HELSINKI UNIVERSITY OF TECHNOLOGY
Faculty of Information Technology
Department of Computer Science

DIGITAL SYSTEMS LABORATORY

Annual Report
May 1995

ANNUAL REPORT FOR THE YEAR 1994

edited by ILKKA NIEMELÄ

Digital Systems Laboratory
Department of Computer Science
Helsinki University of Technology
Otaniemi, FINLAND

Helsinki University of Technology
Department of Computer Science
Digital Systems Laboratory
Otaniemi, Otakaari 1
FIN–02150 ESPOO, FINLAND

HELSINKI UNIVERSITY OF TECHNOLOGY
FACULTY OF INFORMATION TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE
DIGITAL SYSTEMS LABORATORY
Annual Report
May 1995

Annual Report for the Year 1994

edited by ILKKA NIEMELÄ
Senior Assistant

Introduction:

This report describes the educational and research activities of the Digital Systems Laboratory at Helsinki University of Technology during the year 1994.

The educational and research activities of the Chair and of the Laboratory have recently been concentrated upon the areas: specification, modelling, and analysis of parallel and distributed digital systems and theoretical computer science.

Printing: TKK Monistamo; Otaniemi, 1995

Helsinki University of Technology
Department of Computer Science
Digital Systems Laboratory
Otaniemi, Otakaari 1
FIN–02150 ESPOO, FINLAND

Phone: $\frac{90}{+358\text{–}0}$ 4511
Telex: 125 161 htkk fi
Telefax: +358–0–465 077
E-mail: lab@saturn.hut.fi

Contents

1 Personnel

The university resources of the Chair consist of one *professor*, one *senior assistant*, one *teaching assistant*, a *laboratory manager*, and a *secretary*. A heavy load of the teaching tasks is also set to a large number of the students who, at the same time, are participating in the post-graduate education. The need of more permanent personnel resources for management, teaching, and research has been strongly felt during the whole history of the Chair.

1.1 University staff

Ojala, Leo	Prof.	Head of the Laboratory
Ukkonen, Esko	Prof.	Docent
Kangasniemi, Ulla	Mrs.	Laboratory Secretary
Lilius, Johan	Lic.Tech.	Laboratory Manager on leave of absence 1.2.–31.7.
Niemelä, Ilkka	Dr.Tech.	Senior Assistant
Tiusanen, Mikko	Ph.D.	Assistant on leave of absence
Nurmela, Kari	M.Sc.Eng.	Assistant as substitute 1.1.–31.5. and 1.8.–31.12.
Tomi Janhunen	M.Sc.Eng.	Laboratory Manager as substitute 1.6.–31.7.
Jussi Rintanen	Lic.Tech.	Laboratory Manager as substitute 1.4.–31.5.
Patric Östergård	Dr.Tech.	Laboratory Manager as substitute 1.2.–31.3.

1.2 Special lecturers

Heinonen, Rauno	Lic.Tech.	spring and autumn term
Kettunen, Esa	M.Sc.Eng.	spring term
Saksa, Antti	Lic.Tech.	spring term

also:

Janhunen, cf. 1.1, 1.4	spring term
Lilius, cf. 1.1, 1.4	spring and autumn term
Rintanen, cf. 1.1, 1.4	autumn term
Tiusanen, cf. 1.1	autumn term
Östergård, cf. 1.1, 1.4	spring and autumn term

1.3 Part-time teaching assistants

Rautila, Mika	M.Sc.Eng.	spring and autumn term

also:

Pyssysalo, cf. 1.4	spring and autumn term
Janhunen, cf. 1.1, 1.4	autumn term
Väisänen, cf. 1.4	spring term

1.4 Researchers

Janhunen, Tomi	Lic.Tech.	Researcher 1.1.–31.5., 1.8.–31.12. cf. also 1.1
Lilius, Johan	Lic.Tech.	Researcher 1.2.–31.7. cf. also 1.1
Nurmela, Kari	M.Sc.Eng.	Researcher 1.6.–31.7. cf. also 1.1
Pyssysalo, Tino	M.Sc.Eng.	Researcher 1.1.–31.12.
Rintanen, Jussi	Lic.Tech.	Researcher 1.1.–31.3., 1.6.–31.12. cf. also 1.1
Simons, Patrik	Stud.Tech.	Research trainee 1.6.–30.8.
Varpaaniemi, Kimmo	Lic.Tech.	Researcher 1.1.–31.12.
Väisänen, Pauli	Stud.Tech.	Research assistant 1.1.–30.9.
Östergård, Patric	Dr.Tech.	Researcher 1.1.–31.1., 1.6.–31.7. Researcher of the Academy of Finland 1.8.– cf. also 1.1

2 Educational activities

The aim of the education at the undergraduate level is to give students basic insight into theoretical computer science and parallel and distributed digital systems, as well as learning in applying the theoretical results to practice. At the post-graduate level knowledge in the aforementioned areas will be completed further, especially in some particular theoretical questions.

In the following list, for each course it is given in parentheses: the code according to the Study Programme of the University; the number of study credits (abbr. by *crt*, one crt signifies 40 hours of effective work), abbreviations *spt.*, *aut.*, and *N/A* express the spring term, autumn term, and nonavailability during the calendar year, respectively; and the name(s) of the lecturer(s).

2.1 Theoretical computer science

Logic in Computer Science: Basics

(Tik-79.144; 2 crts, aut.; *Rintanen*)
Propositional and predicate calculus; syntax, semantics, and proof theory of these. Applications of logic in computer science, e.g. mechanical theorem proving and logic programming.

Logic in Computer Science: Special Topics

(Tik-79.145; 3 crts, spt.; *Niemelä, Janhunen*)
The basics of modal and epistemic logics: proof, model theory and decidability results. Nonmonotonic logics and their applications in computer science.

Introduction to Theoretical Computer Science

(Tik-79.148; 2 crts, aut.; *Heinonen*)
Basics of the theories of automata and formal languages. Computability theory. Principal limitations of computers.

Discrete Structures

(Tik-79.149; 2 crts, spt.; *Lilius*)
Theory of ordered sets and lattices. Fundamentals of domain theory. Fixpoint theorems.

Automata and Formal Languages

(Tik-79.151; 2 crts, spt.; *Heinonen*)
The topic varies each year. The topic in 1994: Regular, context free, and context sensitive languages. Fuzzy languages. Corresponding automata. Parsing. Lindenmayer languages and systems.

Algorithms and Computability

(Tik-79.153; 2 crts, aut.; *Heinonen*)
Models of computation. Complexity theory. The principles of construction of algorithms. Classification and reducibility of problems. Decidability.

Formal Description of Computing Systems

(Tik-79.157; 2 crts, aut.; *Lilius*)
Introduction to modern specification and verification methods and tools. Fundamentals of algebraic specification, specification using process algebra, and verification using temporal logics. Use of computer tools (Larch Prover, Concurrency Workbench, PAM, OBJ3).

Cryptography and Data Security

(Tik-79.159; 3 crts, spt.; *Saksa, Östergård*)
Data security. Data encryption and decryption. Classical, contemporary and future cryptosystems. Digital signatures and message authentication.

Student Project in Theoretical Computer Science

(Tik-79.189; 3 crts, spt. & aut.)
An independent study in the field of theoretical computer science.

Special Course on Theoretical Computer Science

(Tik-79.192; 2 crts, aut.; *Ojala*)
The course focuses on some current application of theoretical computer science. The topic varies from year to year. The topics in autumn 1994: concurrency theory; timed net formalisms.

Seminar on Theoretical Computer Science

(Tik-79.194; 2 crts, spt.; *Ojala*)
Temporal logic in specification and verification of distributed and parallel systems.

Postgraduate Course on Digital Systems Science

(Tik-79.198, 10 crts, spt. + aut.; *Ojala*)
Topics of the spring term: mathematical logic; model theory.

Topics of the autumn term: probabilistic logic; genetic algorithms.

2.2 Parallel and distributed systems

Parallel and Distributed Digital Systems

(Tik-79.179; 3 crts, aut.; *Lilius, Tiusanen*)
Introduction to net theory. Net classes, their properties and analysis

techniques. Applications in modelling digital systems with nets. Process algebras, specifically CCS, and its application to digital systems.

Parallel and Distributed Computation

(Tik-79.184; 3 crts, N/A; *Östergård*)
Formal specification and verification of parallel systems. Modelling and analysis of communication protocols. Partial analysis of reachability graphs.

Formal Description Techniques for Concurrent Systems

(Tik-79.193; 2 crts, spt.; *Kettunen*)
Specification, validation, testing and analysis methods for large parallel, embedded, and real time systems. Specification languages LOTOS and SDL.

3 Research activities

The particular research topics and projects are described in the following subsections. In the descriptions the members of the research groups are given in parentheses, beginning with the leading or senior researcher.

3.1 Theoretical studies

Petri net research *(Ojala, Lilius, Pyssysalo, Varpaaniemi)*

- *The analysis of algebraic high level nets* (Lilius).

  The notion of folding of nets has been studied further. It is shown that the folding construction of a high level net $Fold(N)$ from a Petri net N can be extended to high level nets. That is, given a high level net N_1, a Petri net N_2 and a folding from the underlying net of N_1 to N_2 we can construct a high level net N_3 such that the unfoldings of N_1 and N_3 are isomorphic. This construction is then used to construct deadlock-free skeletons of algebraic high level nets.

  The semantics of Petri nets has been studied within the "Structured Transition Systems" paradigm of Corradini and Montanari. It is shown that high level nets can be seen as graphs over monoidal substitution systems. The semantics of high level nets are then obtained through a free construction.

  Finally, transformations between different kinds of annotation formalisms have been studied. It is shown that the equivalence between order-sorted algebra and (conditional) many-sorted algebra lifts to an equivalence between the corresponding categories of high level nets.

- *The analysis of broadband multimedia services* (Pyssysalo)

  The study of the properties of a new movie scheduling algorithm of a video on demand system has been initiated. Parallel queues, distributed interactive servers, parallel machine scheduling and the bunching property made the analysis interesting. In the analysis the predicate/transition nets formalism is used with which feasible results of the temporal behaviour of the system could not be obtained.

  In the future the research will concentrate on studying induction theorems for high-level Petri nets, dealing with time, and the application of the theorems to the analysis of distributed telecommunication services provided by the broadband intelligent networks.

- *Efficient reachability analysis* (Varpaaniemi)

  Reachability analysis, also known as *exhaustive simulation* or *state space generation*, is a powerful formal method for detecting errors in such concurrent and distributed systems that have a finite state space. It suffers from the so called *state space explosion problem*, however: the state space of the system can be far too large with respect to the time and other resources needed to inspect all states in the space. Fortunately, errors can be detected in a variety of cases without inspecting all reachable states of the system.

  Techniques alleviating the state space explosion problem have been studied. So far the research has concentrated on two such techniques: Valmari's *stubborn set method* and Godefroid's *sleep set method*. In the research weak but sufficient conditions for combining these two methods have been developed. At the moment the primary goal is to get to know how efficient the stubborn set method, the sleep set method and some related methods are in practice. For this purpose, case studies are performed with the aid of the PROD tool.

Applications of logic in computer science and engineering *(Niemelä, Janhunen, Rintanen, Väisänen)*

The research has concentrated on the theoretical foundations of knowledge representation and it has been focused on *nonmonotonic reasoning*, one of the key areas in knowledge representation. *Autoepistemic logic*, a leading formalization of nonmonotonic reasoning, has been used as the basis of the research. Autoepistemic logic has been studied as a unified framework for nonmonotonic reasoning and, in particular, as a basis for automating nonmonotonic reasoning. The notions of priorities and weakened negative introspection in autoepistemic reasoning have been investigated intensively. A study of the use of the logic of knowledge in distributed systems has been carried out.

- *A framework for automating nonmonotonic reasoning* (Niemelä)

  The problem of automating nonmonotonic reasoning has been studied. Several forms of nonmonotonic reasoning have been proposed in the literature. Despite different starting points and underlying intuitions, leading approaches to nonmonotonic reasoning have turned out to be closely related. The aim of the research is to exploit the close connections so that a single theorem proving method could be used as a unified approach to automating a wide range of forms of nonmonotonic reasoning. An interesting idea is to choose some formalization of nonmonotonic reasoning as a basic system and develop a decision method for it. Decision procedures for other forms of nonmonotonic reasoning can then be realized by reducing decision problems in a given formalization to decision problems in the basic system. We have considered the possibility of using a recently developed variant of autoepistemic logic, L-hierarchic autoepistemic logic, as the basic system. It has already been shown how other leading formalizations of nonmonotonic reasoning such as default logic, circumscription, logic programs, truth maintenance systems, and forms of abduction can be understood as special cases of the new variant of autoepistemic logic.

  A novel decision method for autoepistemic reasoning has been developed. It is applicable in a general setting, i.e. for an autoepistemic logic defined on top of a given classical logic. The method provides a conceptually clear framework for developing optimization techniques where sources of complexity and targets for further optimization are clearly identifiable. Two orthogonal sources can be identified: classical reasoning and conflict resolution. The classical reasoning task can be handled using a separate theorem prover. The decision method imposes no additional requirements leaving abundant room for optimizations of the theorem prover. The conflict resolution task is solved by employing a backtracking scheme. The method exploits efficiently the monotonicity of the underlying consequence relation to reduce choice points in backtracking.

  As an application of the optimization framework provided by the novel method, the automation of Reiter's default logic has been studied. As reasoning in default logic can be mapped straightforwardly to autoepistemic reasoning, the novel method provides a directly applicable basis for automating default logic. We have used the novel method as the basis and developed further optimization techniques which take advantage of the characteristic properties of default logic. This has led to a simple but efficient new decision method for default logic. Experiments with an initial implementation indicate that this decision method can achieve performance unmatched by other currently available decision methods for default logic.

- *Cautious autoepistemic reasoning* (Niemelä, Janhunen)

  The research on *cautious autoepistemic logic* has been continued. This logic can be understood to approximate the reasoning corresponding to cautious reasoning in Moore's autoepistemic logic. A nonmonotonic proof system has been devised for cautious autoepistemic logic in classical style. Structural properties of the corresponding notion of derivability have been investigated. Results indicate, e.g., that cautious autoepistemic reasoning is not cumulative in general but allows the use of the cut rule in derivations. The complexity of cautious autoepistemic reasoning has been analyzed. The major reasoning tasks of cautious autoepistemic logic have been classified with respect to the polynomial time hierarchy (PH). The main reasoning task of cautious autoepistemic logic corresponds to a complete problem on the second level of PH. General logic programs, i.e., logic programs with negation as failure, have also been analysed using the framework. A semantics for general logic programs can be defined in terms of cautious autoepistemic logic. Most importantly, the semantics assigns a unique set of conclusions to every general logic program. Moreover, the sets of conclusions provided by the semantics are more accurate than those provided by the widely known well-founded semantics.

- *Priorities and specificity in nonmonotonic reasoning* (Rintanen)

  The research is continuation of earlier work on priorities in nonmonotonic reasoning. A major problem in representing knowledge is posed by the possibility of default rules that conflict. If the application of both of two default rules leads to a contradiction, they cannot both be applied. In such cases a reasoner may either remain indifferent or prioritize one rule over the other. If there is a conflict between a general default (that concerns the members of some class C) and a less general default (that concerns only a small subset of C), the less general default should be given a higher priority because it is more specific to the situation at hand. This – the specificity of default rules – is an important source of priorities, which has earlier been investigated in detail in the context of inheritance networks.

  A priority mechanism that uses lexicographic comparison has been introduced to Reiter's default logic. The goal of the research is to devise ways of computing priorities according to specificity and to be used with the priority mechanism. As with inheritance networks, there is no single universally accepted notion of specificity. At the initial stages of the research, a weak specificity principle that is satisfied by inheritance theories, logics based on conditional probability, and conditional logics, has been used as the basis of specificity-based priorities. Methods for computing specificity-based priorities according to the principle have been presented, and ways to strengthen the principle have been tentatively investigated. The research has produced a strong basis for further research on specificity in the context of default logic. Short-term goals of the research are the generalization of inheritance networks to the setting of default logic, and the determination of the range of applicability of lexicographic priority mechanisms in achieving specificity-obeying inference.

- *Model determination problems in S5 logic* (Väisänen)

  Reasoning about knowledge in distributed systems is a formal method for modelling, analysing and verifying distributed systems. A formal model of distributed systems consists of runs. A run is a description of the execution of the system over time. Knowledge is ascribed to a distributed system through a view-based knowledge interpretation. Together a view and a run constitute a model structure of S5 logic. Altogether, the study of model determination problems is inspired by the use of the S5 logic as a logic of knowledge in distributed systems.

  The aim of the research is to present a technical foundation for the determination of all possible models of a distributed system. Hence, models of S5 logic are treated rather than models intended only for a certain kind of distributed systems. The work contains an answer to the problem of determining all possible models of a given single agent S5 sentence. The single agent case is carefully considered in order to get a partial solution for a more general problem, namely, the determination of projection models of a given multi-agent sentence. The general problem corresponds to the problem of determining an agent's local knowledge according to a specification of a distributed system.

Stochastic methods in coding theory and discrete geometry
(Östergård, Nurmela)

The aim of the research is to develop methods for solving packing and covering problems in coding theory, design theory and discrete geometry. Particular stress has been laid on computational methods. Among these, simulated annealing and tabu search, two stochastic methods applicable to combinatorial optimization problems, have played a central role. In the research, the performance of these and other optimization methods has also been evaluated.

Stochastic optimization methods can as such successfully be used to construct good small coverings and packings. Research has also been done on constructing very large codes. The two most important methods work as follows: old codes are partitioned and combined to obtain a new code, and a new code is constructed by taking a union of cosets of a linear code. Various other combinatorial and algebraic methods have also been developed. These methods have been used to construct many record-breaking coverings and packings.

Packing codes can be used as error-correcting codes, and covering codes and covering designs can be used as football pool systems and lottery systems, respectively. Methods for finding good packings in Eucledian geometry have many practical applications; they can, for example, be used to optimize container stowage. Preliminary studies have been carried out on constructions of other combinatorial structures than those of the aforementioned types.

3.2 Technical projects

PROD 3.0 *(Varpaaniemi)*

The PROD 3.0 project is funded by Technology Development Centre of Finland (TEKES), Nokia Telecommunications Oy, Telecom Finland Oy, and Commit Oy and it continues the development of PROD, a high-level Petri net reachability analysis tool, and includes case studies. The results of the year 1994 include an on-the-fly verification method that can be used for fast detection of certain kinds of erroneous behaviour in the modelled system. The on-the-fly verification method is supported by the so called stubborn set method and the so called sleep set method. The on-the-fly verification method of PROD has also been extended in such a way that it can be used by the users of another reachability analysis tool, the ARA tool of Technical Research Centre of Finland (VTT). The rest of the project will concentrate on case studies. Until now, a simple telephone protocol, YXA of Nokia Telecommunications Oy, has been analyzed. Many errors have been found in YXA, and the found errors have also been fixed.

Determination of maximal queuing times of Frame Synchronized Ring *(Pyssysalo)*

Frame Synchronized Ring (FSR) is a new high speed interconnection network (up to 1.6 Gbps and more) developed for a wide range of real time switching applications in Technical Research Centre of Finland (VTT). The high throughput of the FSR is due to an effective distributed medium access control (MAC) mechanism.

The aim of this work has been to find the worst case blocking sequence of the MAC algorithm. The behaviour of the algorithm has been analyzed with PROD, which is a predicate/transition net reachability analysis tool developed at the Digital Systems Laboratory. The net model of the algorithm has been constructed in such a way that the firing of the transition in the net model corresponds to the bus clock cycle in the algorithm. By counting the number of transitions in the waiting sequence of one node, it has been possible to determine the waiting time of the node directly by multiplying the number of fired transitions and the frequency of the bus clock. As a result it turned out that the maximal blocking sequences increase much faster than expected. With small number of nodes one extra node almost doubles the worst case blocking sequence.

Broadband intelligent networks *(Pyssysalo)*

The deployment of Asynchronous Transfer Mode (ATM) technology is continuously increasing the transfer capacity of the telephone network. Services demanding data rates of several Mbps can be easily offered to every household and business organization in the network of the future. Examples of such services are Video and Audio on Demand and Video Conferencing System.

The problem of the broadband networks is incomplete standardization. Network operators have to use vendor specific equipment, which is very expensive and may become useless when the standards are developed. In this work it has been studied how suitable different signalling protocols of broadband (Q.2931, Q.2761-Q.2764) and intelligent (Q.1218) networks are for the control of the broadband intelligent networks. During the study, the current standards have turned out to be inconsistent and unmaturate in many ways. For example, the messages of one protocol do not map into messages of another protocol. In the study some guidelines have been presented according to which the standards should be developed so that the broadband intelligent network prototype could be implemented in an inexpensive way.

4 Examinations and theses

4.1 Licentiate in Technology

Janhunen, Tomi:	Investigations on Cautious Autoepistemic Reasoning

4.2 Master of Science in Engineering

Hakulinen, Kari:	Computer-Aided Testing of Cellular Communication Protocols (in Finnish)
Pyssysalo, Tino:	The Modelling and Analysis of a High Speed Data Bus with Predicate/Transition Nets
Rautila, Mika:	Process Algebraic Methods in Specifying and Analysing Intelligent Network Services (in Finnish)
Saarhelo, Jari:	Artificial Intelligence in the Casting Process Design (in Finnish)
Väisänen, Pauli:	A Study of Model Determination Problems in S5 Logic

5 Awards

Ilkka Niemelä was granted the annual Dissertation Award of the Finnish Society for Computer Science for a distinguished doctoral thesis in Computer Science in 1993.

6 Conferences, tours, and visits

6.1 Conferences and tours

Ojala, Leo	5th Conference on Theoretical Aspects of Reasoning about Knowledge, 13.–16.3., Pacific Grove, CA, USA.
	15th International Conference on Application and Theory of Petri Nets, 20.–24.6., Zaragoza, Spain.
	1994 ACM Symposium on Principles of Distributed Computing, 14.–17.8., Los Angeles, CA, USA.
	Fifth International Conference on Concurrency Theory, 22–25.8., Uppsala, Sweden.
	3rd International Workshop on Concurrency, Specification, and Programming, 12.–14.10., Berlin, Germany (Presentation: Modelling of a "Video on Demand" System Using Pr/T-Net Formalism - a Case Study, with Tino Pyssysalo).
	5th International Workshop on Graph Grammars and their Application to Computer Science, 13.–18.11., Williamsburg, VA, USA.
Janhunen, Tomi	7th Finnish Symposium on Computer Science, 10.–12.1, Liperi, Finland (presentation: Cautious Autoepistemic Reasoning Applied to General Logic Programs).
Lilius, Johan	The Annual General Meeting of the ESPRIT Basic Research Working Group 6067 CALIBAN, 20.6., Zaragoza, Spain (presentation: Folding Place/Transition Nets).
	15th International Conference on Application and Theory of Petri Nets, 20.–24.6., Zaragoza, Spain.
	Fifth International Conference on Concurrency Theory, 22–25.8., Uppsala, Sweden.

Algorithmen und Werkzeuge für Petrinetze (Workshop der GI-Fachgruppe 0.0.1 “Petrinetze und verwandte Systemmodelle”), 10.–11.10, Berlin, Germany.

3rd International Workshop on Concurrency, Specification, and Programming, 12.–14.10., Berlin, Germany (presentation: Folding Place/Transition Nets).

Niemelä, Ilkka

4th International Conference Principles of Knowledge Representation and Reasoning, 24.–27.5, Bonn, Germany (presentation: A Decision Method for Nonmonotonic Reasoning Based on Autoepistemic Reasoning).

5th International Workshop on Nonmonotonic Reasoning, 29.5.–1.6, Schloß Dagstuhl, Germany (presentation: Implementations of Nonmonotonic Systems).

12th International Conference on Automated Deduction, 26.6–1.7., Nancy, France (tutorial: Proof System for Nonmonotonic Logics, with Camilla Schwind).

11th European Conference on Artificial Intelligence, 8.–12.8., Amsterdam, the Netherlands.

International Workshop on Algorithms, Complexity, and Commonsense Reasoning, 9.8., Amsterdam, the Netherlands (Presentation: A Decision Method for Nonmonotonic Reasoning Based on Autoepistemic Reasoning).

DRUMS WP2/3 Meeting, 23.–26.9., London, U.K. (presentation: Towards Efficient Nonmonotonic Reasoning).

Logic Programming and Nonmonotonic Reasoning Retreat, 8.–10.10., Pleasant Hill, KY, USA (presentation: Implementing Nonmonotonic Reasoning).

University of Kentucky, 10.–11.10., Lexington, KY, USA, (presentation: Towards Efficient Nonmonotonic Reasoning).

Pyssysalo, Tino

6th Euromicro Workshop on Real-Time Systems, 15.–17.6., Västerås, Sweden.

15th International Conference on Application and Theory of Petri Nets, 20.–24.6., Zaragoza, Spain.

20th Euromicro Conference 5.–8.9., Liverpool, U.K. (presentation: Proving Properties of a New High Speed Data Bus with Predicate/Transition Nets).

3rd International Workshop on Concurrency, Specification, and Programming, 12.–14.10., Berlin, Germany (Presentation: Modelling of a "Video on Demand" System Using Pr/T-Net Formalism - a Case Study, with Leo Ojala).

Rintanen, Jussi

7th Finnish Symposium on Computer Science, 10.–12.1, Liperi, Finland (presentation: Approaches to Priorities in Default Reasoning).

4th European Workshop on Logic in Artificial Intelligence, JELIA'94, 3.-10.9.. York, U.K. (presentation: Prioritized Autoepistemic Logic).

Varpaaniemi, Kimmo

Annual General Meeting of the ESPRIT Basic Research Working Group 6067 CALIBAN, 20.6., Zaragoza, Spain (presentation: ARA and PROD: LOTOS and Petri Nets in Computer-Aided Verification).

15th International Conference on Application and Theory of Petri Nets, 20.–24.6., Zaragoza, Spain (presentations: On-the-Fly Verification with PROD; On Combining the Stubborn Set Method with the Sleep Set Method).

Fifth International Conference on Concurrency Theory, 22–25.8., Uppsala, Sweden.

Algorithmen und Werkzeuge für Petrinetze (Workshop der GI-Fachgruppe 0.0.1 "Petrinetze und verwandte Systemmodelle"), 10.–11.10, Berlin, Germany (presentation: On-the-Fly Verification with PROD).

3rd International Workshop on Concurrency, Specification, and Programming, 12.–14.10., Berlin, Germany (presentation: The Sleep Set Method Revisited).

Östergård, Patric

VI Teollisuus- ja insinöörimatematiikan päivät, 23–24.5., Tampere, Finland (presentation: Combinatorial Optimization by Local Search).

20th Australasian Conference on Combinatorial Mathematics and Combinatorial Computing, 5.–9.12., Auckland, New Zealand (presentation: New Multiple Covering Codes by Tabu Search).

6.2 Visiting scholars

Horst Wedde, Prof., University of Dortmund, Germany, 11.–14.6. and 21.9., (gave two lectures titled "Determining the Worst-Case Blocking sequences for Distributed Real-Time Programs" and "Achieving Dependability in Mission-Critical Operating Systems through Adaptability and Large-Scale Functional Integration").

Juan Garay, Dr, IBM T.J. Watson Research Center, 17.–21.5., (gave four lectures titled "Fully Polynomial Byzantine Agreement in t+1 Rounds"; "Reaching (and Maintaining) Agreement in the Presence of Mobile Faults"; "A Sub-Linear Time Distributed Algorithm for Minimum-Weight Spanning Trees" and "To Share or not to Share: Competitive Algorithms for Call Control and Video on Demand").

7 Documents

7.1 Journal articles

Ilkka Niemelä: Autoepisteeminen logiikka epämonotonisen päättelyn pohjana (Autoepistemic logic as a basis for nonmonotonic reasoning; in Finnish), Tietojenkäsittelytiede 6 (1994), 15–25.

Ilkka Niemelä and *Jussi Rintanen*: On the Impact of Stratification on the Complexity of Nonmonotonic Reasoning, Journal of Applied Non-Classical Logics 4 (1994) 2, 141–179.

Leo Ojala and *Johan Lilius*: Development of Reachability Analysis Tools at Helsinki University of Technology, Petri Net Newsletter 47 (1994), 36–42.

Tino Pyssysalo: Proving Properties of a New High Speed Data Bus with Predicate/Transition Nets, Microprocessing and Microprogramming 40 (1994), 791–794.

Patric Östergård: New Upper Bounds for the Football Pool Problem for 11 and 12 Matches, Journal of Combinatorial Theory. Series A. 67 (1994), 161–168.

7.2 Articles in collections

Ilkka Niemelä and *Jussi Rintanen*: On the Impact of Stratification on the Complexity of Nonmonotonic Reasoning. In: Lakemeyer, G. and Nebel, B.

(eds.), Foundations of Knowledge Representation and Reasoning, Lecture Notes in Artificial Intelligence 810, Springer-Verlag, Berlin, 1994, pp. 275–295.

Patric Östergård: On the Construction of Mixed Covering Codes. In: Gyllenberg, M. and Persson, L.E. (eds.), Analysis, Algebra, and Computers in Mathematical Research, Marcel Dekker, New York, 1994, pp. 387–408.

7.3 Conference papers

Tomi Janhunen: Cautious Autoepistemic Reasoning Applied to General Logic Programs; Proceedings of the Seventh Finnish Symposium on Computer Science, Liperi, Finland, January 1994; University of Joensuu, Department of Computer Science, Report A-1994-1, Joensuu, 1994; pp. 33–46.

Johan Lilius: Folding Place/Transition Nets. Proceedings of the Third International Workshop on Concurrency, Specification, and Programming, Berlin, Germany, October, 1994; Humboldt Universität zu Berlin, Institut für Informatik, Informatik-Bericht 36, Berlin, 1994.

Ilkka Niemelä: A Decision Method for Nonmonotonic Reasoning Based on Autoepistemic Reasoning; Proceedings of the Fourth International Conference Principles of Knowledge Representation and Reasoning, Bonn, Germany, May 1994; Morgan Kaufmann Publishers, San Francisco, 1994; pp. 473-484.

Tino Pyssysalo and *Leo Ojala*: Modelling of a "Video on Demand" System Using Pr/T-Net Formalism - a Case Study; Proceedings of the Third International Workshop on Concurrency, Specification, and Programming, Berlin, Germany, October, 1994; Humboldt Universität zu Berlin, Institut für Informatik, Informatik-Bericht 36, Berlin, 1994.

Jussi Rintanen: Approaches to Priorities in Default Reasoning; Proceedings of the Seventh Finnish Symposium on Computer Science, Liperi, Finland, January 1994; University of Joensuu, Department of Computer Science, Report A-1994-1, Joensuu, 1994; pp. 121–131.

Jussi Rintanen: Prioritized Autoepistemic Logic; Proceedings of the Fourth European Workshop on Logics in AI, JELIA'94, York, England, September 1994; Lecture Notes in Artificial Intelligence 838, Springer-Verlag, Berlin, 1994; pp. 232–246.

Kimmo Varpaaniemi: On Combining the Stubborn Set Method with the Sleep Set Method; Proceedings of the 15th International Conference on Application and Theory of Petri Nets, Zaragoza, Spain, June 1994; Lecture Notes in Computer Science 815, Springer-Verlag, Berlin, 1994; pp. 548–567.

Kimmo Varpaaniemi: On-the-Fly Verification with PROD. Proceedings of Workshop der GI-Fachgruppe 0.0.1 "Petrinetze und verwandte Systemmodelle", Berlin, Germany, October 1994; Universität Karlsruhe (TH), Institut für

Angewandte Informatik und Formale Beschreibungsverfahren, Bericht 309, Karlsruhe, 1994; pp. 80–83.

Kimmo Varpaaniemi: The Sleep Set Method Revisited; Proceedings of the Third International Workshop on Concurrency, Specification, and Programming, Berlin, Germany, October, 1994; Humboldt Universität zu Berlin, Institut für Informatik, Informatik-Bericht 36, Berlin, 1994.

7.4 Laboratory reports

Ilkka Niemelä (Ed.): Annual Report for the Year 1993, May 1994, 21 p.

Series A: Research Reports

No. 29 *Tino Pyssysalo*: The Modelling and Analysis of a High Speed Data Bus with Predicate/Transition Nets, March 1994, 73 p.

No. 30 *Johan Lilius*: On the Folding of Algebraic Nets, August 1994, 28 p.

No. 31 *Tomi Janhunen*: Investigations on Cautious Autoepistemic Reasoning, December 1994, 77 p.

Series B: Technical Reports

No. 12 *Kimmo Varpaaniemi*: On Computing Symmetries and Stubborn Sets, April 1994, 16 p.