HELSINKI UNIVERSITY OF TECHNOLOGY
Faculty of Information Technology
Department of Computer Science
DIGITAL SYSTEMS LABORATORY
Annual Report
August 1996

ANNUAL REPORT FOR THE YEAR 1995

edited by JOHAN LILIUS

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

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Department of Computer Science
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Otaniemi, Otakaari 1
FIN–02150 ESPOO, FINLAND

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Ass. Professor

Introduction:

This report describes the educational and research activities of the Digital Systems Laboratory at Helsinki University of Technology during the year 1995.

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.

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Contents

1 Personnel

The university resources of the Chair consist of one *professor*, one *assistant professor*, 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
Kangasniemi, Ulla	Mrs.	Laboratory Secretary
Ukkonen, Esko	Prof.	Docent
Östergård, Patric	Dr.Tech.	Docent
Lilius, Johan	Dr.Tech.	Laboratory Manager on leave of absence 1.4.–31.12.
Jussi Rintanen	Lic.Tech.	Laboratory Manager as substitute 1.4.–31.7.
Sandqvist, Sam	Lic.Tech.	Laboratory Manager as substitute 1.8.–31.12.
Niemelä, Ilkka	Dr.Tech.	Assistant Professor on leave of absence 1.7-31.12
Husberg, Nisse	Dr.Tech.	Assistant Professor as substitute 1.8.–30.9.
Lilius, Johan	Dr.Tech.	Assistant Professor as substitute 1.10.–31.12.
Tiusanen, Mikko	Ph.D.	Assistant on leave of absence
Aura, Tuomas	Stud.Tech.	Assistant as substitute 1.1.–31.8
Jyrinki, Tero	Stud.Tech.	Assistant as substitute 1.9.–31.12

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:

Husberg, cf. 1.1, 1.4	autumn term
Janhunen, cf. 1.4	spring and autumn term
Nurmela, cf. 1.4	spring term
Rintanen, cf. 1.1, 1.4	autumn term
Sandqvist, 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
Salmenkaita, Jukka-Pekka	Stud.Tech.	autumn term

also:

Aura, cf. 1.1, 1.4	autumn term
Pyssysalo, cf. 1.4	spring and autumn term
Janhunen, cf. 1.4	autumn term
Vainonen, cf. 1.4	spring and autumn term

1.4 Researchers

Aura, Tuomas	Stud.Tech.	Research assistant 1.9.–31.12.
Heljanko, Keijo	Stud.Tech.	Research assistant 1.12.–31.12.
Husberg, Nisse	Dr.Tech.	Researcher 1.10.– 31.12. cf. also 1.1
Janhunen, Tomi	Lic.Tech.	Researcher
Lassila, Eero	M.Sc.Eng.	Researcher
Niemelä, Ilkka	Dr.Tech.	Researcher of the Academy of Finland cf. also 1.1
Nurmela, Kari	Lic.Tech.	Researcher
Penttinen, Olli-Matti	Stud.Tech.	Research assistant 1.6.–31.12.
Pyssysalo, Tino	M.Sc.Eng.	Researcher
Rintanen, Jussi	Lic.Tech.	Researcher 1.1.–31.3., 1.8.–31.12. cf. also 1.1
Simons, Patrik	Stud.Tech.	Research assistant 1.6.–30.8.
	M.Sc.Tech.	Researcher 1.9.–31.12.
Vainonen, Antti	Stud.Tech.	Research assistant 1.5.–31.12.
Varpaaniemi, Kimmo	Lic.Tech.	Researcher
Östergård, Patric	Dr.Tech.	Researcher of the Academy of Finland 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.; *Janhunen*)
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.

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.; *Ojala*)
Causally ordered computation. Model-based software engineering.

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.; *Sandqvist*)
The course focuses on some current application of theoretical computer science. The topic varies from year to year. The topic in autumn 1995: The theory of genetic algorithms.

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.; *Tiusanen*)
Introduction to net theory. Net classes, their properties and analysis techniques. Applications in modelling digital systems with nets.

Parallel and Distributed Computation

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

Reactive Systems

(Tik-79.187; 3 crts, N/A; *Nurmela*)
Linear temporal logic in specification of distributed systems.

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, Aura)*

- *On the Structure of High-level Nets* (Lilius)

  The structure of High-level nets was studied from an algebraic and a logical point of view using Algebraic nets as an example. First the category of Algebraic nets was defined and the semantics given through an unfolding construction. Other kinds of High-level net formalisms where then studied. It was shown that nets given in these formalisms can be transformed into equivalent Algebraic nets. Then the semantics of nets in terms of universal constructions were investigated. A definition of Algebraic nets in terms of structured transition systems was proposed. In this case the semantics of the Algebraic net is given as a free completion of a structured transition system to a category. As an alternative also a sheaf semantics of nets was examined. Here the semantics of the net arises as a limit of a diagram of sheaves. Next Algebraic nets were characterized as encodings of special morphisms called foldings. Each algebraic net gives rise to a surjective morphism between Petri nets and conversely each surjective morphism between Petri nets gives rise to an algebraic net. Finally it was shown how Algebraic nets can be described as sets of formulae in a typed version of intuitionistic predicate linear logic.

- *Petri Net Semantics for Object-Oriented Languages* (Lilius)

A translation from the object-based language $OB(PN)^2$ to a class of high-level Petri nets was developed. This translation defines the semantics of a $OB(PN)^2$ program as a net, which can then be analyzed using existing reachability analysis tools. The $OB(PN)^2$language is an extension of $B(PN)^2$ as defined by Best and Hopkins, and the semantics is inspired by the $B(PN)^2$ semantics defined in terms of M-nets. The translation relies on the CCS-like composition operators defined for M-nets. Each program construct is translated to a box (a special kind of net) or an operation for combining boxes. Thus in essence each program is translated into an expression in the algebra of boxes.

- *Time processes of time Petri nets* (Aura, Lilius)

  The objective of of the project was to give time Petri nets a partial order semantics, like the nonsequential processes of untimed net systems. A time process of a time Petri net was defined as a causal process with occurrence times on the events. The times must satisfy specific validness criteria. In order to show that the definition agrees with intuition, the the relationship between linearizations of the time process and the firing schedules of the time Petri net was studied. An efficient algorithm for checking validness of timings was developed. Alternatively, the set of all valid timings can be characterised by linear constraint equations which make it possible to solve optimization problems on the set of all valid timings of a process. The techniques developed can be used to compute, for example, the maximum time separation of two events in a process.

- *Relieving the state space explosion* (Varpaaniemi)

  State space generation is often needed in the analysis of concurrent and distributed systems. The *stubborn set method* is one of the techniques that try to alleviate the state space explosion encountered in state space generation. An algorithm for finding a stubborn set having as few enabled transitions as possible has been designed. The practicality of the algorithm has been studied, and it has turned out that the algorithm tends to reduce the time spent in state space generation.

  Another way to get more advantage of the stubborn set method is to eliminate intermediate states during the construction of the reduced state space. By an intermediate state we mean a state from which only one state transition is chosen. Such elimination is motivated by the fact that intermediate states are by no means unusual when the stubborn set method is used. The practicality of the elimination of intermediate states has been studied.

  At the moment the primary goal is to study how the stubborn set method can take advantage of fairness assumptions in the verification of linear time temporal properties.

- *High level net model of an adaptive video on demand system* (Ojala, Pyssysalo)

  Different Pr/T-net models for the resource allocation algorithm of the adaptive video on demand system have been studied further. A simple net model with a reasonable size reachability graph has been developed for a multi-FIFO queue with the bunching property. In the future the research will concentrate on the performance analysis of the adaptive and sharing VOD resource allocation algorithms. The effectiveness of the algorithms is going to be determined using real VOD data gathered at the Helsinki Telephone Company.

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

The research has concentrated on knowledge representation and it has been focused on *nonmonotonic reasoning*, one of the key areas in knowledge representation. We have studied intensively the automation of nonmonotonic reasoning, the notion of cautious nonmonotonic reasoning as well as priorities and specificity in nonmonotonic reasoning.

- *Automating nonmonotonic reasoning* (Niemelä, Simons)

  This is a continuation of our earlier research where we have developed a framework for devising decision methods for nonmonotonic logics. The framework is based on autoepistemic reasoning. Now we have studied the applicability of the framework to Reiter's default logic. We have 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 indicate that this decision method can achieve performance unmatched by other currently available decision methods for default logic.

  Encouraged by the positive results we have applied the same framework to developing an implementation of the stable model semantics of normal logic programs. In order to achieve as efficient an implementation as possible, we have adapted the Dowling-Gallier algorithm for computing deductive closures of Horn clauses to the special needs of stable model computation. The result is a simple implementation that employs powerful pruning techniques to find stable models in space proportional to the input. We have tested the implementation with a wide variety of test cases and compared it with a state of the art implementation of the stable model semantics, the SLG system. The tests show that for ground programs our implementation clearly outperforms SLG.

- *Cautious semantics for nonmonotonic reasoning* (Janhunen)

This research continues earlier work on cautious autoepistemic reasoning. First of all, we have studied how the principles of cautious autoepistemic logic can be applied in a logic programming context. This led to the introduction of *cautious (model) semantics* for normal logic programs. A comparison with other semantics was made: it turned out that the novel semantics has attractive properties compared to other approaches. Complexity results indicate that the cautious model semantics and the stable model semantics are classified to the same level in polynomial time hierarchy. This result provides a starting point for our long term goal of developing approximations methods for semantics of logic programming. We have also evaluated preliminary ideas of improving the cautious semantics to solve the so called floating conclusions problem.

Another track of our research has concentrated on generalizing the notion of cautious semantics for other formalizations of nonmonotonic reasoning. This has been approached in terms of a meta-level specification for nonmonotonic theories that covers e.g. normal logic programs, default logic and separated autoepistemic logic. The last of these is a reformulation of autoepistemic logic in terms of separate modalities for beliefs and disbeliefs. The specification was invented when the interconnection of autoepistemic logic and default logic was investigated in terms of novel translation functions. Using the meta-level specification, various nonmonotonic reasoning semantics (including stable, stationary, regular and cautious semantics) can be defined on a very abstract level. This approach has turned out to be beneficial since many properties of the semantics can be verified directly from the specification and simultaneously for all instances of the specification.

- *Priorities in nonmonotonic reasoning* (Rintanen)

  The research is a 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. This priority mechanism has been used as a basis for investigating the complexity of prioritized default reasoning, algorithms for automated default reasoning, and representation of inheritance reasoning in default logic. Also several embeddings of earlier systems of prioritized default reasoning in prioritized default logic have been devised.

Modern Heuristics in Optimization *(Östergård, Nurmela, Sandqvist)*

- *Stochastic Optimization and its Applications in Telecommunications* (Östergård, Nurmela)

  The aim of the research is to study new (combinatorial and global) stochastic optimization methods. These include methods such as simulated annealing, tabu search, and evolutionary algorithms. The methods have further been applied to a wide variety of problems, many of which are related to telecommunications. In the research, the performance of these and other optimization methods has also been evaluated.

  In particular, construction methods for different kinds of codes—for example covering codes, error-correcting codes, and constant-weight codes—have been developed. Some of these combinatorial and algebraic methods lead to good codes directly, while others turn code construction into an optimization problem, which then can be solved using any of the aforementioned stochastic methods. A multitude of new, record-breaking codes have been obtained.

  Many of the types of codes that have been studied have the property that they are coverings (covering codes) or packings (error-correcting codes) in the Hamming space. Recently, the approach has been carried over to coverings and packings in other spaces, for example, the Euclidean space. Whereas most code constructions are discrete optimization problems, in the Euclidean space we are mainly dealing with continuous function. This has turned out to be a good testbed for applying methods primarily developed for discrete problems to continuous problems. Methods for finding good packings in Euclidean geometry have many practical applications; they can, for example, be used to optimize container stowage.

  Preliminary studies have been carried out on computer-aided constructions of other mathematical structures than those of the aforementioned types. Cross-connecting networks and routing problems in switching systems have also been considered within the framework of this research.

- *The Theory of Genetic Algorithms* (Sandqvist)

  This work extends the existing theoretical framework by applying logic to the modelling of the GA. The GA is characterised by two central concepts: that of evolution in time (temporal aspect), and that of Darwinian (or perhaps more often a combination of Lamarckian and Darwinian) selection of the fittest (with a stochastic aspect in selection). Using a combination of temporal logic, probabilistic logic and classical first-order logic a model of the genetic algorithm is being developed.

This model will provide useful and novel insights into e.g. the temporal evolution of the population so central to the GA. The formalism will also succintly describe the basic characteristics of the GA on a very abstract level: for instance, the mechanisms of crossover and mutation are independent of the formalism.

This work is a continuation of the Licentiate thesis (1993) of the author, and has been reported in e.g. the annual Nordic Workshop on GAs.

Abstraction mechanisms for embedded processor code generation *(Lassila)*

Code generation for embedded special-purpose processors is a difficult task for compiler writers. Typically, the main burdens are the unconventional functionality and the architectural irregularity of the processor. Accordingly, in many real-time telecommunication systems, for instance, compiled code is currently ruled out by efficiency requirements: the programmers get themselves involved in the mess known as assembly language programming.

The aim of the research is to develop powerful abstraction mechanisms for embedded special-purpose processor code generation; in computer programming in general, abstraction through modularity improves readability, maintainability, and reusability. In particular, the work concentrates on novel machine-code-level macro expansion techniques that support freely hierarchical macro libraries. An essential component of this support is program flow analysis capability. Results of the research are demonstrated by a retargetable code generation tool, whose experimental prototype implementation is currently available.

3.2 Technical projects

PROD 3.0 *(Varpaaniemi)*

The project continued the development of PROD, a high level Petri net reachability analysis tool. An on-the-fly verification mechanism of linear time temporal properties was designed and implemented in the project. To alleviate state space explosion, the theory of stubborn sets and sleep sets was utilized. The implemented verification mechanism can be used by the users of another reachability analysis tool, the ARA tool of Technical Research Centre of Finland (VTT). The project also had a case study where a simple telephone protocol, YXA of Nokia Telecommunications, was analyzed.

Broadband intelligent network application protocol (BINAP) *(Pyssysalo)*

The BINAP project has been funded by Technology Development Centre of Finland (TEKES), Helsinki Telephone Company Ltd, Nokia Research Center Ltd, and Telecom Finland Ltd and it has concentrated on the specification and implementation of the BINAP protocol. BINAP will take care of the intelligent call control and operation and maintenance functions in the future broadband integrated services digital networks (B-ISDN). The specification part includes the definition of signalling messages and communicating state machines. The messages have been defined using abstract syntax notation one (ASN.1). The CASN ASN.1 compiler has been used to generate encoding and decoding functions for messages. Encoding and decoding functions are exploited by the C-based virtual operating system (CVOPS), with which a tool emulating the signalling protocol has been developed. During the project B-ISDN user network and network node interface protocols have been implemented too in order to study the interoperability of the BINAP protocol together with other B-ISDN signalling protocols.

Pr/T-based Reachability Analyzer for TNSDL *(Husberg)*

The aim of the project is to develop a dynamic analyzer Emma (Extendible Multi-Method Analyzer) for TNSDL programs (TeleNokia SDL), which supports the detection of some errors related to parallelism and the investigation of their causes. The Emma analyzer is designed on top of Nokia's TNSDL translator and the PROD Pr/T analyzer of the Digital Systems Laboratory. The user of Emma is working only on the level of TNSDL.

4 Examinations and theses

4.1 Doctor of Technology

Johan Lilius: On the Structure of High-level Nets

4.2 Licentiate in Technology

Jari Juopperi: PrT-Net Based Analysis of Information Flow Security Nets.

Kari Nurmela: Constructing Spherical Codes by Global Optimization Methods

4.3 Master of Science in Engineering

Aapo Rautiainen: Conformance Testing in a Distributed Testing Architecture

Patrik Simons: Efficient Implementation of the Stable Model Semantics for Normal Logic Programs.

5 Conferences, tours, and visits

5.1 Conferences and tours

Aura, Tuomas 16th International Conference on Application and Theory of Petri Nets, 26.6–30.6.95, Torino, Italy.

Husberg, Nisse 11th ADT Workshop and 8th General Compass Meeting, 19.9–23.9.95, Oslo, Norway. (Presentation: Practical Modelling with High Level Distributed Transition Systems).

Seventh SDL Forum, 26.9—29.9.95, Oslo, Norway.

Janhunen, Tomi 12th International Conference on Logic Programming, 13.6–16.6.95, Kanagawa, Japan.

3rd International Workshop on Deductive Databases and Logic Programming, 17.6.95, Kanagawa, Japan. (Presentation: Cautious Models for General Logic Programs).

Lassila, Eero HeCSE Summer School, 14.8–15.8.96, Siuntio.

Niemelä, Ilkka IJCAI'95 Workshop on Applications and Implementations of Nonmonotonic Reasoning Systems, 21.08.95, Montreal, Canada, (Presentation: Evaluating an Algorithm for Default Reasoning, with Patrik Simons).

14th International Joint Conference on Artificial Intelligence, 20.8–25.8.95, Montreal, Canada (Presentation: Towards Efficient Default Reasoning).

Universität Karlsruhe, Institut fur Logik, Komplexität und Deduktionssysteme, 16.11.95, Karlsruhe, Germany (Presentation: On Computing Minimal Models).

Nurmela, Kari 17th IFIP TC7 Conference on System Modelling and Optimization, 10.7–14.7.95, Prague, Czech

Republic (Presentation: Solving Circle Packing Problems by Stochastic Optimization Methods, with Patric Östergård).

HeCSE Summer School, 14.8–15.8.95, Siuntio.

Ojala, Leo

Structures in Concurrency Theory 95 (STRICT'95), 8.5–14.5.95, Berlin, Germany.

16th International Conference on Application and Theory of Petri Nets, 26.6–30.6.95, Torino, Italy.

Principles of Distributed Computing 95, 20.8–22.8.95, Ontario, Canada.

CONCUR'95, 23.8–26.8.95, Philadelphia, Pennsylvania.

Petri Nets and Performance Models 95, 2.9–6.9.95, Durham, USA.

Pyssysalo, Tino

COST 247 Meeting, 9.2–10.2.95, Berlin, Germany (Presentation: The Modeling and Analysis of the Frame Synchronized Ring Using the Predicate/Transition Net Formalism).

Workshop on Real-Time Systems, 14.6–16.6.95, Odense, Denmark (Presentation: FSR—A Fair Switching Architecture).

6th IFIP international conference on high performance networking HPN'95, 11.9–15.9.95, Palma de Mallorca, Spain.

Rintanen, Jussi

14th International Joint Conference on Artificial Intelligence, 20.8–25.8.95, Montréal, Canada (Presentation: On Specificity in Default Logic).

Shell Oil Symposium Series: Theories of Logic Programming, Non-Monotonic Reasoning, and their application to reasoning about Actions, 5.11.95, El Paso, Texas, USA (Presentation: A Tableau-Based Proof System for Concurrent Actions and Events).

Sandqvist, Sam

GALESIA: Genetic Algorithms in Engineering Systems: Innovations and Applications, 12.9–14.9.95, Sheffield, England.

EUROGEN95: Genetic Algorithms in Engineering and Computer Science, 4.12–8.12.95, Las Palmas de Gran Canaria.

Simons, Patrik	14th International Joint Conference on Artificial Intelligence '95, 19.8–25.8.95, 1995, Montreal, Canada.
Varpaaniemi, Kimmo	The 16th International Conference on Application and Theory of Petri Nets, 26.6–30.6.95, Torino, Italy (Presentation: PROD 3.0).
Östergård, Patric	5th British Combinatorial Conference, 3.7.–7.7.1995, Stirling, United Kingdom (presentation: On Sliding Block Puzzles, with Filip Karlemo).
	1995 IEEE International Symposium on Information Theory, 17.9–22.9.1995, Whistler, Canada (presentation: Tabu Search in Coding Theory, with Kari Nurmela).
	25th Manitoba Conference on Combinatorial Mathematics and Combinatorial Computing, 29.9–1.10.1995, Winnipeg, Canada (presentation: The Football Pool Problem).

5.2 Visiting scholars

Reisig, Wolfgang	Prof. Institut für Informatik, Humboldt-Universität zu Berlin. 14.–16.3.

5.3 Visits

Lilius, Johan	Gastdozent der Informatik, Universität Hildesheim, 1.4-30.9.1995
Niemelä, Ilkka	Visiting researcher, Universität Koblenz, Institut für Informatik, 1.7-31.12.1995.
Östergård, Patric	Visiting researcher, Discrete Mathematics group, Department of Mathematics and Computing Science, Eindhoven University of Technology, 1.12-31.12.1995.

6 Documents

6.1 Journal articles

Ilkka Niemelä: A decision method for nonmonotonic reasoning based on autoepistemic reasoning. Journal of Automated Reasoning, 14 (1995), 3-42.

Patric R. J. Östergård: Om approximativa lösningar till kombinatoriska optimeringsproblem. Elementa, 78 (1995), 17-19.

Patric R. J. Östergård: New multiple covering codes by tabu search. The Australasian Journal of Combinatorics, 12 (1995), 145-155.

H.O. Hämäläinen, *I.S. Honkala*, *S.N. Litsyn* and *Patric R. J. Östergård* and : Football pools—A game for mathematicians. The American Mathematical Monthly, 102 (1995), 579-588.

H.O. Hämäläinen, *I.S. Honkala*, *S.N. Litsyn* and *Patric R. J. Östergård* : Bounds for binary codes that are multiple coverings of the farthest-off points. SIAM Journal of Discrete Mathematics, 8 (1995), 196-207.

6.2 Conference papers

Tomi Janhunen: Cautious Models for General Logic Programs. The Third International Workshop on Deductive Databases and Logic Programming. Kanagawa, Japani 1995, Gesellschaft fur Mathematik und Datenverarbeitung, 25-39.

Ilkka Niemelä: Towards Efficent Default Reasoning. International Joint Conference on Artificial Intelligence, Montreal , Canada, 1995. Montreal, Canada 1995, 312-318.

Ilkka Niemelä and *Patrik Simons*: Evaluating an Algorithm for Default Reasoning. IJCAI'95 Workshop on Applications and Implementations of Nonmonotonic Reasoning Systems, Montreal, Canada, 21.8.1995. Montreal, Canada 1995, Working Notes of the IJCAI'95 Workshop on Applications and Implementations of Nonmonotonic Reasoning Systems, 66-77.

Kari J. Nurmela and *Patric R. J. Östergård*: Solving Circle Packing Problems by Stochastic Optimization Methods. 17th IFIP TC7 Conference on System Modelling and Optimization, Prague, Czech Republic, 10-14.7.1995. Prague, Czech Republic 1995, 501-504.

Tino Pyssysalo: The Modeling and Analysis of the Frame Synchronized Ring using the Predicate/Transition Net Formalism. COST 247 Meeting. Berlin 1995, Humbolt-University Berlin, 6 s.

Tino Pyssysalo and *Pertti Raatikainen* and *Juha Zidbeck*: FSR-A Fair Switching Architecture. The Seventh Euromicro Workshop on Real-Time Systems, Odense, Denmark 14.-16.6.1995. Los Alamitos, California 1995, The Institute of Electricial and Electronics Engineers (IEEE) Computer Society Press, 116-123.

Jussi Rintanen: On Specificity in Default Logic. Proceedings of the 14th International Joint Conference on Artificial Intelligence. Morgan Kaufmann Publishers, 1995, 1474–1479.

Sam Sandqvist: Modelling the Time Behaviour of Genetic Algorithms Proc. 1st Nordic Workshop on Genetic Algorithms and Their Applications, University of Vaasa. 1995, University of Vaasa,

6.3 Other Publications

Kari J. Nurmela and *Patric R. J. Östergård*:, Matematikon kaljakori ei kilise. Helsingin Sanomat 17.6.1995, 1995, sivu D2.

6.4 Laboratory reports

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