Logic in Action

An NWO Spinoza Award Project

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Leaflet and report, 1997/98

Institute for Logic, Language and Computation
Department of Mathematics, Computer Science, Physics and Astronomy
Department of Humanities
University of Amsterdam
Amsterdam, 1998

In October 1996 Johan van Benthem, professor of mathematical logic at the University of Amsterdam, was awarded one of the Spinoza prizes by the National Dutch Organization for Research (NWO). The award consists of an amount of two million guilders, meant as financial support for future research.

Logic in Action is an initiative of the Spinoza recipient and his research group members made possible by this grant.

Its general aims are the formal study of information flow and the promotion of logic as an interdisciplinary focus for the information sciences.

A snapshot of the Spinoza ceremony, October 10, 1996, De Ronde Lutherse Kerk, Amsterdam.

Photo: ©J.A. Krielen

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1 The Award in Context

The Spinoza Programme of NWO

The following is an excerpt from an NWO brochure

The NWO Spinoza programme was launched by the Netherlands Organization for Scientific Research as a complement to promoting science in research schools. The programme is the most prestigious one in Dutch science. Its aim is the promotion of excellent research by identifying and awarding a very limited number of scientists (circa 3 per year) with a large grant. Spinoza laureates are scholars and scientists who are internationally recognized and whose contributions have been of paramount importance to their scientific field of research. They have an impressive list of high-quality publications, an excellent citation-index and are stimulating leaders towards their numerous Ph.D. students. Their outstanding abilities have been recognized both nationally and internationally by means of awards, prizes, invitations, etcetera.

Candidates are selected by a central committee, on the recommendation of invited leading figures from the Dutch academic community. The Spinoza programme corresponds to NWO's philosophy that the determining factor for 'top research' (which will usually take place in a research school) is in the first instance a person with vision and not an institution.

The awards honour past performance, and are also meant as a stimulus for future innovative research. Spinoza laureates are entirely free in spending their award on research of their choice. The following scientists have been honoured by a Spinoza prize so far:

1995
- G. 't Hooft (theoretical physics, Utrecht University)
- E.P.J. van den Heuvel (astronomy, University of Amsterdam)
- F.G. Grosveld (cell biology, Erasmus University Rotterdam)
- F.P. van Oostrom (Dutch literature, Leiden University)

1996
- J.F.A.K. van Benthem (mathematical logic, University of Amsterdam)
- P. Nijkamp (regional economics and economical geography, Free University Amsterdam)
- G.A. Sawatzky (material physics, Groningen University)

1997
- F.H.H. Kortlandt (Balto-Slavic linguistics, Leiden University)
- H.M. Piñedo (medical oncology, Free University Amsterdam)
- R.A. van Santen (inorganic chemistry and catalysis, Technical University Eindhoven).

Logic and the Information Sciences

An electronic column in the February 98 edition of the University of Amsterdam home page

'Information is the only resource that grows with use.'

prof. dr J.F.A.K. van Benthem
Logic
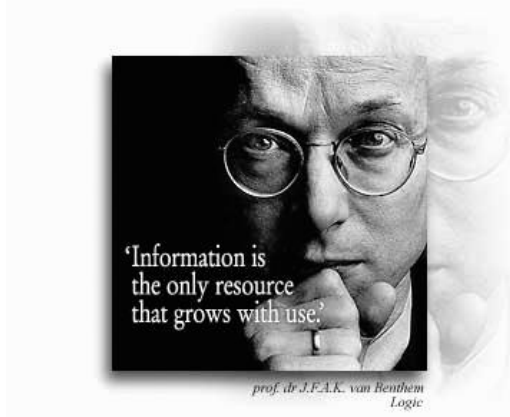
"Information shapes our whole lives. Inside information can make me rich, ignorance can make me happy. Man is a creature that processes information, keeps learning as he lives, reasons and communicates, and has created the computer to fill the need to store and process even more information. The fact that you are reading this home page after traveling the electronic highway illustrates in itself the speed of our information society. Unlike the resources that nature provides, there are no limits to information. Every intelligent use of it serves to produce new insight and consequently new information. These familiar everyday facts are simultaneously an enormous scientific challenge. Because we do not really fundamentally understand them. No exact definition of information has ever been formulated. Information is found, made and conveyed, but no one knows the exact laws of this flow. Various sciences study pieces of the puzzle: psychology and philosophy as well as linguistics, computer science and mathematics. The work I am doing now is focused on finding an information theory that integrates all these sub-insights. I use ideas from mathematical logic, my own field, to describe how one situation can reflect information on a very different one, and how coded information can dynamically transform people's state of knowledge. A linguistic text — like this one — consists for example of successive instructions that change the readers' information situation step by step.

Ultimately a general theory like this ought to provide a context for more concrete questions. No matter how simple it might look, your first experience with this electronic column is teeming with questions. What is the information content of the symbols and pictures you see here, and how do these two information bearers work together so effectively? How do unconscious information-processing mechanisms like reading work, and how do you manage to smoothly integrate them with conscious intelligent behaviour like comprehending the column, deciding to go on surfing, of perhaps writing a response to the author of this column? And to mention another challenge: in essence our confrontation as author and reader is a social process. But how does the interaction work between the knowledge of one individual and people's

social information about each other? So in a nutshell, our brief electronic meeting already contains the most fundamental scientific themes! Of course exploring all this is not a task for one scholar, not even if he is part and parcel of a world wide web. It is more of a job for my entire research institute or for an up and coming new group of 'information sciences.' This group is still at the conception stage at the moment, going way beyond the obsolete borders separating the fields that still prevail — but hopefully not for long — at today's secondary schools and universities."

Prof. dr Johan van Benthem *is professor of logic at the University of Amsterdam, and holds the Bonsall visiting chair of humanities at Stanford University (California). He is director of the Institute for Logic, Language and Computation (ILLC). Van Benthem studied mathematics and philosophy at the University of Amsterdam, where he obtained his Ph.D. in mathematics in 1977. From 1977 to 1986 he was an associate professor in Groningen. In 1986 he became a full professor at the University of Amsterdam. Up until now, he has supervised some 50 Ph.D. theses, so as to cover more ground with an 'extended family.' He is the author of several well-known books on logic and its applications in philosophy, linguistics and computer science. Van Benthem is a member of the Royal Academy of Arts and Science (1991) and of Academia Europaea (1992).*

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2 Logic in Action

Overall Purpose

The overall aim of the Spinoza project is to strengthen the position of Logic, in the current broad sense of that term employed in The Netherlands. Our field is in transition, in several ways. It is becoming increasingly important as a catalyst in a new constellation of academic disciplines, around the theme of 'information science.' This is an intrinsic scientific movement, but it is also linked with our 'information society' in several ways. Logic seems on the verge of greater computational maturity in applications, and it also has a broader potential to penetrate further into general culture, via educational dissemination. The following separate projects address these directions.

"Logic in Communication" sits at the interdisciplinary interface between humanities and exact sciences which is a traditional strong point of Dutch scientific culture. It aims at further 'alpha-beta-ization' of the university, by strengthening the ties between the best current research in linguistic information-oriented semantics and dynamic logics in computer science. "Computational Logic" is a pilot project for making computational concerns and facilities an essential part of our research efforts. Thus, it aims at broadening the agenda for everyone. We want to turn our sophisticated abstract theories into 'systems that work,' with a range of genuine applications. Finally, "Dissemination of Logic" is a kernel project for translating our research efforts into insights and tools for a much larger community. The broader prospects of our discipline are decided eventually in high school class rooms, and the book shelves or computer screens of a general educated public.

Of course, these projects can only do so much. Their specific core aims are necessarily modest (even the Spinoza Award is very finite). But we hope to use them as a broader public asset, through the Dutch Graduate School in Logic. Logic in Communication will organize national events and colloquia for the 'Dutch School' in dynamic logic and semantics, Computational Logic will provide logistic and organizational support for our national automated deduction community, and Dissemination of Logic will work with other groups to make didactive innovation an item on the national agenda.

Finally, not all the award money is spent this way. Several smaller things can be done, as opportunities arise — including prizes for bright new ideas, or student achievements. Also, 'the unknown' deserves a hearing, for which we will create public (sometimes electronic) 'windows' into our field inviting outside suggestions.

The Scientific Spinoza Team

The staff of the project consists of Johan van Benthem, Paul Dekker (Logic in Communication), Jan van Eijck (Dissemination of Logic), Maarten de Rijke (Computational Logic), and Yde Venema (Logic in Communication).

The Spinoza project leaders on their island in Amsterdam. From left to right: Maarten de Rijke, Paul Dekker, Johan van Benthem, Yde Venema and Jan van Eijck.

Ms. Ingrid van Loon *is the business administrator of the project.*

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Logic in Communication

While logic and formal semantics are firmly rooted in the Netherlands, Amsterdam has grown to be a special focus of research in modal logic and dynamic semantics. Logic in Communication aims at combining and strengthening the latter expertise in these fields. It is directed at the formal notion of *information*, which figures as a focal point for studies in logic and reasoning, natural language semantics, the philosophy of action and cognition, AI and computer science. Within Logic in Communication information is studied from two perspectives. One is formal modeling of dynamic properties of communication, using updates on individual and collective states of participants. The second is modal logic, which is becoming a flexible mathematical paradigm for information structure. These two perspectives figure as two poles around which the project is organized. Specific subjects of study include more concrete samples of our themes, such as *modal logic in communication*, *discourse and information structure*, *formal models of communicative interaction*, and *efficient systems of dynamic interaction*. The shared goal of the activities consists in laying foundations for theories of information exchange.
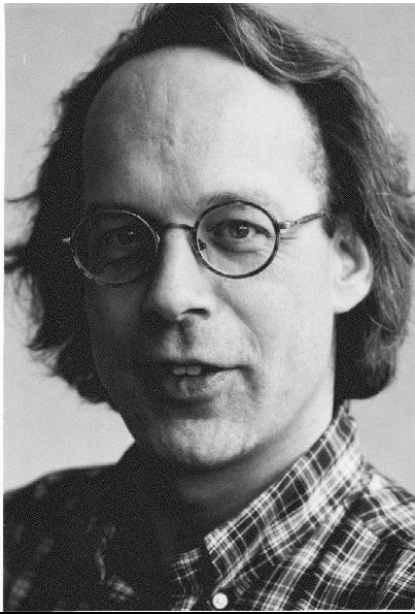
Dr Paul Dekker *is a research fellow of the Royal Netherlands Academy of Arts and Sciences, stationed at the Department of Philosophy of the University of Amsterdam. Dekker has studied linguistics, semantics and philosophy of language, and received his Ph.D. in 1993 with a thesis "Transsentential Meditations" on the dynamic interpretation of discourse.*

Dekker's work focuses on the structural and philosophical aspects of the semantics of natural language. His interests include modality, quantification, domain structure, and information structure and information exchange.

He has published on these subjects in international journals, and presented the results at various international venues. Dekker has given courses on the dynamic semantics of natural language at various places, as well as a course over the internet.

The project will be staffed by the project leaders, two post doctoral researchers and two Ph.D. students. The project will also enhance information dissemination and collaboration with congenial spirits, by organizing workshops on topics of suitable

interdisciplinary interest, such as, e.g., temporal logic, game theory, dynamic semantics, and information packaging.

Dr Yde Venema *(Ph.D. mathematics, Amsterdam 1992) is a research fellow of the Royal Netherlands Academy of Arts and Sciences, stationed at the Department of Mathematics and Computer Science of the Free University Amsterdam. From May 1998 onwards he will be employed by the University of Amsterdam. Venema graduated in mathematics with minors in philosophy and computer science, and wrote his dissertation on "Many-Dimensional Modal Logic."*
Venema's current research interests include modal and algebraic logic, and the interdisciplinary area of logic, linguistics and computer science. He has written a monograph "Multi-Dimensional Modal Logic" (co-authored with M. Marx) and is currently preparing a text book on modal logic (together with P. Blackburn and M. de Rijke). Venema is currently working on dynamic, temporal and spatial logics.
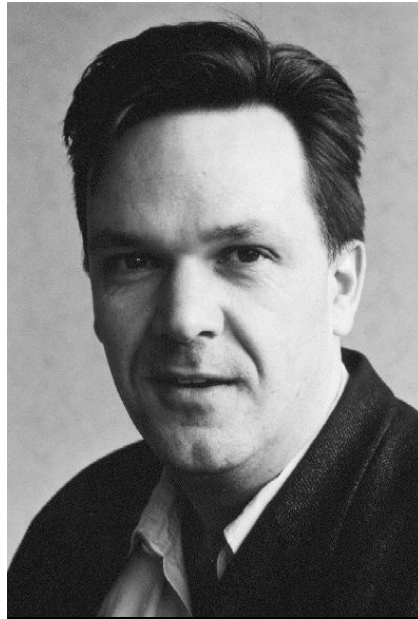
Computational Logic

Computational Logic is a pilot project for making computational concerns and facilities an essential part of our research efforts at the Institute for Logic, Language and Computation. The project is a family of concentrated small scale research efforts together with coordinating activities and services for the broader computational logic community in the Netherlands.

A central topic of the project is *modularity and cooperation* as a means to achieve improved performance in computational logic. Recent developments have created a need for logical and symbolic computation systems that are both flexible and modular, and that allow for structuring large amounts of information and for seamless integration with further components. One of the core technologies here concerns so-called restricted *description formalisms* as they have arisen in databases and knowledge engineering. Such formalisms are used to describe both the contents and structure of information, often in a graphical way. What can one express in these languages? Are they rich enough to model our intended application domains? At which

computational expenses can information described in these formalisms be retrieved and explored? Although it is generally believed that the more expressive a description language is, the more expensive its computational reasoning tasks are, there is no firm understanding of this connection. A further research theme is the design, implementation and use of *automated theorem proving* tools, especially in relation to the high-level logical theories developed and studied at ILLC. There is a special focus on the semantics and syntax of natural language with the aim of developing robust and efficient workbenches. In addition, there is an interest in bringing methods of computational logic to bear on novel application areas such as sociology and law.

The key words characterizing the service activities of the Computational Logic project are accessibility and performance. Top of the line computational logic systems will be developed, installed, and maintained by the project, and to stimulate their use the project will stage demonstrations and short courses. To increase their impact, these activities will be combined with special seminars, reading groups, as well as contributions to the regular curriculum.

Dr Maarten de Rijke *is an assistant professor at the Department of Mathematics, Computer Science, Physics and Astronomy of the University of Amsterdam. He obtained an M.Sc. in philosophy in 1989, one in mathematics in 1990, and a Ph.D. in mathematics at the University of Amsterdam in 1993 ("Extending Modal Logic"). In 1994 and 1995 he was a research scientist at the Centre for Mathematics and Computer Science (CWI) in Amsterdam, and during 1996 and 1997 he was a Warwick Research Fellow at the University of Warwick.*
De Rijke's current research interests include computational logic, pure and applied logic, semantics, and complex systems. He has published about 40 refereed papers on the interface of logic and computation, he is writing two books on logic and its applications, and has edited a dozen volumes and special issues in the area. De Rijke is one of the founders of the international Advances in Modal Logic initiative, he is a managing editor of the book series 'Studies in Logic, Language and Information' (CSLI Stanford and Cambridge UP), and he has organized a large number of workshops on logic and its applications.
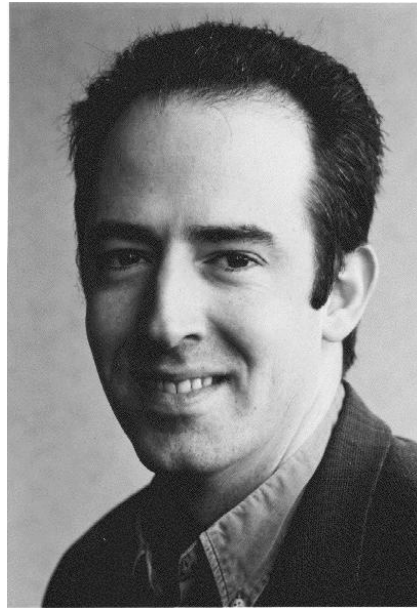
Dissemination of Logic

Just as calculus was the core of the scientific revolution in physics in the seventeenth century, logical computability may become the core of the present information revolution. Thus, it deserves a place in the common knowledge of the general educated public, and the logic community has the duty to make this happen. The scientific revolution shaped the world view of the educated public, not least through the secondary school curriculum. In the same way, we seek to establish an informed, critical understanding of the information era firmly in the minds of the people getting their education at the turn of the twentieth century.

We are planning the dissemination of a systematic perspective, by means of a series of electronic books with internet support, to be distributed free of charge, aimed at undergraduate university students, at secondary school curricula, and at the general educated public. Our pilots include: *Programming and Reasoning* (what do the activities of programming and reasoning have in common?), *Logic, Structure, and Proof* (what are the ingredients of mathematical proofs?), *Logic, Programs and Programming* (how does logic help us understand programs and actions in general?), *Language, Grammar and Meaning* (how does logic help us understand language structure and language meaning?), *Knowledge, Information Flow and Learning* (how can we understand knowledge acquisition and learning from experience?).
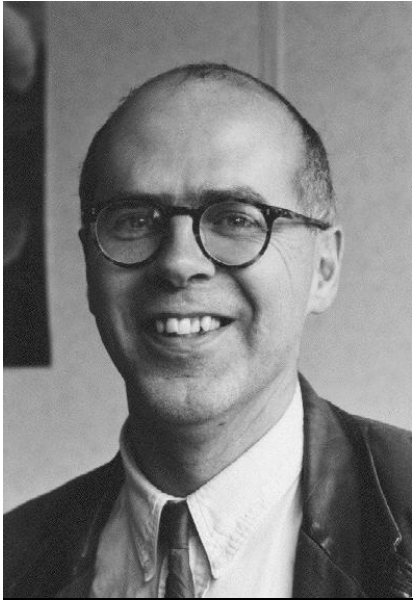
Prof. dr Jan van Eijck *is a Senior Researcher at CWI in Amsterdam, and scientific director of the Dutch Research School in Logic (OzsL). He also holds a part-time professorship at Uil-OTS, the Research Institute for Language and Speech at Utrecht University.*
Van Eijck's dissertation (1985) was on "Logical Aspects of Quantification in Natural Language." His current research interests are logical aspects of computational linguistics, semantics of natural language and its relation with programming languages. From 1987 until 1989, Van Eijck was employed by the CLE project at the Cambridge (UK) Computer Science Research Centre of SRI. Before that, he was an associate professor at the University of Tilburg, and in an even more distant past he was a teacher of philosophy and wrote a philosophy textbook that is still in use today.

We intend to link up with other national initiatives, and to establish closer links between university education and secondary school education. Internationally, cooperation is underway with the COMPULOG Network of Excellence created by the European Community. In addition, the project will offer post-academic courses for secondary school teachers in mathematics and computer science, and more generally, work toward involvement of our community in secondary school curriculum development for 'information science.'

3   Activities in 1997 and Plans for 1998

Further Support for the Project

First and foremost, 1997 was conspicuous, just for internal activities, but also for encouraging external support. The Spinoza team effort has been enhanced by a generous decision by the *Faculty of Mathematics, Computer Science, Physics and Astronomy* at University of Amsterdam to establish permanent positions for the team leaders De Rijke and Venema after the conclusion of this project. A similar decision by the *Faculty of Humanities* for the project leader Dekker is expected. Finally, the *Centre for Mathematics and Computer Science* has graciously offered some matching funds for additional post doc and Ph.D. positions in the Spinoza subprojects.

The Free Space of the Project

Beyond its three core projects, the overall project Logic in Action has a free space, devoted to stimulating general events and individual initiatives. This general part of the Spinoza project will continue to look for new opportunities for broader communication. No deterministic plan is envisaged. But here are some future projections.

There will be border crossing events, including several workshops: one on interfaces between logic and cognitive psychology (in cooperation with ILLC's NWO Pionier project on 'Reasoning with Uncertainty'); one on logic and economics (during the seventh CSLI Workshop on Logic, Language and Computation, Stanford), as well as further contacts of this kind with the international TARK society ('Theoretical Aspects of Rationality and Knowledge'); and one on visual reasoning (between the Intelligent Systems Lab Amsterdam and the Center for the Study of Language and Information, Stanford). These activities will be integrated with larger efforts towards a Center for Information Science at the University of Amsterdam.

A first round of Spinoza lectures, prizes, and other grants has started. In particular, these will be visible at the annual European Summer Schools on Logic, Language and Information (ESSLLI), where this project was strongly represented at Aix-en-Provence, August 1997, as it will also be at the next instalment in Saarbrücken, August 1998. Logic in Action has established an annual Spinoza lecture, plus some student grants at these international events. Further Spinoza grants have been made available to the 'Master of Logic' program at the University of Amsterdam, to increase its international range (current recipients are from Georgia, Israel and Russia). Another noteworthy type of sponsoring is an annual European prize for a best dissertation in pure and applied logic. Further types of broader communication are also envisaged, preferably in cooperation with NWO.

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Logic in Communication, Report 1997

The Logic in Communication project started its activities in 1997, making plans for the whole period, initiating a regular series of meetings on dynamic semantics, the organization of a couple of workshops, and a retraite which served to synchronize the activities of the main protagonists.

The first aim of Logic in Communication is to form a research group at ILLC, whose investigation centering around two firmly rooted research lines: modal logic and dynamic semantics. Paul Dekker has focused on the development of generally adequate formal notions of information exchange and 'information-support.' This has produced a formulation of felicity conditions which have been shown to preserve information quality. Yde Venema investigated the landscape of modal logics and showed various axiomatization and preservation results for relational algebras, Boolean algebra with operators, and modal logics for geometric structures and information change. One of the intended post doctoral researchers, Jelle Gerbrandy, is finalizing his thesis, which is concerned with common knowledge, dynamic epistemic logic, and non-well-founded sets.

Logic in Communication started a bi-annual series of strategic meetings on dynamic interpretation, bringing together Dutch researchers in dynamic semantics. In addition, the project organized a workshop on temporal logic (October), a workshop on games in logic and a workshop on topic and focus in discourse (both in December).

The *Temporal Logic* event served to promote interaction and cross-fertilization among active researchers in the area of temporal logic from the computer science and logic communities. The *Games in Logic* workshop at the eleventh Amsterdam Colloquium provided the audience with accessible overviews of the application of game-theoretic methods in various branches of logic, formal semantics and economic decision theory. On the spot, it led to some interesting interaction with similar ideas from computer science. The *Semantics of Topic and Focus in Discourse* was the theme of another workshop at the Amsterdam Colloquium. This is a lively subject in current research in linguistics and discourse semantics, and the workshop highlighted its role in the dynamic of discourse.

Apart from the organization and funding of directly project-related events, Dekker and Venema engaged in the international workshop "Questions under Discussion" (Amsterdam), a sixteen hour crash-course on 'Dutch style' dynamic semantics (Bielefeld, Germany), and the organization of the eleventh Amsterdam Colloquium on formal semantics (Amsterdam). Finally, one noteworthy development has been the award of a five-year extension by the KNAW to the earlier three year fellowship of Yde Venema. A similar extension will be requested for Paul Dekker in 1998.

Logic in Communication, Plans for 1998

In 1998 Logic in Communication will really start up and lay out further infrastructure. Apart from the two project leaders, three post doctoral researchers Jelle Gerbrandy (University of Amsterdam), Maarten Marx (Imperial College, London) and Alexandru Baltag (Indiana University, Bloomington) will be hired. The latter appointment will be a collaboration with the Programming Group of the Centre for Mathematics and Computer Science in Amsterdam. In addition, the project plans to extend the team with two Ph.D. students.

The major research activities in 1998 will lie at the interface between logic, reasoning and interpretation:

- products of modal logics
- spatial and temporal logics
- pragmatics and dynamics of interpretation
- discourse and information structure
- non-boolean modal logic
- information exchange and attitudinal structure
- dynamic logics for non-monotonic reasoning.

Logic in Communication, furthermore, has the following special events in store:

- Dynamic Interpretation Foundations Day (March)
- workshop Communication and Attitudes (Spring)
- ECDS Course Dynamic Semantics over the internet (Summer)
- workshop on Modal Logics for Space (Autumn)
- preparations for an International Colloquium on Knowledge and Action (to be held in 1999)
- invitation of guests working on Related Topics.

The first workshop brings together researchers of dynamic interpretation in the Netherlands to exchange recent insights and ideas. The workshop 'Communication and Attitudes' aims at cross-fertilization between theories of attitude ascriptions and information oriented theories of interpretation. The ECDS course 'Dynamic Semantics' is an academic and international course which is given entirely over the internet. 'Modal Logics for Space' constitutes the natural follow-up to the very successful workshop 'Temporal Logic' which was organized by Logic in Communication in 1997; the proceedings of the latter workshop will appear in 'Logic and Computation.' Finally, the colloquium Knowledge and Action will constitute the core event in Logic in Communication's existence, aimed at combining and reinforcing research in logic, language and artificial intelligence, bringing together Uppsala, Pittsburgh and other international centers in this field.

Computational Logic, Report 1997

In 1997 a number of pilot research efforts were started. These covered the following areas: *Expressiveness vs. Complexity in Description Logics*, *Semistructured Data*, *Natural Language Semantics*, and *Multi-Agent Theory Change*. We propose a brief description of each.

As to the first area, techniques from modal logic have been applied to characterize the expressive power of so-called 'terminological languages' in knowledge representation; both exact characterizations of individual languages and a complete classification of their relative expressive power have been obtained in collaboration with Natasha Kurtonina (Philadelphia) and Carlos Areces.

Data of the kind that can be found on the internet usually lacks the kind of rigid structure found in traditional databases. As it usually possesses some structure, this type of data is called 'semistructured' data. It is modeled using graphs, and the core database technologies for dealing with semistructured data are now being developed at various locations using graph based description logics. As part of the Computational Logic project, various aspects of expressive power have been studied in cooperation with Natasha Alechina (Birmingham).
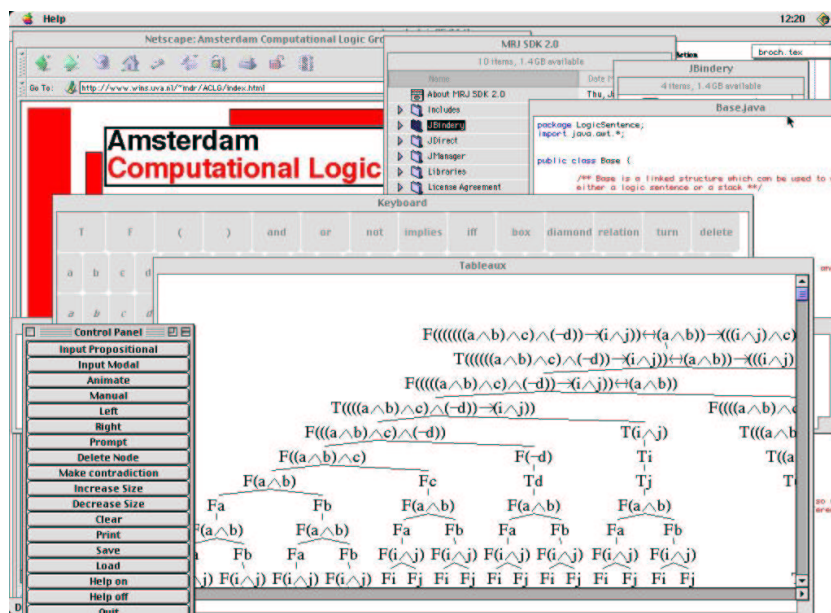
The Logic Proof Tableaux Animator, a graphical tool for tableaux proofs, developed by the Computational Logic project.

Natural language poses serious challenges to computational systems, one of the main reasons being the fact that most statements in natural language have multiple readings. While human beings don't usually have problems selecting the intended readings, for automated tools multiple readings pose a genuine problem with far reaching combinatorial, computational and logical implications. As part of the Computational Logic project, Christof Monz and Maarten de Rijke, developed a calculus for coping with ambiguous quantifier expressions such as 'Every man loves a woman.'

Information changes. As we discover new facts, our information may have to change to preserve consistency. The mechanisms underlying this process have been studied extensively over the past decade, but attention has mainly been restricted to a single agent operating in isolation. In collaboration with Wiebe van der Hoek (Utrecht) and Patrick Blackburn (Saarbrücken), we have developed a formal setting in which multiple agents change their information, some of which may be shared. The most important achievements have been identifying the relevant parameters, describing the interaction, and guaranteeing fairness and consistency.

As to service activities, in the course of 1997 a Computational Logic web site has been set up. This site is designed to become a 'one stop resource' for all computational logic matters at ILLC. In addition to providing access to theorem proving tools, it contains documentation, examples, comparisons, and links to further resources.

Computational Logic, Plans for 1998

Research efforts on the aforementioned research areas will be continued and expanded during 1998. In addition, a number of additional subprojects will be started up. These cover *Grammar Formalisms*, *Proof Strategies*, *the Bliksem Theorem Prover*, and *Java-based Logic Tools*.

Recent grammar formalisms use very rich, often multi-layered structures to explain linguistic phenomena. In many cases the function of the component structures is reasonably well understood, but it is not clear how computational properties of the complex structure are determined by the properties of the components. Together with Natasha Kurtonina (Philadelphia), we will study information flow in complex grammatical structures that are composed out of various kinds of graphs.

The subproject on proof strategies will be developed with Breanndán Ó Nualláin (CCSOM). It deals with improving the performance of existing automated theorem proving tools by combining aspects of reasoning that have traditionally been kept apart, such as proof search and the generation of countermodels. It is hoped that these approaches can interact in fruitful ways. Issues to be addressed are efficiency analysis, and completeness and incompleteness aspects of combined proof methods.

Bliksem is a theorem prover that was developed at ILLC by Hans de Nivelle. Using novel and highly optimized implementation techniques, increased efficiency and speed have been obtained. Further short term goals include extensive experimentation and benchmarking, and the development of strategies for dealing with special classes of problems.

The Java-based logic tools project will be developed in collaboration with Lex Hendriks and the 'Dissemination of Logic' project. Its aim is to implement basic logic techniques and algorithms in an object-oriented and visually attractive way. The result should be a workbench that is easily accessible and available on multiple platforms, and that can be integrated in current courses at ILLC.

Further ad hoc projects and collaborations will pursued as they arise. Currently, a joint effort with Brink (Cape Town) and Priestley (Oxford) concerns information order in the semantics of non-deterministic programs.

Seminars and reading groups on computational logic have been set up, and several scientific events are being planned as part of the project's service activities. These include the workshop FroCoS'98 on *combination of systems*, and a short course on the theorem prover Isabelle. The project's internet presence will be expanded, and we will start development of a 'virtual' Computational Logic Laboratory.

Dissemination of Logic, Report 1997

Dissemination of Logic is closely tied to logic research in those areas of logic where visualization of logic techniques and presentation of applications in various disciplines from a common perspective are the key factors. *Dynamic logic* provides such a perspective, by linking natural language processing to programming semantics. *Proof theoretic aspects of computational linguistics* are another example, because of the link between parsing and deduction. The quest for a *logic of ambiguity* addresses a concern in information processing and information presentation and suggests a new topic in logic research. Presentation of information and the logic of concept formation are all within the compass of the research connected to logic dissemination efforts. Dissemination of Logic has studied topics in all of these research areas.

Dissemination activities proper were started by setting up an infrastructure in the form of a support group to monitor the activities of the project and to maintain links with the surrounding world. The support group acts as a source of suggestions for setup of courseware, for comments on preliminary versions of material, and for experiments in the form of try-out runs of the material in teaching situations. Some of the support group members are involved in other national activities in logic dissemination, and will be giving feedback to the Spinoza initiative as a participant of these

sister projects. The support group also is the recruitment ground for a larger scale initiative to introduce information science (in a suitably broad sense, including logic) in the secondary school curriculum.
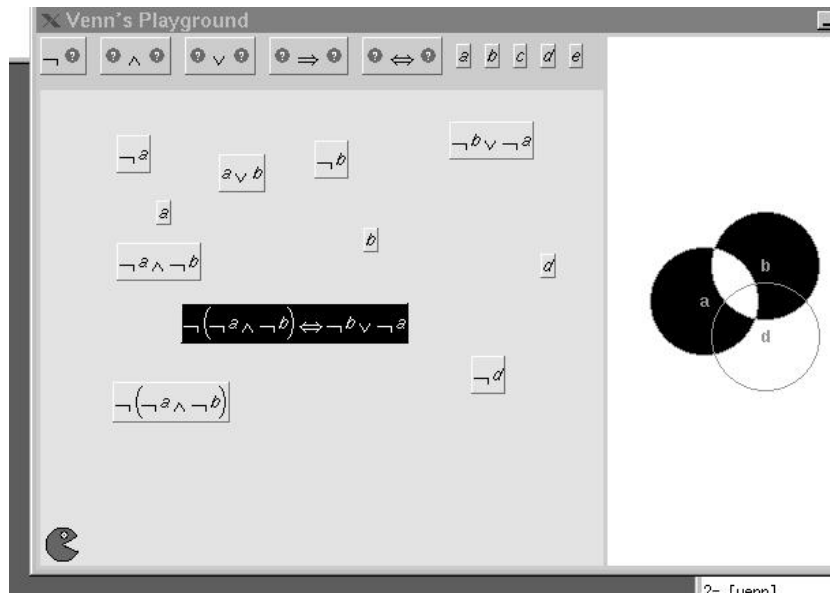
The Venn Playground tool for manipulating Venn diagrams was developed by the Dissemination of Logic project.

Actual course development work has started, either on the basis of involvement in existing courses (undergraduate courses in logic, reasoning and programming, teaching the language of mathematics) or development from scratch (dynamic logic hypertextbook, Logic Modules project). The first concrete result of these efforts is a manuscript 'Logic, Structure and Proof,' developed by Kees Doets and Jan van Eijck for a course on logic as the language of mathematics. The manuscript is now being tried out and will be turned into a book in 1998.

Public events were a lecture by Jan van de Craats during OzsL Prize Winner's day, a dissemination lunch during the OzsL School Week in October 1997, to establish firmer nationwide links, and a master course for mathematics teachers of secondary schools that was held at the University of Amsterdam, on proofs and algorithms.

Services to the local community include contributions to the logic curriculum at ILLC, with the aim of restructuring the material for existing courses, an international liaison service to The European Network of Excellence Compulog, where a vision of a distributed European Ph.D. curriculum is under development, and a national liaison service in linking up with other Dutch initiatives in Logic Dissemination.

Dissemination of Logic, Plans for 1998

Dissemination of Logic plans to integrate dissemination of old and new insights with research, with an emphasis on interesting new viewpoints. Presenting programming semantics and natural language semantics from uniform viewpoints suggests new research questions in dynamic logic. Visualizing proof systems in logic and parsing systems for natural language suggests strengthening of the links between deduction and parsing. Visualization of proof techniques also suggests a connection with new research in visual reasoning. And visualizing the progress of a computation throws new light on the process of computation itself. We plan to link up dissemination efforts with research in areas in logic where visualization and illustration of abstract principles by means of implementations shows the clearest promise.

In 1998 we will release first versions of courses that we have started to develop. A set-up of an electronic course on dynamic logic with a broad range of applications will be delivered. A new version of a course on 'Logic, Structure and Proof,' where the language of mathematics is introduced for undergraduate students of mathematics and computer science, will be produced, with emphasis on illustrating abstract principles by means of programs in a high level functional language (Haskell). We will extend our contribution to the production of material for the course 'Reasoning and Programming,' where the connection between reasoning about states of a system and logic-based program design is worked out. We will also produce a first version of Logic Modules, a modular course on logic at the undergraduate level. Work is underway to extend Logic Modules with material on Lambda Calculus, and to illustrate the abstract principles from lambda calculus with programs in Haskell and demonstrations in TYPO, an automatic type checker developed at ILLC and CWI.

A Java/Haskell based logic tools project will be set up in collaboration with the 'Computational Logic' project, to develop visually attractive implementations and illustrations of basic logic techniques and algorithms. The results of these development efforts will be integrated in current courses at ILLC.

A series of Logic Dissemination Events, biweekly on Fridays in Amsterdam, has been set up to serve as a means of interaction with our community. Dissemination events will be integrated with the activities of OzsL. A workshop on the theme of Modular Courseware Development to monitor the progress of the Logic Dissemination on a national scale, with speakers from the various Dutch groups involved in innovating courseware in our field. Contacts with secondary schools are being established, to investigate the possibilities for developing new teaching material for the pre-academic level from undergraduate courseware. Finally, we will prepare and submit at least one new grant proposal, preferably in collaboration with a broader group interested in the advancement of 'information science, broadly conceived.'

Grants

Logic in Action has awarded several grants, and will continue to do so.

1997
- Two grants for international students to attend the ESSLLI Summerschool.
- All students of the Dutch Graduate School in Logic OzsL received free membership of the European Association of Logic, Language and Information FoLLI.
- Two students were awarded a fellowship for the Master of Logic program at the ILLC.

1998
- A continuation and extension of the above.
- Award for the best European Ph.D. thesis in the field of logic.
- Special support for colleagues in Eastern Europe.

Eyal Hurvitz, student of Hebrew University, Jerusalem, was awarded a grant for the Master of Logic Program at ILLC.

"My formal background includes a bachelor degree from the Hebrew University of Jerusalem in Mathematics as a major, but during my studies I took many courses in theoretical linguistics, computational linguistics and AI. Last year I started an MA program in linguistics at the Hebrew University. My linguistic inclinations started with a strong attraction to modern theories of syntax, but then my interest in the semantics of natural languages was growing constantly just as my disappointment with the Chomskian tendency to ignore and to leave aside semantic aspects of the study of language. However, I was not satisfied with my detachment from mathematics. I felt that I needed a broader logical background. But at my home university I found no real cooperation between logicians and linguists. I felt that I needed a broader logical background. But at my home university I found no real cooperation between logicians and linguists. This was exactly what I was hoping to find at the University of Amsterdam, and in particular in the Master of Logic program,
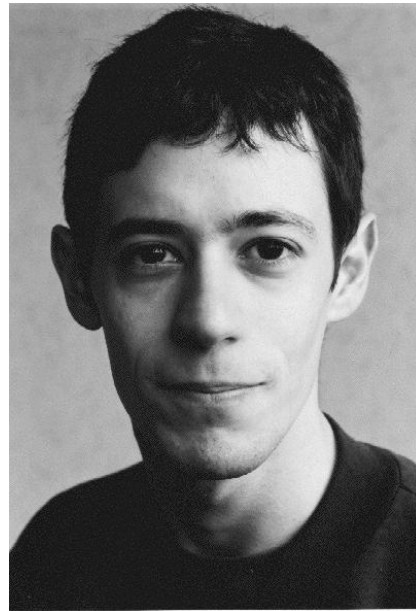
which is the result of a very deep collaboration between different departments. Indeed, at ILLC, logic is considered from an extremely wide perspective. Developments in one field often have broad consequences in others. For example, a great deal of the dynamic approach to meaning in natural language has its origins in the semantics of programming languages. New surprising and useful connections are being discovered constantly, and one gets more and more convinced that indeed, as some people have suggested, there emerges a new science that will capture all these fields, namely a new Information Science. As a Master of Logic student, I no longer feel that the fact that my interests criss-cross different fields makes me just an undecided student. I feel that I have found the right place. So far I have taken courses in dynamic semantics, intensional logic, non-monotonic reasoning, the semantics of programming languages, and I also attended classes such as proof theory. The Spinoza Fellowship, offered by Johan van Benthem, has made it possible for me to spend a year in Amsterdam, which apart from the Master of Logic programme constitutes a unique center of fruitful cooperation for logicians, linguists, computer scientists and philosophers of language."

Thomas Hofweber, student at the department of philosophy, Stanford University, attended ESSLLI'97 with a grant awarded by Logic in Action.

"ESSLLI is a large interdisciplinary conference that takes place every year in a different European city. Last year it was in Aix-en-Provence, France, and because of financial support I received from the Spinoza grant. The summer school consists in a number of introductory and advanced courses, workshops and symposia. It was attended by several hundred people, with quite a few of them presenting papers. The range of the topics under discussion was extremely wide, from the pure parts of logic, computer science and linguistics to any combination of the above, pure or applied.

ESSLLI is a combination of an intensive two week conference, a social event and a holiday, with the choice of the individual participants to focus on any one of these. It is a great opportunity to catch up with the latest developments in a field one knows something about, and to learn the basics in an area one has hardly heard of before. The Summerschool is in particular a great opportunity for people who mainly reside in the US, since it allows them to catch up with projects that get pursued in Europe, which are often quite different than the dominant ones in the US. It is a great opportunity to present one's own work. Because of the large number of experts that are present at the summer school one can expect to have quite a few in every presentation that is given, and one can expect to get critical feedback and hints about new direction one could take with one's work.

My own experience with this years summer school was very much in this spirit. I attended courses in areas that I have worked on quite a bit before, and in areas that

I knew basically nothing about. In some of them I learned things that I believe will be extremely helpful for me to know and that I will take recourse to in my dissertation. I got lots of feedback concerning the talks I gave. I presented a paper in the Symposium on Compositionality entitled "Does a Compositional Semantics Play an Explanatory Role?" where I tried to argue that the answer is, most likely at least, "No." And I presented a paper in a Workshop on Quantification, entitled 'Inferential Role and Domain Conditions' where I argued that some quantifier phrases have a reading that is mostly ignored, and I gave a formal model of quantifier phrases with this reading. I profited a lot from the comments I got on these papers. Some of them I got in the discussions following the presentations, but even more I got at dinners, in cafes and at parties in the evenings. A lot of the people I met in Aix I expect to see again next year, in Saarbrücken at ESSLLI 98."

Sol Feferman, professor at the department of philosophy and mathematics, Stanford University, gave the first Spinoza lecture at ESSLLI: "*What is a logical operation?*"

"In his well-known 1936 paper on the notion of logical consequence, Tarski left unsettled (and perhaps unsettleable) the exact division between logical and non-logical notions of a formal language. But then in a lecture thirty years later (published only in 1986 as a posthumous paper), Tarski proposed an explication of what constitutes a logical notion applying to objects in a type hierarchy over any given domain M, as being one which is invariant under arbitrary permutations of M. This notion has been characterized by Vann McGee in a recent paper in the J. Philosophical Logic, in terms of very strong infinitary languages. Though Tarski's proposal is simple and has an immediate intuitive appeal, and has been influential in abstract model theory and logical linguistics, I am deeply dissatisfied with it, especially as a result of McGee's characterization. In my talk I will explain the reasons for my dissatisfaction, and suggest alternative approaches to the main question which remain to be explored."

Exchanges

Logic in Action encourages international exchanges.

1997   • Nikolai Vereshagin from Moscow State University (13 May – 12 June).
       • Vladimir Rybakov from Krasnoyarsk, Russia (28 Sept – 12 Oct).
       • Johan van Benthem went to South Africa (17 – 28 Nov).

1998   • Grigori Mints from Stanford University (1 March – 22 March), as well as several other visitors.

Johan van Benthem's little trek in South Africa

"South African colleagues working on logic, computer science, and philosophy are seeking contacts with their Dutch counterparts. Last November, I made a lecture-packed two-week tour to Pretoria, Johannesburg, and Cape Town, visiting some five universities to explore the lie of the land, and preach logic à l'Hollandaise. Professionally, these colleagues are an interesting community, which we might support both for their own sake, and because this is a unique halfway station into black Africa, a continent which still has to really join the international scientific world.

The universities visited ran a gamut from western-style research establishments with an international flavour, through Afrikaans-speaking ones, to a 'correspondence university', and one in a former home land. These are really different cultures, with different problems. E.g., the University of South Africa is serving 130.000 students in a vast country by correspondence courses. I saw great opportunities for cooperation in electronic courseware — with the additional benefit that this way of teaching might spread into Africa at large. (More knowledgeable academic African explorers tell me that this might be the only form of development aid which has not yet been proven to fail.) More grimly, the homeland university was a battle zone between the races, where western methods of examining are considered racist and alien to African culture, and anyone opposing the slogan "Pass one, pass all" can count on violent invective, plus physical intimidation. But also nationally, I was shown official directives indicating how the government is pushing for a 'non-Europe-centric' curriculum, which means in practice: hiding the true history of the sciences, and inventing political myths.

Speaking generally, I found the picture painted in Dutch newspapers about the South African 'miracle' much rosier than what one can see with one's own eyes. At best, three very different worlds are co-existing (black, Afrikaans, English), which do not even share the same history. (I had to buy three books to get a perspective.) In logic, there is a much-used picture of branching 'possible futures.' South Africa has several of these: reconciliation, upsurge, downsurge, violence. I never realized that future branches can be so utterly different, and yet so very close together in historical space-time. But because of this very instability, the balance may be tipped by small things, and hence there is all the more reason for The Netherlands to get involved."

List of Events

The following is a calendar of events sponsored by Logic in Action.

1997

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May, 13 – 16	**TABLEAUX'97**, Analytic Tableaux and Related Methods, Pont-à-Mousson, France
May, 18	**Communication and Attitudes**, workshop, Amsterdam
July, 10	**Dynamic Semantics Workshop**, Amsterdam
August, 11 – 22	**ESSLLI'97**, Aix-en-Provence, France Spinoza Lecture by Prof. S. Feferman, Stanford University
October, 3	One day workshop on Temporal Logic
December, 18 – 20	**The 11th Amsterdam Colloquium**, Amsterdam – Workshop on Games in Logic – Workshop Semantics of Topic and Focus in Discourse

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1998

Spring	**Modular Course Development**, workshop to monitor the progress on a national scale of the Logic Dissemination activities.
March, 30	**Dynamic Interpretation**, workshop, Free University Amsterdam.
May, 18	**Communication and Attitudes**, workshop, ILLC.
Spring '98	A short course on the **Isabelle** workbench.
August, 17 – 28	**ESSLLI'98**, Saarbrücken, Germany – Maarten de Rijke is chairing the program committee. – The annual Spinoza lecture at ESSLLI. – 'Dynamic Semantics and Information Interchange', a course by David Beaver (Stanford) and Paul Dekker – 'Term Rewriting Systems', a course by Vincent van Oostrom (Utrecht University) and Yde Venema.
October, 2 – 4	**FroCoS'98**, the Second International Workshop on Frontiers of Combining Systems, Amsterdam
October, 16 – 18	**AiML'98**, Advances in Modal Logic '98, Uppsala, Sweden.

Local events include two bi-weekly colloquia on Fridays: "Dissemination" (Jan van Eijck) and "Logic Meetings" (Maarten de Rijke).

4 The World of Logic

Logic in Amsterdam (ILLC)

The local habitat of the Spinoza project Logic in Action is the Institute of Logic, Language and Computation (ILLC) at the University of Amsterdam. This is an interdisciplinary distributed research community, as shown in the map and table below:
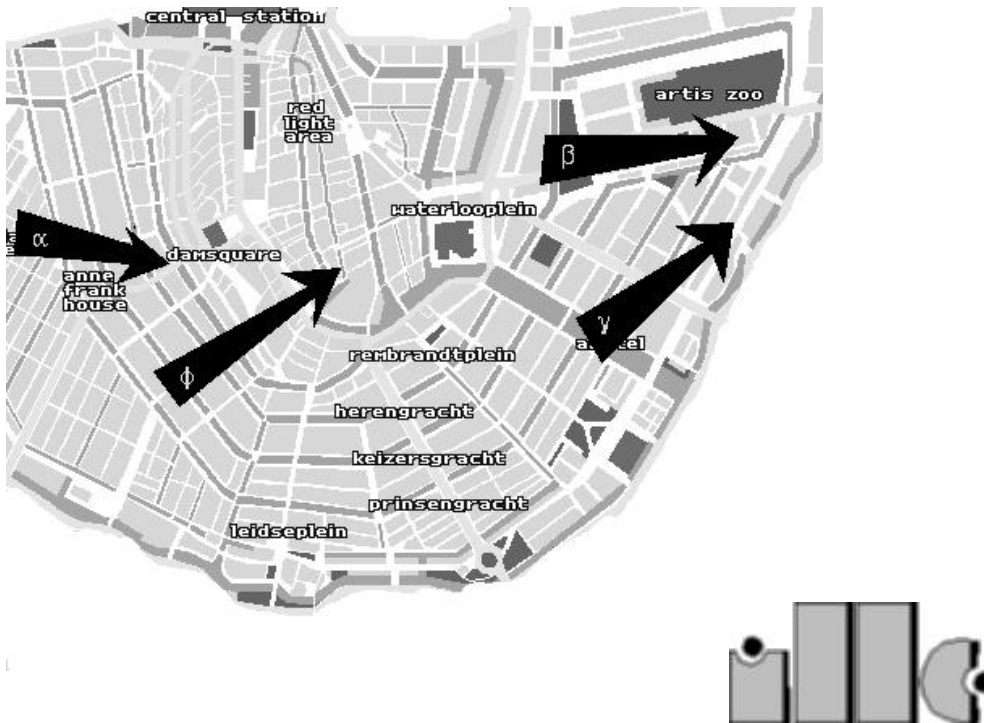
α Computational Linguistics, Faculty of Humanities

β Logic and Theoretical Computer Science, Faculty of Mathematics, Computer Science, Physics and Astronomy (WINS)

γ Applied Logic Lab, Faculty of Social Sciences

ϕ Philosophy of Language and Philosophical Logic, Faculty of Humanities

In addition, some ILLC research resides at the Science Park, Watergraafsmeer, Amsterdam.

For further information about ILLC, see the home page www.wins.uva.nl/research/illc/.

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Logic in The Netherlands (OzsL)

The national habitat of the Spinoza project Logic in Action is the Dutch Graduate School in Logic (OzsL), whose members and associatives are shown on the map and in the table below.

Amsterdam
- Institute for Logic, Language and Computation (ILLC), University of Amsterdam
- Intelligent Sensory Information Systems, University of Amsterdam
- Intelligent Autonomous Systems Group, University of Amsterdam
- Department of Social Science Informatics, University of Amsterdam
- Faculty of Computer Science, Free University Amsterdam
- Centre for Mathematics and Computer Science (CWI)

Utrecht
- Research Institute for Language and Speech (OTS), Utrecht University
- Department of Computer Science, Utrecht University
- Faculty of Philosophy, Utrecht University

Groningen
- Institute for Mathematics and Computer Science, University of Groningen
- Institute for Behavioral and Cognitive Neurosciences (BCN), University of Groningen

Nijmegen
- Computing Science Institute (section Logic), University of Nijmegen

Tilburg
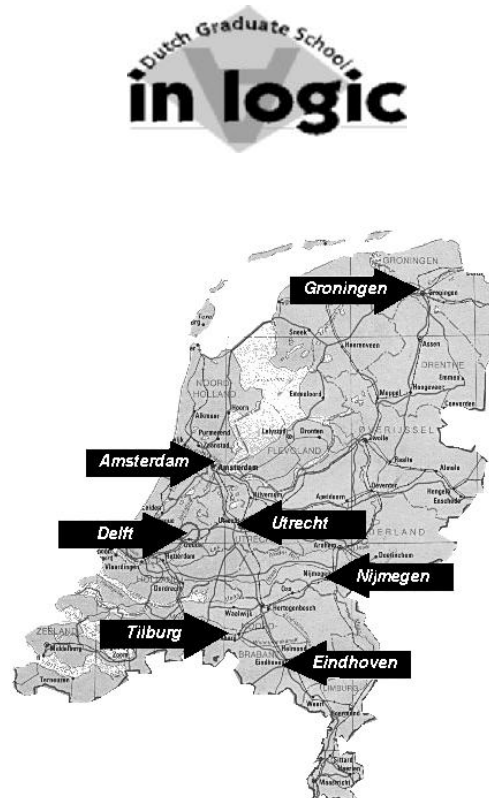- Faculty of Arts, Tilburg University

Delft
- Department of Technical Informatics, Delft University of Technology

Eindhoven
- Faculty of Mathematics and Computing Science, Computing Science Department Formal Methods Group, Eindhoven University of Technology

Electronic information about OzsL: www.wins.uva.nl/research/ozsl/.

Logic in Europe (FoLLI)

The closest international environment of the Spinoza project Logic in Action is the European Association for Logic, Language and Information (FoLLI). The organization gathered several enterprises under its aegis, including the Amsterdam Colloquia in Formal Semantics, the London-based Interest Group in Pure and Applied Logic (IGPL), and the European Summer Schools in Logic, Language and Information (ESSLLI). The map below shows the places where Summerschools took place.

1989: Groningen, 1990: Leuven, 1991: Saarbrücken, 1992: Colchester, 1993: Copenhagen, 1994: Lisbon, 1995: Barcelona, 1996: Prague, 1997: Aix en Provence, 1998: Saarbrücken

Logic in Action plays a supporting role at all levels of the next Summerschool. Students can apply for a grant to participate. Logic in Action sponsors the Spinoza Lecture, and moreover, most of the project leaders are involved in lecturing and in the organization. Maarten de Rijke is program chair. The 1999 Summerschool will be held in Utrecht (1999), and members of the Logic in Action project will participate in its organization.

Logic in Action provides free membership of FoLLI for all OzsL students.

Further information about FoLLI: www.wins.uva.nl/research/folli/

5 Spinoza and the Golden Age

An afterthought of Johan van Benthem to this project and its cultural setting

"Spinoza flourished in the 17th century, at the peak of Holland's Golden Age. The sciences had their Stevin, Huygens, Van Leeuwenhoeck, the arts their Rembrandt, Hals, Vermeer. Significantly, the commercial world showed amazing energy and creativity at the same time, and so did the political arena.

My personal favourite from this whole age is someone whose regent class was largely responsible for the climate of intellectual toleration which allowed Spinoza to flourish. *Johan de Witt* was the grand pensionary of Holland and the United Provinces. But also: mathematician, lawyer, statesman, and a man of great physical courage. While at the helm of the Dutch State, he also published a book on geometry praised by Newton, and in his studies of national finance, wrote "Waerdije", a little gem of a treatise on probability, statistics and life insurance, which made him one of the recognized founders of statistics in Europe. To be quite honest, I have spent some of my Spinoza time in 1997 for a study of De Witt. This is not entirely inappropriate. After the De Witt brothers died their gruesome death at the Plaats in Den Haag (my native city), Spinoza was one of the very few who dared protest — and who wanted to put a placard saying that the Dutch were barbarians. He was wisely restrained from putting the famed national tolerance to the test.

I hope that NWO will institute a 'De Witt Award' one day, but I wonder which latter-day Dutch person would ever be eligible for this kind of achievement. Recently, Bastiaan Willink has identified a second Golden Age, in the first decades of the 20th century, when Holland had its Lorentz, Brouwer, Van 't Hoff in science, its Van Gogh and Mondriaan in the arts. He does not treat the concomitant economical upsurge, but I think that Philips, Shell and Unilever demonstrate the same linkage as that in the 17th century. Did politics match in great personalities? No De Witt emerged, although I do think that prime minister Abraham Kuyper was an interesting figure, combining politics with cultural and religious vision. Read his Stone lectures, which are an unusual piece of intellectual achievement by present-day political measures.

What is the course of history? The ancient Greek poets saw a steady decline from golden ages through silver to bronze (and beyond . . .). What is the metal of our age? Modern ministers do not write innovative intellectual treatises. They do not lead the troops out to battle, not even on peace missions. The heroics of Dutch politics are confined to the corridors and debating rooms of a tiny enclave in Den Haag. But NWO's search for excellence emanates from that same city, and its helmsmen do mean old-fashioned 'excellence.' Let's work toward a third Golden Age then, and let time tell whether it was a search for the real thing, or for El Dorado."

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