. Technical Report INS-R0020, CWI, Amsterdam, October 2000.
- M. Pauly. *Game Logic for Game Theorists*, Technical report INS-R0017, CWI, Amsterdam, 2000.

APPENDIX 2 RESEARCH REPORTS, TECHNICAL NOTES AND MASTER OF LOGIC THESES

MoL = Master of Logic Thesis

PP = Prepublication Series

X = Technical Notes

- MoL-2000-01
Sophia Velissaratou: *Conditional Questions and Which-Interrogatives.*
- MoL-2000-02
Mariana Haim: *Duality for Lattices with Operators: A Modal Logic Approach.*
- MoL-2000-03
Sjaak Verbeek: *An Information Theoretic Approach to Finding Word Groups for Text Classification.*
- MoL-2000-04
Catarina Dutilh Novaes: *A Study of William of Ockham's Logic - from Suppositio to Truth Conditions.*
- MoL-2000-05
Patrick Yancey: *Indeterminacy and Translatability.*
- MoL-2000-06
Shai Berger: *Studies on the Uses and Usefulness of Diagrams.*
- PP-2000-01
Ian Hodkinson, Szabolcs Mikulás, Yde Venema: *Axiomatizing Complex Algebras by Games.*
- PP-2000-02
Johan van Benthem: *Information Transfer across Chu Spaces.*
- PP-2000-03
Giovanna D'Agostino: *Characterizing Interpolation Pairs in Infinitary Graded Logics.*

- PP-2000-04
Keith Stenning, Michiel van Lambalgen: *Semantics as a foundation for psychology: a case study of Wason's selection task.*
- PP-2000-05
Kees Doets: *Short Proof(s) for Classical Theorems.*
- PP-2000-06
Rosalie Iemhoff: *A(nother) characterization of Intuitionistic Propositional Logic.*
- PP-2000-07
Carlos Areces, Patrick Blackburn, Maarten Marx: *The Computational Complexity of Hybrid Temporal Logics.*
- PP-2000-08
Annette Bleeker, Jan van Eijck: *The Epistemics of Encryption.*
- PP-2000-09
Maarten Marx, Yde Venema: *Local Variations on a Loose Theme: Modal Logic and Decidability.*
- PP-2000-10
Nick Bezhanishvili: *Varieties of Two-Dimensional Diagonal-Free Cylindric Algebras. Part I.*
- PP-2000-11
Eva Hoogland, Maarten Marx: *Interpolation in Guarded Fragments.*
- PP-2000-12
Valentin Gorankov: *The Basic Algebra of Game Equivalences.*
- PP-2000-13
Maarten Marx, Szabolcs Mikulás: *Products, or How to Create Modal Logics of High Complexity.*
- PP-2000-14
Maarten Marx, Nick Bezhanishvili: *All proper normal extensions of $S5$ -square have the polynomial size model property.*

- PP-2000-15
Alessandro Agostini, Dick de Jongh, Franco Montagna: *Coordination of 01-agents vs. coordination of worlds-based agents.*
- X-2000-01
H.P. van Ditmarsch: *Dynamic Knowledge Logic.*
- X-2000-02
H.P. van Ditmarsch: *Axioms for Card Games.*
- X-2000-03
Johan van Benthem: *Logic and Games: the third encounter.*
- X-2000-04
Anne Troelstra: *Ware en Gevoelige Verhalen.*



APPENDIX 3 EVENTS

Talks by visiting scholars

Speaker: Ernst-Rüdiger Olderog, University of Oldenburg
Title: Combining Specification Techniques for Processes, Data and Time
Date: January 12, 2000
Place: Amsterdam

Speaker: Guram Bezanishvili, Georgian Academy of Sciences
Title: Finite-variable fragments of intuitionistic predicate logic and their relations with provability logic
Date: February 4, 2000
Place: Amsterdam

Speaker: Joachim Niehren, University of Saarbrücken
Title: Constraint Programming in Computational Linguistics
Date: March 21, 2000
Place: Amsterdam

Speaker: James Bradley, Memorial University of Newfoundland, Canada
Title: On the very idea of a speculative scheme: logical analysis, Continental thought, and whitehead's metaphysics of the function
Date: March 29, 2000
Place: Amsterdam

Speaker: Leonid Libkin, Bell labs
Title: Constraint Databases: Redoing Database Theory from Scratch
Date: March 29, 2000
Place: Amsterdam

Speaker: Talk by Ramon Jansana, University of Barcelona
Title: Local and global consequence relations: an abstract algebraic logic perspective
Date: April 17, 2000
Place: Amsterdam

Speaker: Wim Veldman
Title: An intuitionistic proof of Kruskal's Theorem
Date: June 20, 2000
Place: Amsterdam

Speaker: Mario Szegedy, Rutgers University / Institute for Advanced Studies
Title: Towards a Katona type proof for the 2-intersecting Erdos-Ko-Rado theorem, and a generalization of Bollobas's theorem
Date: June 28, 2000
Place: Amsterdam

Speaker: Mai Gebrke, New Mexico State University
Title: Canonical extensions of distributive lattice expansions
Date: July 10, 2000
Place: Amsterdam

Speaker: Tamara Munzner, Stanford University
Title: Interactive Visualization of Large Graphs and Networks
Date: Monday July 17 2000
Place: Amsterdam

Speaker: E.W. Dijkstra, University of Texas at Austin
Title: On avoiding avoidable case analyses
Date: October 10, 2000
Place: Amsterdam

Speaker: Valentin Goranko, Rand Afrikaans University
Title: Generalizing Sahlqvist formulae, From Sahlqvist to van Benthem: the long and winding road
Date: October 17, 2000
Place: Amsterdam

Workshops

2-day workshop on quantum computing
Date: April 6-7, 2000
Place: Amsterdam
Organization: Harry Buhrman, Ronald de Wolf.

Games in Logic, Language and Computation 1
Date: April 14, 2000
Place: Amsterdam
Organization: Paul Dekker, Yde Venema.

Games in Logic, Language and Computation 2

Date: June 23, 2000

Place: Amsterdam

Organization: Paul Dekker, Yde Venema

Co-Algebra meeting

Date: July 18, 2000

Place: Amsterdam

Organization: Yde Venema

OZSL Schoolweek

Date: October 23-27

Place: Nunspeet

Organization: Rafaella Bernardi, Peter Blok, Jan van Eijck, Joost Joosten, Marco de Vries

Games in Logic, Language and Computation 3

Date: October 26, 2000

Place: Nunspeet

Organization: Paul Dekker, Yde Venema

An Afternoon on Satisfiability in the Netherlands

Date: November 3, 2000

Place: Amsterdam

Organization: Maarten de Rijke

Games in Logic, Language and Computation 4

Date: November 21, 2000

Place: Groningen

Organization: Paul Dekker, Hans van Ditmarsch, Barteld Kooi, Gerard Renardel de Lavalette and Rineke Verbrugge.

Sinn und Bedeutung V

Date: December 18-20, 2000

Place: Amsterdam

Organization: Renate Bartsch, Peter Blok, Balder ten Cate, Paul Dekker, Markus Egg, Helen de Hoop, Alice ter Meulen, Robert van Rooy, Rob van der Sandt and Henk Zeevat.

Colloquia series

Computational Logic Seminar

Weekly series of talks on computational aspects of logic.

Organization: Maarten de Rijke.

Information: <http://www.illc.uva.nl/~mdr/ACLG/Local/seminar.html>

DIP Colloquium

Bi-weekly series of talks on topics in discourse semantics and information processing.

Organization: Maria Aloni, Balder ten Cate, Robert van Rooy and Henk Zeevat.

Information: <http://www.illc.uva.nl/dip>

Dynamo Colloquium

Weekly meetings on topics in computational dynamic logic.

Organisation: Jan van Eijck.

Seminar on Games and Logic

Bi-weekly

Organization: Yde Venema.



APPENDIX 4 OTHER CONTRIBUTIONS

ILLC Project: Theory of Interpretation

Principal Researchers

M. Aloni, R.I. Bartsch, E.C. Brouwer, B.D. ten Cate, J.A.G. Groenendijk, H.L.W. Hendriks, T.M.V. Janssen, J. Maat, R.A.M. van Rooy, H.P. Stein, M.J.B. Stokhof.

Lectures

- R.I. Bartsch, *An architecture of episodic and conceptual maps*, Perception and Production: Interaction of human and artificial communicating systems, December 15, Bielefeld.
- E.C. Brouwer, *Concepts in Reflection*, IXer Internationale Kant-Kongress, March 8, Humboldt Universität Berlin.
- B.D. ten Cate, *Composing Questions*, Sinn und Bedeutung 2000, December 19, Amsterdam.
- J.A.G. Groenendijk, *The Logic of Interrogation*, Logic and Cognition, May 20, Rome.
- H.L.W. Hendriks, *Raising Alternatives*, Conference in honour of Hans Kamp's Sixtieth Birthday, October 3, Stuttgart, Germany; *Linguistic Politeness and the Civilizing Process*, International Symposium on Linguistic Politeness, January 7, Bangkok, Thailand; *Language, Rationality and Politeness*, Research Colloquium Lego, Department of Philosophy, March 3, Amsterdam; *Compositionality and Model-Theoretic Interpretation or Linguistic Politeness and the Civilizing Process*, Adult Accolade 2000, October 23, Nunspeet, The Netherlands.
- T.M.V. Janssen, *An algebraic approach to grammatical theories for natural language*, Algebraic methods in language processing (TWLT 16/ Amilp 2000), May 21, Iowa City; *Tree adjoining grammar in algebraic perspective*, Computational linguistics in the Netherlands, November 3, Tilburg; *Frege, contextuality and compositionality*, Sinn und Bedeutung 2000, December 19, Amsterdam; *A logic with independent choices*, Adult Accolade 2000, October 23, Nunspeet.
- J. Maat, *The Linguistic Ideas of Robert Hooke (1635-1703)*, Annual Colloquium of the Henry Sweet Society for the History of Linguistic Ideas, September 21, Edinburgh.
- R.A.M. van Rooy, *Relevant Questions and Answers*, ICCS 8th International Conference on Conceptual Structures, August 14, Darmstadt; *Presupposition Satisfaction*, Conference in honour of Hans Kamp's Sixtieth Birthday,

October 15, Stuttgart; *Optimality Theory and Game Theory: Some Parallels*, Second Workshop on Optimality Theoretic Semantics, January 4, Utrecht; *Decision Problems in Pragmatics*, GötaLog, June 15, Göteborg; *Bidirectional OT: Q&I, or R&E?*, Third Workshop on Optimality Theoretic Semantics, September 17, Utrecht; *The Question of the three condemned men*, Sinn und Bedeutung 2000, December 19, Amsterdam; *Questioning to Resolve Decision Problems*, Semantic Colloquium at MIT, May 16, Boston; *The Relevance of Relevance*, Games in Logic, Language and Computation 2, June 23, Amsterdam.

Functions

- M.J.B. Stokhof, *OZSL*, Member of the Board.

Editorships

- R.I. Bartsch, *Theoretical Linguistics*, Consulting Editor.
- J.A.G. Groenendijk, *Linguistics and Philosophy*, Associate Editor Semantics; *Natural Language Semantics*, Member Editorial Board; *Current Research in the Semantics/Pragmatics Interface*, Advisory Editor; *Language and Computation*, Member Editorial Board.
- R.A.M. van Rooy, *Journal of Semantics*, Guest Editor for 1 issue in 2000.
- M.J.B. Stokhof, *Linguistics and Philosophy*, Associate Editor Semantics; *Logic and Computation*, Member Editorial Board; *Natural Language Semantics*, Member Editorial Board; *Current Research on the Semantics Pragmatics Interface*, Member Editorial Board.

Program Committees

- R.I. Bartsch, *Sinn und Bedeutung 2000*, Member of Program Committee, December 18-20, Amsterdam.
- R.A.M. van Rooy, *Sinn und Bedeutung 2000*, Member of Program Committee, December 18-20, Amsterdam.
- M.J.B. Stokhof, *Semantics and Linguistic Theory X*, Member of Program Committee, March, Cornell, Ithaca NY.

Scientific Events Organized

- B.D. ten Cate, *Sinn und Bedeutung 2000*, December 18-20, Amsterdam.
- R.A.M. van Rooy, *Sinn und Bedeutung 2000*, December 18-20, Amsterdam.

Scientific Awards

- FoLLI Outstanding Dissertation Award: Jelle Gerbrandy, *Bisimulation on Planet Kripke*.

ILLC Project: Cognitive Systems

Principal Researchers

- G. Kerdiles, K.L. Kwast, A.M. Tamminga, F. Veltman, S.D. Zwart.

Lectures

- A.M. Tamminga, *Finite State Belief Dynamics*, ESSLLI'2000, August, Birmingham; *Evidential Belief Revision, Belief Change and Pragmatist Philosophy*, March, Regensburg; *Four-Valued Information Revision*, LeGO-Lectures, November, Amsterdam.m F.
- Veltman, *Semantics and Pragmatics. Is there any distinction left?*, Belief and Meaning, May 26, Regensburg.
- S.D. Zwart, *Geloofsrevisie en waarheidsgelijkenis*, Gloval Village, de 22e Nederlands-Vlaamse Filosofiedag, October 28, Leiden; *Belief Revision and Verisimilitude: The research project*, Leerstoelgroep lecture UvA, June 30, Amsterdam.

Editorships

- F. Veltman, *Argumentation*, Member Editorial Board; *Journal of Applied Non-Classical Logics*, Member Editorial Board.

ILLC Project: Information Processing

Principal Researchers

- R. Bod, R.L. Bonnema, N. van Leusen, R.J.H. Scha, K. Sima'an, H.W. Zeevat.

Lectures

- R. Bod, *An Improved Parser for Data-Oriented Lexical-Functional Analysis*, ACL'2000, October 3, Hong Kong, China; *Parsing with the Shortest Derivation*, COLING'2000, August 1, Saarbrücken, Germany; *An Empirical Evaluation of LFG-DOP*, COLING'2000, August 3, Saarbrücken, Germany; *The Storage and Computation of Frequent Sentences*, Architectures and Mechanisms in Language Processing (AMLAP'2000), September 20, Leiden, The Netherlands; *What are the Structural Units of Language Processing?* Linguistic Society of America (LSA-2000), January 3, Chicago, IL; *Memory of Language*, October, Max Planck Institute for Psycholinguistics; *Probabilistic Approaches to Language*, January 23, University of Oxford, United Kingdom; *Numerical vs. Non-Numerical Data-Oriented Parsing*, January 22, University of Sussex, United Kingdom.

- R.L. Bonnema, *Parse Tree Probability in Data Oriented Parsing*, CICLing 2000, February 17, Mexico City, Mexico.
- N. van Leusen, *Description grammar for Discourse*, Sinn und Bedeutung 2000, December 18, Amsterdam; *Description Grammar for Discourse*, Semantics Colloquium, December 12, Nijmegen; *Description Grammar for Discourse*, Linguistics colloquium, Sprachwissenschaften Universität Konstanz, December 7, Konstanz.
- K. Sima'an, *Tree-gram Parsing: Structural Relations and Lexical Dependencies*, ACL'2000, October 4, Hong Kong; *Efficient Parsing of Domain Language*, BNAIC'2000, December 2, Kaatsheuvel; *Generative Probabilistic Tree-gram Parsing*, Natural Language Processing Colloquium, May 15, Technion, Haifa, Israel.
- H.W. Zeevat, *Anchoring and Bidirectionality*, Optimal Interpretation of Words and Constituents, September 1, Utrecht; *Discourse Particles and Presupposition*, Workshop Communicating Agents, February 15, Bonn; *Discourse particles: Information Management instead of Interaction Management*, GESUS Tagung, March 21, Berlin; *The Asymmetry of Optimality Theoretic Syntax and Semantics*, Workshop Formal Pragmatics, March 24, Sklarska Poreba; *Discourse Particles as Speech Act Markers*, Götaolog, June 17, Göteborg; *Explaining Presupposition Triggers in Optimality Theory*, Second Workshop on Optimality Theoretic Semantics, January 2, Utrecht.

Functions

- R. Bod, *Engineering and Physical Sciences Research Council (EPSRC)*, United Kingdom, Member of the Peer Review College since 2000.
- R.J.H. Scha, *NWO, Priority Program Language and Speech technology*, Theme Group Leader.

Program Committees

- R. Bod, *ACL'2000*, Member of Review Committee, October 2-6, Hong Kong; *ROMAND'2000*, Member of Program Committee, August 26-29, Lausanne; *ESSLLI'2000*, Member of the Reviewing Committee of student papers, August, Birmingham.
- K. Sima'an, *38th Annual Meeting of The Association For Computational Linguistics (ACL'2000)*, Reviewer, October 1-7, Hong Kong.

Scientific Events Organized

- K. Sima'an, *Computational Linguistics In the Netherlands (CLIN'2000)*, December 3, Tilburg, The Netherlands.

Scientific Awards

- K. Sima'an, *FoLLI Outstanding Dissertation Awards 2000*, Foundation of Logic, Language and Information, October, Amsterdam; *BNAIC Best Paper Award.*, BNAIC/BNVKI, December 2, Kaatsheuvel, The Netherlands.

ILLC Project: Mathematical Logic

Principal Researchers

- M. Aiello, J.F.A.K. van Benthem, H.C. Doets, E. Hoogland, R. Iemhoff, D.H.J. de Jongh, A.S. Troelstra, P. van Ulsen, D. Zambella.

Lectures

- M. Aiello, *Topo-distance: Measuring the Difference between Spatial Patterns*, JELIA 2000, September 29, Malaga, Spain; *Combining Linguistic and Spatial Information for Document Analysis*, RIAO 2000, April 13, Paris, France; *Topo-distance: Measuring the Difference between Spatial Patterns*, JELIA 2000, September 29, Malaga, Spain.
- J.F.A.K. van Benthem, *Dynamic Epistemic Logic of Games*, LOFT IV, July, Torino; *Update Delights*, ESSLLI'2000, August, Birmingham; *Changing Your Mind*, Deutsche Gesellschaft für Analytische Philosophie, September, Bielefeld; *On Being Informed*, JELIA 2000, September, Malaga; *Hintikka Self-Applied*, Hintikka Symposium, November, Helsinki; *Proof and Meaning*, Formal Methods in Language II, December, Bonn; *From Logic to Game Theory, mini-course of lectures*, Graduate Program in Logic and Theory of Algorithms, January, University of Athens; *Logic Games for Economists*, Department of Economics, March, Tel Aviv; *Update Logic and Information Flow*, Departments of philosophy and computer science, Hebrew University, March, Jerusalem.
- R. Iemhoff, *Intuitionistic Provability Logic*, Colloquium Nijmegen, December 5, Nijmegen.
- D.H.J. de Jongh, *Teaching Logic in the Humanities*, Tools for Teaching Logic, June 14, Salamanca, Spain; *Learning and Grammar*, JOLLI, November 29, Sevilla, Spain.

Functions

- J.F.A.K. van Benthem, *International Federation for Computational Logic*, Vice-president since 1999; *Reasoning About Knowledge and Rationality*, Member of the Board since 1994; *Beth Foundation*, Member of the Board; *Vienna Circle Archive*, Chairman of the Board; *Amsterdam Centre for Computational Science*, Chairman oversight committee.

Editorships

- M. Aiello, *ACM Transaction on Computational Logic*, Information Director.
- J.F.A.K. van Benthem, *The Philosopher's Annual*, Nominating Editor since 1988; *Journal of Philosophical Logic*, Member Editorial Board; *Studia Logica*, Member Editorial Board; *Studies in Linguistics and Philosophy*, Member Editorial Board; *Logic Journal of the Interest Group in Pure and Applied Logics*, Member Editorial Board; *Logic and Computation*, Member Editorial Board; *Language and Computation*, Member Editorial Board; *Cognitive Science Quarterly*, Member Editorial Board; *Amsterdam University Press*, Member Editorial Board. A.S.
- Troelstra, *Indagationes Mathematicae*, Editor.

Program Committees

- J.F.A.K. van Benthem, *Formal and Applied Practical Reasoning*, Area Chair Logic, September 11-13, London.

Scientific Events Organized

- J.F.A.K. van Benthem, *Ninth Workshop 'Logic, Language and Computation'*, May 30-June 1, CSLI Stanford.
- D.H.J. de Jongh, *Tools for Teaching Logic*, June 14-June 17, Salamanca, Spain.

Visiting professorships

- J.F.A.K. van Benthem, *Stanford University, Department of Philosophy, Bonsall Visiting Chair*, March-June.

Scientific Awards

- J.F.A.K. van Benthem, *Essay Prize*, Hollandse Maatschappij van Wetenschappen, December 1, Haarlem.

ILLC Project: Complexity and Computation Theory*Principal Researchers*

- P.W. Adriaans, P. van Emde Boas, H.M. Buhrman, W.K. van Dam, L. Torenvliet, P.M.B. Vitányi, R.M. de Wolf

Lectures

- P.W. Adriaans, *Towards High Speed Grammar Induction on Large Text Corpora*, Sofsem 2000, December 2, Milovy, Czech Republic; *Robosail*, BNAIC, November 3, Kaatsheuvel, Netherlands; *Learning to Sail*, Benelearn, December 13, KUB, Tilburg, Netherlands.

- H.M. Buhrman, *Quantum Communication Complexity*, Conference on Search and Communication Complexity, July 3, Balatonlelle, Hungary; *Quantum Algorithms for the Element Uniqueness Problem*, Workshop on Quantum Computing, July 14, Benasque Spain; *Overview of the QUAIP Project*, meeting for QUAIP Project, September 27, Potsdam, Germany; *Quantum Mechanics and Computer Science: Quantum Computing*, CWI in bedrijf, October 6, Amsterdam; *series of 3 talks on quantum computing*, Short Course Quantum Computing, March 29, Edinburgh, Scotland; *NMR quantum computing*, Element 2000 PAC symposium, March 2, Utrecht; *Quantum Kolmogorov Complexity*, Center for Quantum Computing University of Oxford, June 13, Oxford, United Kingdom; *Quantum Communication Complexity*, Work visit Würzburg, April 28, Würzburg; *Quantum Communication Complexity*, Work visit Aachen, May 10, Aachen, Germany; *Are bitvectors optimal*, Work visit University of Oregon, May 19, Eugene: Oregon, *Quantum Communication Complexity*, Work visit Caltech, November 22, Pasadena CA; *Quantum Computing*, visit of Busquin, Euro Commissioner of research, December 7, Amsterdam.
- W.K. van Dam, *NMR Quantum Computing*, “Element 2000” PAC-Symposium, March 2, University of Utrecht, The Netherlands; *Self-testing of universal and fault-tolerant sets of quantum gates*, 32nd Annual ACM Symposium on Theory of Computing, May 23, Portland, Oregon; *Quantum Kolmogorov Complexity*, 15th Annual IEEE Conference on Computational Complexity, July 7, Florence, Italy; “*Quantum Kolmogorov Complexity*”, seminar at the Oxford Centre for Quantum Computation, June 22, University of Oxford *Quantum Kolmogorov Complexity*, CS theory seminar at the University of Waterloo, August 23, University of Waterloo, Canada; *Quantum Computation*, mini course at the Alternative Computational Models Workshop, September 16-October 2, City University of Hong Kong, Hong Kong; *Quantum queries to oracles in the polynomial hierarchy and beyond*, Berkeley Quantum Computation Seminar, October 23, University of California, Berkeley, California; *Quantum Kolmogorov Complexity*, Visit to Waterloo, August 26, Waterloo, Canada; *Quantum Computing*, Visit to Hong Kong, September 16, Hong Kong; *Quantum queries to oracles in the polynomial hierarchy and beyond*, Visit to Berkeley, October 9, Berkeley, CA.
- P. van Emde Boas, *The connection between Games and Computer Science*, CS Seminar University of Petroleum, April 6, UPC ChangPing Beijing; *The connection between Games and Computer Science*, General Math. Seminar JiaoTong University, April 12, JiaoTong University Xian; *Wat er over bleef.....*, Feestcolloquium 40 jaar J. Aarts TU Delft, October 27, Delft; *Objects, Interaction, Agents, Games, Complexity*, Workshop 3,

OOPSLA'2000, October 15, Minneapolis; *The Games of Computer Science*, 2nd ILLC workshop on Logic and Games, June 23, Amsterdam; *The Games of Computer Science*, General Math. colloquium University Lille, February 18, Lille; *The Games of Computer Science*, SCS Meetings, March 3, Amsterdam; *Die Lui van het Computer parket*, Nationale Wetenschapsdag, October 8, WCW Amsterdam; *The Games of Computer Science*, gastcollege, November 24, Prague; *Playing Savitch*, SOFSEM'2000 Rump Session, December 1, Milovy; *Teaching Games*, Anti-SOFSEM'2000, December 1, Milovy.

- P.M.B. Vitányi, *MDL Induction, Bayesianism and Kolmogorov Complexity*, Rank Prize Fund Meeting on Model Selection and Learning, April 10, Grasmere, United Kingdom; *Three approaches to the quantitative definition of the information in a pure quantum state*, Workshop on Algorithmic Information Theory, June 9, Lille, France; *Classical and quantum Kolmogorov Complexity*, Quantum Computation and Communication Meeting, July 8, Benasque, Spain; *The Quantum Computing Challenge*, 10 years jubilee of the International Dagstuhl Computer Science Seminar Centre, August 24, Saarbrücken; *The incompressibility method with applications*, SOFSEM, November 15, Milovy, Czech Republic; *Algorithmic Statistics*, Algorithmic Learning Theory, December 6, Sidney; *Three approaches to the quantitative definition of the information in a pure quantum state*, IEEE Computational Complexity Conference, July 2, Florence, Italy.
- R.M. de Wolf, *Average-case quantum query complexity*, STACS 2000, February 17, Lille, France; *Characterization of non-deterministic quantum query and quantum communication complexity*, IEEE Computational Complexity, July 7, Florence, Italy.

Functions

- P.W. Adriaans, *MLNET*, Board Member since 1997; *HPCN*, Board Member since 1998; *BMI-IOP Genomics*, Advisory Board since 2000.
- P. van Emde Boas, *SOFSEM International Advisory Board*, Member, since 1996.
- H.M. Buhrman, *Steering committee Computational Complexity Conference*, Member; *Project Quantum Algorithms and Information Processing*, Coordinator.
- L. Torenvliet, *Dutch Association for Theoretical Computer Science (NVTI)*, Board Member since 1996.
- P.M.B. Vitányi, *BRA IV Neurocolt Working Group*, site coordinator; *IFIP Special Interest Working Group Descriptive Complexity*, Member; *IFIP SGI Computational Machine Learning*, Co-chair; *Japanese Discovery Science Project*, advisor.

Editorships

- P. van Emde Boas, *Information and Computation*, Editor, since 1987;
RAIRO Informatique theorique, Editor, since 1986.

Program Committees

- P.W. Adriaans, *ICGI 2000*, Technical Program Committee, September, Lisbon, Portugal.
- P. van Emde Boas, *SOFSEM'2000*, Member, November 25-December 1, Milovy, Czech republic; *MFCs'2001*, Member, August 27-31, Marianske Lazne; *SOFSEM'2001*, Member, November 24-31, Piestian Slovakia.
- H.M. Buhrman, *ICALP 2000*, Member, July 9-15, Geneva; *Mathematical Foundations of Computer Science*, Member, August 27-21, Marianske Lazne.
- P.M.B. Vitanyi, *Computational Learning Theory*, Conference Chair, July 16-19, Amsterdam; *ICALP 2002*, Committee Member, July 8-13, Malaga; *ECML 2001*, Member, September 3-7, Freiburg; *IFIP 2000*, Member, August 17-19, Sendai, Japan.

Scientific Events Organized

- W.K. van Dam, *Alternative Computational Models Workshop*, September 11 -October 16, City University of Hong Kong, Hong Kong.
- H.M. Buhrman, *QIP 2001*, January 9-12, Amsterdam; *Kickoff meeting fifth framework project QAIP*, April 6-7, Amsterdam.

Visiting professorships

- P. van Emde Boas, *Guest Professorate*, University of Petroleum, Beijing PR China, April 5, ChangPing China.

ILLC Project: Reasoning with Uncertainty

Principal Researchers

- M. van Lambalgen, N. Massios, M.R. Vervoort, F.P.J.M. Voorbraak

Lectures

- M. van Lambalgen, *Psychology of reasoning, logic and semantics*, Seminar für Sprachwissenschaft, Universität Tübingen, January 7, Tübingen, Germany; *If probabilists would rule the world...*, Delft University of Technology Stochastics Colloquium, October 26, Delft, Netherlands.
- N. Massios, *Robotic Surveillance in a POMDP setting*, AIO SooS, February 22, Amsterdam; *Cluster expected cost computation for hierarchical decision theoretic surveillance*, AIO SooS, October 31, Amsterdam.

- M. Vervoort *The Emile Approach to Grammar Induction put into Practice*, TAI2000, June 9, Villeneuve d'Ascq, France; *Blackwell Games*, Games in Logic, Language and Computation 3, October 26, Nunspeet, the Netherlands; *EMILE*, Computational Logic Seminar, June 16, Amsterdam, the Netherlands; *The EMILE Grammar Inducer*, General Mathematics Colloquium, November 8, Amsterdam, the Netherlands.
- F.P.J.M. Voorbraak, *Reasoning with Uncertainty in Robotics*, Workshop on Soft Computing, September 21, Ulster.

Functions

- M. van Lambalgen, *Association for Symbolic Logic*, Member of Council since January 1, 1997.

Editorships

- M. van Lambalgen, *Journal of Symbolic Logic*, Editor since January 1, 1997; *Journal of Logic, Language and Information*, Editor since January 1, 2000

Visiting professorships

- M. van Lambalgen, *Seminarium für Sprachwissenschaft, Universität Tübingen*, January; *Seminarium für Sprachwissenschaft, Universität Tübingen*, June.

ILLC Project: Applied Logic

Principal Researchers

- J. Kamps, M. Marx, J.M.F. Masuch, R.J. Mokken, B. Ó Nualláin, I.E. Vermeulen

Lectures

- J. Kamps, *Applying Logic and Automated Reasoning Tools to the Social Sciences*, Computational Logic Seminar, ILLC, May 12, Amsterdam, The Netherlands; *On 'Model-based' abduction*, ECAI WS on Scientific Reasoning and Artificial Intelligence, August 21, Berlin.
- M. Marx, *Complexity of the validity problem of intuitionistic predicate logic with one variable*, Advances in Modal Logic (AiML2000), October 5, Leipzig; *Computing with cylindric modal and arrow logics, lower bounds*, Workshop on Many-dimensional logical systems, ESSLLI'2000, August 10, Birmingham; *Modal logic, bisimulation, games and guarded quantification*, December 15, INRIA/LORIA, Nancy, France; *Decidable fragments of first order logic and description logics*, ESSLLI'2000, August 7, Birmingham;

Complexity of Hybrid Logics, Workshop on Hybrid Logic (HyLo 2000), August 14, Birmingham, United Kingdom; *Course on Modal logic and guarded fragments*, Institute of Cybernetics, Georgian Academy of sciences, May, Tbilisi, Georgia; *Relativisation, guarded fragments and decidability*, Institute of Cybernetics, Georgian Academy of sciences, May 31, Tbilisi, Georgia; *Complexity of intuitionistic predicate logic with one variable*, Algebraic Logic Seminar, University College London, March 20, London, United Kingdom

- B. Ó Nualláin, *Is Davis-Putnam Heavy-tailed?*, ECAI Workshop Empirical Methods in AI, August 23, Berlin; *A Tableau Calculus for Dynamic First Order Logic with Applications in Natural Language Semantics*, Inference in Computational Semantics, July 29, Dagstuhl; *Theorem Proving and Programming with Dynamic First Order Logic*, 9th International Workshop on Functional and Logic Programming, September 30, Benicassim, Spain; *Restart Strategies for Search*, ALL seminar, February 23, ALL, Amsterdam; *Computational Social Dilemmas*, Games in Logic, Language and Computation 1, April 14, Amsterdam; *The Geography of Satisfiability*, Adult Accolade 2000, October 23, Nunspeet; *Leveraging Empirical Results to Improve SAT Algorithms*, Satisfiability in the Netherlands, November 3, Amsterdam.
- I.E. Vermeulen, *Formal Theory Applied*, PhD Accolade 2000, October 27, Nunspeet.

Editorships

- M. Masuch, *Computational and Mathematical Organization Theory*, Area Editor; *Journal of Artificial Societies and Social Simulation (JASSS)*, Associate Editor.

Scientific Events Organized

- M. Marx, *Adult Accolade 2000*, October 23, Nunspeet, Netherlands.

Visiting professorships

- R.J. Mokken, *Netherlands Institute for Advanced Study in the Social Sciences at Wassenaar*, NIAS fellow.

ILLC Project: Logic in Action: (a) Computational Logic

Principal Researchers

- K.R. Apt, C.E. Areces, S.B. Brand, R. Gennari, A. Hendriks, C. Monz, H.J.N. Ragetli, M. de Rijke

Lectures

- K.R. Apt, *The Alma Project or How First-Order Logic Can Help Us in Imperative Programming*, In Pursuit of Simplicity, May 13, Austin, USA; *A Denotational Semantics for First-Order Logic and Alma-0 Language*, Computational Logic Conference (CL2000), July 26, London; *Constraint Programming viewed as Rule-based Programming*, ADVIS'2000, First Biennial International Conference on Advances in Information System, October 26, Izmir, Turkey.
- C.E. Areces, *Hybrid Binders*, HyLo 2000, August 16, Birmingham, United Kingdom; *Description and/or Hybrid Logics*, HyLo 2000, August 15, Birmingham, United Kingdom; *Polarity in the Base Logic*, Mini-Workshop on Categorical Grammar and Natural Logic, September 6, Utrecht, The Netherlands; *Dealing with Structure, Logically*, 1st Benelux Workshop on Computational Logic, May 25, Lommel, Belgium; *Description Logics, Hybrid Logics and The Land in Between*, At INRIA Lorraine, December 8, Nancy, France; *HLs and DLs*, Computational Logic Seminar, May 12, Amsterdam; *Logicas Computacionales a Medida*, Seminario de Logica, December 20, Buenos Aires, Argentina.
- S.B. Brand, *Arrays and Constraint Programming*, CWI Logic and Constraints Seminar, November 13, Amsterdam.
- R. Gennari, *Arc Consistency via Subsumed Functions*, CL00, July, London; *Constraint Propagation for Soft Constraints*, CP00, September, Singapore; *A Generic Iteration Algorithm Schema with Functions*, Computational Logic Seminar, January, Amsterdam; *Arc Consistency via Iterations of Functions*, Logic and Constraints Seminar, June, Amsterdam; *Local Consistency for Soft Constraints*, OSZL 2000 Autumn School, October, Nunspeet; *Local Consistency via Iterations of Functions*, SAT Day in the Netherlands, November 3, Amsterdam; *Soft Constraints*, Visit, June, Padua.
- C. Monz, *Computational Semantics in Information Retrieval*, 2nd Workshop on Inference in Computational Semantics, July 30, Dagstuhl, Germany; *Ambiguous Communication in a Multi-Agent System*, Workshop on Communicating Agents, February 12, Bonn, Germany; *Concept-Based Computer-Aided Link Generation for Electronic Handbooks*, 1st Dutch Information Retrieval Workshop, September 13, Maastricht.
- J. Ragetli, *Wrapper Generation via Grammar Induction*, European Conference on Machine Learning 2000, June, Barcelona;
- M. de Rijke, *Modal Experiments*, Automated Reasoning Workshop, July, London; *Tree-Based Heuristics in Modal Theorem proving*, ECAI-2000, August, Berlin; *Description and/or hybrid logic*, AiML 2000, October, Leipzig; *Content*, Computational Logic Seminar, January, Amsterdam;

Computing with Meaning, NWO, February, The Hague; *Efficient Reasoning for Shallow Representation*, IMS, February, Stuttgart; *Logic in Action*, WEISS Lustrum, March, Amsterdam; *Representatie vs Algoritme*, Computational Logic Seminar, April, Amsterdam; *Logic and Language Links*, L3 Project meeting, June, Amsterdam; *Balancing Inference and Representation*, LFCS Edinburgh, October, Edinburgh; *Three Adverts and A Bit*, Adult Accolade 2000, October 23, October, Nunspeet; *Computing with meaning*, NWO, November, Utrecht.

Functions

- K.R. Apt, *Association for Logic Programming*, President; *ERCIM Working Group on Constraints*, Chairman.
- C.E. Areces, *FoLLI*, Information Officer.
- C. Monz, *ACL Special Interest Group in Computational Semantics*, Information Officer; *Association for Logic, Language and Information*, Information Officer.
- M. de Rijke, *Inference in Computational Logic*, Member of Steering Committee; *Advances in Modal Logic*, President; *ESSLLI*, Member of Steering Committee; *FoLLI*, Executive Officer; *Advances in Modal Logic*, Publicity Chair; *FACCS-Lab*, Research associate; *Methods for Modalities (M4M)*, Co-chair Steering Committee; *IFCoLog*, Member Executive Committee.

Editorships

- K.R. Apt, *ACM Transactions on Computational Logic*, Editor-in-chief and Founding Editor; *Journal of Logic and Computation*, Editor; *Theory and Practice of Logic Programming*, Editor.
- C.E. Areces, *Methods for Modalities I. Special Issue in the Logic Journal of the IGPL, Vol 8(3)*, Co-editor.
- M. de Rijke, *ACM Transactions on Computational Logic*, Editor; *Journal of Language and Computation*, Editor; *Journal of Logic, Language and Information*, Review Editor; *Studies in Logic, Language and Information*, Managing Editor.

Program Committees

- K.R. Apt, *1st International Conference on Computational Logic (CL2000)*, Member of Program Committee, July, London; *6th International Conference on Principles and Practice of Constraint Programming*, Member of Program Committee, September, Singapore.
- R. Gennari, *IJCAI 01*, Member of Program Committee, August, Seattle.

- M. de Rijke, *Frontiers of Combining Systems*, Member of Program Committee, March, Nancy; *KR-2000 Workshop on Semantic Approximation*, Member of Program Committee, April, Boulder, Col. USA; *Inference in Computational Semantics 2*, Member of Program Committee, July, Dagstuhl, Germany; *Computational Logic 2000*, Member of Program Committee, July, London; *WoLLIC-2000*, Member of Program Committee, August, Sao Paulo, Brazil; *Advances in Modal Logic 2*, Member of Program Committee, October, Leipzig; *International Conference on Temporal Logic*, Member of Program Committee, October, Leipzig.

Scientific Events Organized

- K.R. Apt, *ERCIM/COMPULOG Workshop on Constraints*, June 19-21, Padova, Italy;
- K.R. Apt, *Workshop on Constraint Programming and Integer Programming*, January, Dagstuhl, Germany.
- C.E. Areces, *HyLo 2000. Workshop on Hybrid Logics*, August 14-August 18, Birmingham, United Kingdom.
- C. Monz, *ACL/EACL Student Research Workshop*, July 6-11, Toulouse, France.

Visiting professorships

- C.E. Areces, *Computerlinguistik. Universität des Saarlandes*, June; *Computerlinguistik. Universität des Saarlandes*, October; *Departamento de Computation. Universidad de Buenos Aires*, December.

ILLC Project: Logic in Action: (b) Logic in Communication

Principal Researchers

- A. Baltag, A.M. Bleeker, B.P. de Bruin, P.J.E. Dekker, Y. Venema.

Lectures

- A. Baltag, *Information update and epistemic actions*, Amsterdam Coordination Group, April 11, Amsterdam; *A Logic of Epistemic Actions*, GROLOG Seminar, February 17, Groningen; *Logics for Information Updates*, February, Indiana University, Stanford University, University of Chicago; *A Logic for Coalgebraic Simulation*, CMCS 2000, March 25-26, Berlin; *Logics for Games Games in Logic, Language and Computation 2*, April 14, Amsterdam; *A logic for suspicious players: epistemic actions and belief-update in games*, LOFT'00 (Logic and Foundations of Game and Decision Theory), June 30-July 2, Torino, Italy; *Model Theory of*

Coalgebraic Logic: Characterization, Preservation, Definability, BLM'00 (Barcelona Logic Meeting), July 5-9, Barcelona; *Co-algebraic Logic*, Seminar on Coalgebras and Modal Logic, July 18, Amsterdam; *Universal Set Theory and Strong Modal Reflection Principles*, LC'00 (Logic Colloquium 2000), July 23-31, Paris; *Modeling Games using Probabilistic-Epistemic Processes and Modal Logic*, Amsterdam Coordination Group, October 3, Amsterdam; *Modal Logic for Games: Tools for studying the dynamics of knowledge and belief*, Foundations of Formal Sciences II, November 10-13, Bonn, Germany; *Games and Epistemic Actions*, Games in Logic, Language and Computation 4, November 21, Groningen.

- A.M. Bleeker, *Epistemic Action and Change*, LOFT4, July 1, Torino, Italy; *Crypto-protocols*, GLLC, April 14, Amsterdam; *Functions for actions*, PhD Accolade 2000, October 27, Nunspeet.
- P.J.E. Dekker, *Optimality Theory and Game Theory*, Workshop Optimization of Interpretation, January 5, Utrecht; *Optimality Theory and Game Theory*, Ninth CSLI Workshop on Logic, Language and Computation, May 26, Stanford; *Support for Update Semantics*, GötaLog, June 15, Göteborg.
- Y. Venema, *Canonicity for Boolean Algebras with Operators*, Sixth Barcelona Logic Meeting, July 6, Barcelona; *On Pragmatic Semantics*, 7-th International Pragmatics Conference, July 11, Budapest; *"If" and "Only If"*, Workshop on Presupposition, October 5, Stuttgart; *Ultrafilter unions: an exercise in modal definability*, JoLL2000 (workshop on Logic and Language), November 29, Sevilla.
- M. Pauly, *From Programs to Games: Invariance and Safety for Bisimulation*, Computer Science Logic 2000, August 22, Fischbachau, Germany; *A logical framework for coalitional effectivity in dynamic procedures*, LOFT 4, July 1, Turin, Italy.

Editorships

- P.J.E. Dekker, *Journal of Semantics*, Editor.

Program Committees

- A. Baltag, *CMCS'01: the fourth international workshop on Coalgebraic Methods in Computer Science*, Member, April 6-7, Genova, Italy.
- P.J.E. Dekker, *Sinn und Bedeutung 2000*, Member, December 18-20, Amsterdam.

Scientific Events Organized

- P.J.E. Dekker, *Games in Logic, Language and Computation*, April 14, Amsterdam; *Games in Logic, Language and Computation 2*, June 23, Amsterdam; *Games in Logic, Language and Computation 3*, October 26, Amsterdam; *Games in Logic, Language and Computation 4*, November 21, Groningen; *Sinn und Bedeutung 2000*, December 18-20, Amsterdam.

ILLC Project: Logic in Action: (c) Education and Dissemination of Logic

Principal Researchers

- D.J.N. van Eijck, J.M. Heguiabehere, M. Pauly

Lectures

- D.J.N. van Eijck, *Tutorial on Reasoning and Programming with Dynamic First Order Logic*, EEf Foundations School Deduction and Theorem Proving (DTP'00), April 8, Edinburgh; *Reasoning and Computation with Dynamic First Order Logic*, Festival Workshop in Foundations and Computations, July 17, Edinburgh; *Logic Dissemination with Functional Programming: Reasoning + Computation*, Tools for Teaching Logic, June 16, Salamanca; *Epistemic action and change*, LOFT-4, July 1, Torino; *A Tableau Calculus for Dynamic First Order Logic with Applications in Natural Language Semantics*, ICOS-2, July 29, Dagstuhl; *Reasoning and Programming with Dynamic First Order Logic*, WFLP-2000, September 28, Benicassim; *Modality in Context*, CLIN-2000, November 1, Tilburg; *Incremental Montague Grammar*, DIP Colloquium, February 11, Amsterdam; *Tableaux Reasoning for Dynamic First Order Logic*, Computational Logic Seminar, March 31, Amsterdam.
- J.M. Heguiabehere, *Theorem Proving and Programming with Dynamic First order Logic*, Workshop on Inference in Computational Semantics (ICoS-2), July 29, Dagstuhl, Germany.

Scientific Events Organized

- D.J.N. van Eijck, *School Week Dutch Research School in Logic*, October 23-27, Nunspeet.



APPENDIX 5: CONTACT INFORMATION

<i>Last name</i>	<i>Initials</i>	<i>First name</i>	<i>Phone</i>	<i>Email</i>
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Dekker	P.J.E.	Paul	020 525 4541	<i>dekker@illc.uva.nl</i>
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Please contact the bureau if you would like to obtain one of the following (series) of documents:

- ILLC Research Reports and Master theses
- ILLC Dissertations
- ILLC Research plan 2001-2004
- ILLC Brochure Graduate Program in Logic
- ILLC Brochure Logic in Action
- ILLC Annual Report
- Proceedings of scientific events (such as the Amsterdam Colloquia) organized by ILLC
- Other documentation, e.g. concerning visits or scholarships

Information about activities based at or represented by ILLC can be obtained from the following persons or www-addresses:

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