UNIVERSITY OF HELSINKI

Department of Computer Science
Annual Report 2003

University of Helsinki

Department of Computer Science

Annual Report 2003

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Department of Computer Science

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1. THE STRATEGIC YEAR 2003 OF THE DEPARTMENT OF COMPUTER SCIENCE

In 2003, the strategic planning of the department's future was in focus. The past year was the last one of the university's three-year planning period. The department strategy for the next period, 2004-2006, was drawn up during this year, and at the same time, the plans were laid for the Faculty of Science, which was reformed at the beginning of 2004. The department strategy focuses on teaching, research and societal interaction, and it is based on the general strategy for the University of Helsinki as well as the strategy for the Faculty of Science 2004-2006.

## Quality of teaching awarded at the department

The main areas of education and research at the department during years 2001-2003 followed the specialisation areas of teaching: algorithm research, adaptive and intelligent systems, data communications and distributed systems, software engineering and software architectures, analysis and management of large and complex data warehouses, and technology for new media applications and document management. The main targets of development in teaching at the department this year were student-centred teaching, online education, improving the quality of teaching, diversifying the workload of teachers, and decreasing the number of drop-outs. As recognition for the active work for improving the quality of teaching, the university chose the department as one of three to receive an added bonus for good teaching in 2003.

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The new strategy period 2004-2006 brings the department new targets to invest in alongside the old ones. The two-cycle degree structure will be applied and some new sub-programmes will be available in teaching: the method sciences minor subject module, bioinformatics and the Master's programme for foreigners. The quality of teaching and learning will be further improved with the help of study circles, study monitoring and more effective post-graduate studies. Several projects for improving teaching will be implemented in co-operation with the other departments in the faculty, and supported by separate funding.

The post-graduate education at the department stands on three legs. The management and co-ordination of the HeCSE and ComBi research schools became the responsibility of the department during the strategic period 2001-2003. In addition, the department joined the national research school for language technology, KIT.

Research focuses on data analysis and mobile computing

The strength of research at the department lies in its scope, diversity, state-of-the-art research profile and some senior researchers and research projects of international standing. Problems include the small number of post doc researchers and the workload of the professors, which restricts the resources available for research. During the period 2001-2003, issues that were
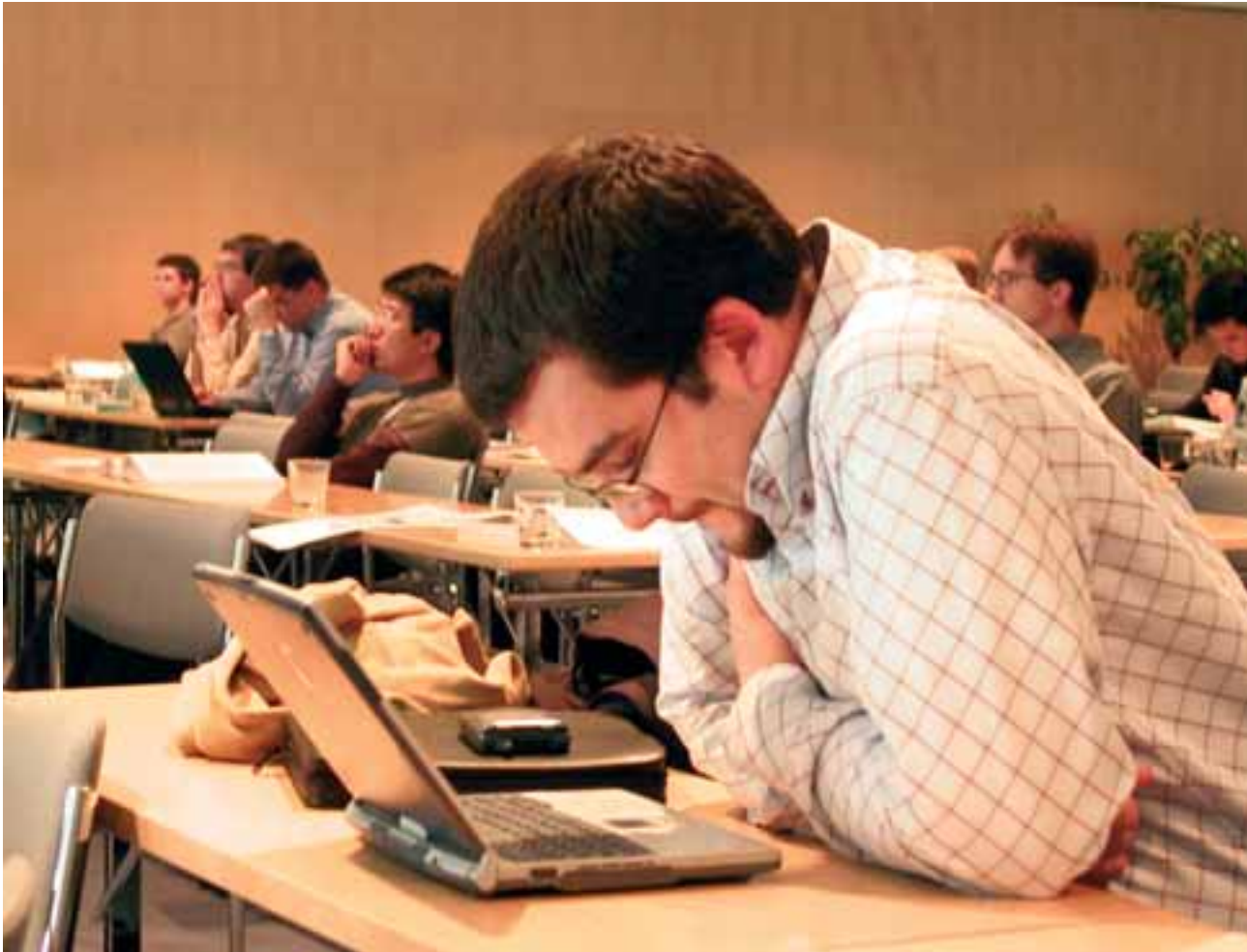
In September 2003, the department arranged the two coupled international software engineering conferences ESEC/FSE, attracting over 200 participants.

seen to bring opportunities for improvement in research at the department were the improvement of research facilities, developing the structure of employment at the department, integrating students into research at an earlier stage, more effective international recruiting of researchers, and extending co-operation to other universities and the business world.

In 2002 the FDK research unit received the status of Centre of Excellence. The Helsinki Institute for Information Technology (HIIT) and its Basic Research Unit (BRU), established in 2002 and mainly operating at the department, for its part, has started to actively recruit international researchers, co-operate with multi-disciplinary partners and improving the research facilities for their researchers. The department has promoted inter-disciplinary co-operation in the 2001-2003 period especially through the national language technology programme and the sub-programme for bioinformatics and computational biology.

Data analysis and mobile computing have been chosen as the target areas of research at the department for the years 2004-2006. Language technology, bioinformatics and empirical software research have been noted in the strategy as new and important areas of research. To promote these new areas, professorships and university lectureships specialising in them have been established.

The department will move to the new Exactum building in Kumpula in summer 2004.

Relocation to the Kumpula campus in 2004

When the department moves to the Kumpula campus to join the rest of the faculty in summer 2004, it will have a considerable impact on its societal interaction as well as administrative services and resources. In addition to operations on faculty and campus level, the department will focus on developing an industrial advisory board and establishing a Linux centre as well as improving the infra-structure of teaching.

The department staff is active in the administration of the Faculty of Science. The following members of staff were elected for the faculty council 2004-2006 in the elections at the end of 2003: Professor Jukka Paakki (deputy Inkeri Verkamo), Professor Henry Tirri (Hannu Toivonen) and Professor Matti Nykänen (Harri Laine). Computer science undergraduate Mikko Pörö (Antti Mattila) was also elected. Jukka Paakki was elected First Vice-Dean under Faculty Dean Heikki Saarinen, professor of inorganic chemistry.

In 2002, planning and development talks were instigated for every term as the main tool for improving the work of the department and supporting the staff. In connection with the talks, sabbaticals were established in 2003 for members of staff who want to focus on research projects or teaching development. During this year, the personnel policy of the department was updated and a personnel strategy to implement it was created.

Resources for teaching and research will still be needed in future in spite of the current recession in the IT industry

The possible decrease of funding for the department has become the worst threat envisioned in both strategic planning and personnel policy. The special IT education programme that the Ministry of Education started in 1998 will be wound down so that the funding for the department in 2004 will be less than half of what it was in 2003, and the same trend continues in 2005. This means that the department will have to trim its expenses in the planning period 2004-2006 by such measures as cutting back on posts to balance income and expenditure.

The winding down of the IT programme is part of a trend to reduce the national investment in information technology. This education and science policy outline is a result of the recession in the IT industry, but such a harsh cut is clearly exaggerated and does not concur with the prospects of the IT industry in the near future; the IT business will remain one of the corner stones of our industry, and in the field of software engineering, for example, labour shortage has been predicted to set in within a few years, though the field has been quiet lately. The department is faced with the challenge of retaining the quality and scope of research and teaching, with less funding, at the level that will be necessary when another upswing starts.

Year 2003 was a year of transition between two planning periods. Department development projects that were started in 2001-2003 will be continued seamlessly into the 2004-2006 period, when new projects will also be established. Work at the department will be as challenging as ever in the future, but it will be eased considerably by the extensive planning carried out by the whole department in 2003.

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Jukka Paakki
Head of the department

2. AN OVERVIEW OF YEAR 2003

Staff and funding

After the previous year of keen activity to develop staff structure, year 2003 was fairly quiet on this front. The only new person to be appointed for a teaching post was the professor of algorithms and data structures, Jyrki Kivinen. Juha Puustjärvi, PhD, Juho Rousu, PhD and Kjell Lemström, PhD, were appointed docents of computer science. During the leaves of absence of the departmental information officer and research secretary, their duties were attended to by Lotta Lounasmeri and Marja-Liisa Lonardi.

The staff in number of person-years has remained the same as the previous year, when the increase was some 20 per cent. The funding of the department has continued to grow during 2003. The increase has been rapid; while funding amounted to circa 5 million euros in 1999, in 2003 it reached over 11 million.

The largest factor in increasing the funding has been the Ministry of Education's national IT education programme and its upgrading studies programme, though other financing sectors have also increased steadily.

The total financing of the department reached a record high in 2003, but unfortunately, this record may last for many years to come. The winding down of the IT programme, starting in 2004, will turn around the funding trend at the department, so the funds carried over from previous years will soon dwindle. As an illustration of the inconstancy of the department's funds, the basic university funding to the department has decreased from 38 per cent in 1999 to just over 20 per cent in 2003. Since basic funding will not rise significantly in the coming years, the department will have to compensate for the loss of the IT programme by other sources of funding.

Results in teaching and research

After the record year of 2002, the number of Master's degrees returned to its 'normal' level of 60. This slight disappointment was amply compensated for by the new record in post-graduate degrees: during 2003, as many as 7 PhD graduated (and one defended his thesis). The goal is to keep the number of post-graduate degrees at this level, and no longer return to that of earlier years, around 2-3.

The number of publications decreased slightly from the year before, but the number of journal and conference articles increased.

In 2003, Research Director Heikki Mannila was awarded the prestigious ACM SIGKDD Innovation Award for his scientific work in the information management field of data mining.

During 2003, members of the department acted as experts in the following investigating bodies at national, university and faculty level: Professor Hannu Toivonen drew up the plans for implementing the method science minor subject module for the faculty, Lecturer Heikki Lokki, in the capacity of IT expert, created the outline for the university's IT strategy, Lecturer Hannu Erkiö (Head of Studies) and Office Manager Päivi Karimäki-Suvanto participated in writing the proposals for the duties of the Kumpula campus service unit, Lecturer Timo Alanko and Jouni Siren (undergraduate) participated in the faculty committee preparing the transition to the two-cycle degree structure, and University Lecturer Jaakko Kurhila investigated the state of IT education in Nepal in connection with a development project of the Ministry for Foreign Affairs.

The department participated in the Assembly event for the young computer generation in August 2003.

In 2003, preparations were made for arranging a mutual distributed software project during the academic year 2003-2004, with participants from both the University of Petrozavodsk and the Department of Computer Science at the University of Helsinki.

In this project, a group of students will be working at each department at the same time, developing a shared software product and co-ordinating their work by e-mail and other communication methods suitable for distributed working.

Calendar of events 2003

January

8th-9th
The department planning event in Gustavelund in Tuusula
Nearly 100 of the department's teachers, researchers, administrative staff and students were present to draw the outlines of the three-year strategy for the department.

8th-12th
The Science Days 2003 event arranged by the University of Helsinki for the general audience
Professors Eero Hyvönen, Henry Tirri and Hannu Toivonen from the department spoke at the event, as did Academy Professor Esko Ukkonen and Research Director Heikki Mannila.

14th
Guest lecture: On the structure and user interface of the Survo software
Professor Emeritus Seppo Mustonen

20th
Guest lecture: New Results on Computing in Games
Tuomas Sandholm, Associate Professor, Carnegie Mellon University

21st
Guest lecture: Research Directions in Music Information Retrieval Theory and System Development
Dr Pierre-Yves Rolland, Université d'Aix-Marseille III - FEA & Université de Paris 6 (Pierre & Marie Curie)

25th
Thesis defence: Optimistic Concurrency Control Methods for Real-Time Database Systems
Jan Lindström, MSc

February

4th
Guest lecture: Finding Frequent Substructures in 3D-Protein Databases
Alexander Hinneburg, Universität Halle-Wittenberg

15th
Thesis defence: Supporting Nomadic Agent-based Applications in the FIPA Agent Architecture
Heikki Helin, PhLic

17th
Guest lecture: Are Intelligent Agents too Complex to Engineer for Business Deployment?
Stefan Poslad, PhD, Department of Electronic Engineering, Queen Mary, University of London

18th
Guest lecture: Linear Diophantine Equations and Array Data Dependencies: Analysis of Loops in Programs
Dmitri G. Korzoun, University of Petrozavodsk

26th
Guest lecture: Networking technologies and their applications
Juha Puustjärvi, PhD, HUT

March

6th
Lectures on the globalisation of Finnish software business
The subject of the final event of the series of invited talks for the software business course at the department was globalisation. At the event, we heard of the successes and bitter experiences of Finnish software enterprises in the United States, Europe and Asia. The pioneers and top-ranking names of the Finnish software industry spoke at the event.

21st
Guest lecture: CCC: A Cluster Management System
Researcher Lars Burchard, Technische Universität Berlin

25th
Guest lecture: Advance Reservations in Computer Networks
Researcher Lars Burchard, Technische Universität Berlin

26th
Public lecture for docentship: Error-minimizing discretion in learning classifiers
Juho Rousu, PhD

April

11th
The Great Expedition – lost in the bit jungle? –Find your way in Cyberspace
The traditional Open Day at the department, an expedition into computer science. The teaching and research at the department was presented during the day, and a panel of participants from the worlds of business and science met in a discussion with the audience about what computer science should study.

12th
Thesis defence: Middleware Infrastructure for Distributed Mobile Applications
Stefano Campadello, MSc

May

2nd
Guest lecture: Management of data security
Aaro Hallikainen, Data Security Manager of The National Bureau of Investigation

8th
Guest lecture: Some Combinatorial Algorithms for Molecular Biology
Marie-France Sagot, PhD, INRIA Rhône-Alpes, Lyon

13th

Demonstrations of the Spring 2003 Software Engineering projects
The project groups demonstrated their software creations

24th

Thesis defence: Design and Analysis of a Distributed Database Architecture for IN/GSM Data
Juha Taina, PhLic

June

2nd

Thesis defence: Considering Individual Differences in Computer-Supported Special and Elementary Education
Jaakko Kurhila, PhLic

12th

Guest lecture: Discovering Best Variable-Length-Don't-Care Patterns
Shunsuke Inenaga, PhD, Kyushu University

12th-13th

HeCSE summer school course: Basic Concepts of Object-oriented and Component-based Software Engineering
Professor Joost Kok, Universiteit Leiden

24th-29th

8th Annual Finnish Data Processing Week seminar
The department arranged the seminar in co-operation with the Department of Computer Science at the State University of Petrozavodsk. The setting was exceptionally festive this time, as the seminar was arranged at the same time as the tri-centennial of Petrozavodsk.

August

7th-10th

The Assembly event at the Hartwall Arena
For the first time, the department participated in this annual event for the younger computer generation. In addition to the information and board game corner maintained by the student organisation TKO-äly and the department's information officer Janne Saarinen, Petri Kutvonen and Jukka Paakki were interviewed for the Assembly TV, and the department's maintenance unit offered computers with the Linux environment for Assembly visitors.

18th

Demonstrations of the summer 2003 Software Engineering projects
The project groups demonstrated their software creations

19th

Thesis defence: Parameterized Approximate String Matching and Local-Similarity-Based Point-Pattern Matching
Veli Mäkinen, MSc

20th

Guest lecture: A Sub-quadratic Sequence Alignment Algorithm for Unrestricted Scoring Matrices
Professor Gad M. Landau, University of Haifa

21st

Guest lecture: Alignment of Tandemly Repeated Sequences and Applications
Eric Rivals, PhD, Montpellier

25th-29th

4th AgentCities Information Days (ID4)
Seventh International Workshop CIA-2003 on COOPERATIVE INFORMATION AGENTS
- Intelligent Agents for the Internet and Web -
The department participated in arranging the technical meeting and the conference that followed. Heikki Helin, Heimo Laamanen, Kimmo Raatikainen and Henry Tirri from the department were among the organizers.

September

1st-5th

9th European Software Engineering Conference (ESEC) and 11th ACM SIGSOFT Symposium on the Foundations of Software Engineering (FSE-11)
The department organised this dual conference on software engineering that gathered over 200 participants. Jukka Paakki acted as leader of the organising committee and its other members were Inkeri Verkamo, Juha Taina, Antti Viljamaa and Jukka Viljamaa.

4th

The topping-out ceremony for the new Exactum building at the Kumpula campus
Jukka Paakki spoke for the future users of the building. The ceremony signified a festive start to the process of moving to Exactum along with the departments of Seismology as well as Mathematics and Statistics in summer 2004.

4th

Guest lecture: Designing Learning Objects: A Semiotic Model
Pithamber R. Polsani, PhD, Faculty Fellow, Learning Technologies Center, University of Arizona, Tucson

9th

Opening of a new academic year at the department
Professor Emeritus Martti Tienari gave the opening speech

10th

Guest lecture: Enumerating Maximal Frequent Sets using Irredundant Dualization
Professor Ken Satoh, Japan National Institute of Informatics

29th

Public lecture for docentship: Geometric algorithms for content-based music retrieval
PhD Assistant Kjell Lemström

October

8th

Public professorship lectures: Algorithms for data analysis in bioinformatics
The scope of the professorship is data analysis and its applications in bioinformatics
Jaakko Hollmen
Samuel Kaski
Juho Rousu
Mikko Sillanpää

16th

Guest lecture: Stream and Graph Data Mining
Professor Christos Faloutsos, Carnegie Mellon University

16th

Guest lecture: The Post-PC Era: It's About the Services
Professor Randy Katz, University of California Berkeley

November

3rd

Guest lecture: Answering Queries using Views
Professor Foto Afrati, National Technical University of Athens

6th

Guest lecture: Research of Musical Instrument Models at Helsinki University of Technology
Professor Vesa Välimäki, Helsinki University of Technology

12th

Public test lecture: Introduction to empirical software research
The scope of this University Lecturer post is empirical software research
Juha Taina, PhLic

13th

Guest lecture: Peer Advertising, Discovery and Inquiry
Titos Saridakis, PhD, Peer-to-Peer programme director, NOKIA Research Center

15th

Thesis defence: A Process Algebraic Reduction Strategy for Automata Theoretic Verification of Untimed and Timed Concurrent Systems
Matti Luukkainen, PhLic

27th

Guest lecture: Measuring pitch in polyphonic music
Researcher Anssi Klapuri, MSc (Tech)

December

2nd

Conference simulation for the course Scientific Writing
The students taking the Scientific Writing course presented their work at a conference simulation event.

4th

Poster presentation of the course Character String Methods

8th

Guest lecture: The Current Truth about Multiway Heaps
Docent Jyrki Katajainen

10th

Demonstrations of the autumn 2003 Software Engineering projects

17th

Traditional Christmas coffee party
The party reached its climax when the awards for good teaching and research were handed out. The awards for good teaching were given to Matti Luukkainen (senior teacher) and Matti Kääriäinen (junior teacher). The first ever awards for good research were given to Kjell Lemström (senior researcher) and Jukka Manner (junior researcher).

19th

Thesis defence: Provision of Quality of Service in IP-based Mobile Access Networks
Jukka Manner, PhLic

Randy Katz from Berkeley visited in October 2003

THE DEPARTMENT IN FIGURES

Staff

Person-years in 1998-2003

Staff (person-years)		1998	1999	2000	2001	2002	2003
Teaching		43,0	49,0	60,0	53,5	63,1	65,1
	Professors	9,0	9,0	9,6	12,1	12,3	13,2
	Senior and PhD Assistants	4,0	3,0	3,4	1,4	2,6	3,9
	(University) Lecturers	10,0	11,0	12,8	14,2	17,0	17,9
	Assistants	8,0	9,0	12,9	10,4	8,3	9,1
	Full-time teachers	7,0	7,0	4,4	4,2	5,3	6,1
	Part-time teachers	5,0	10,0	16,9	11,2	16,6	15,0
Post-graduates		14,0	11,0	14,9	17,7	17,1	16,8
Researchers and research staff		35,0	37,0	37,2	39,0	55,8	56,4
Administration		11,0	13,0	13,0	16,5	17,0	17,0
Total		**103,0**	**110,0**	**125,1**	**126,7**	**152,9**	**155,4**

Person-years in per cent of funding sources

	1999	2000	2001	2002	2003	Change from previous year
	py %	py %	py %	py %	py %	py %
Budgeted Funding	65,3	76,1	69,8	83,8	92,5	8,7
EU Funding	4,5	2,6	4,4	1,2		
Paid Business Income	12,7	10,7	8,7	16,9	9,7	-7,2
Trust Funds and Foundations			1,4			
Other Ministry Of Education	8,2	10,6	11,7	11,6	8,9	-2,6
Academy of Finland	8,3	9,6	14,3	25,7	23,1	-2,6
Employment Funding		0,3				
Communal Funding (e.g. TEKES)	11,3	12,4	15,1	12,9	21,2	8,3
University Funding	1,0	0,4				
University Foundation	1,1	2,6	1,0	1,0		
Person-years total %	**112,42**	**125,11**	**126,54**	**152,97**	**155,40**	**2,43**

Average age and gender distribution of staff at the Department of Computer Science years 2002-2003

Year	Average age in years	Gender distribution		Foreign employees
		Women %	Men%	%
2002	32,8	20,8	79,2	10,3
2003	33	20,7	79,2	10,9

Funding

Funding (Million Euros)	1999	2000	2001	2002	2003
Basic funding	1,92	1,92	1,93	2,24	2,34
Carried over from previous year	-	-	0,94	1,43	2,57
Additional funding/Directed special funding	1,21	1,72	2,14	2,78	3,28
external funding	1,86	2,22	2,09	2,84	3,10
Total	**4,99**	**5,86**	**7,10**	**9,29**	**11,29**

Funding in % during years 1999-2003

Additional funding/Directed special funding (Million Euros)
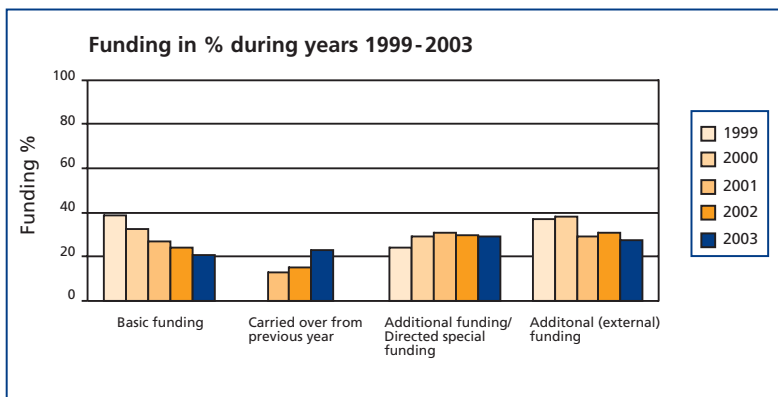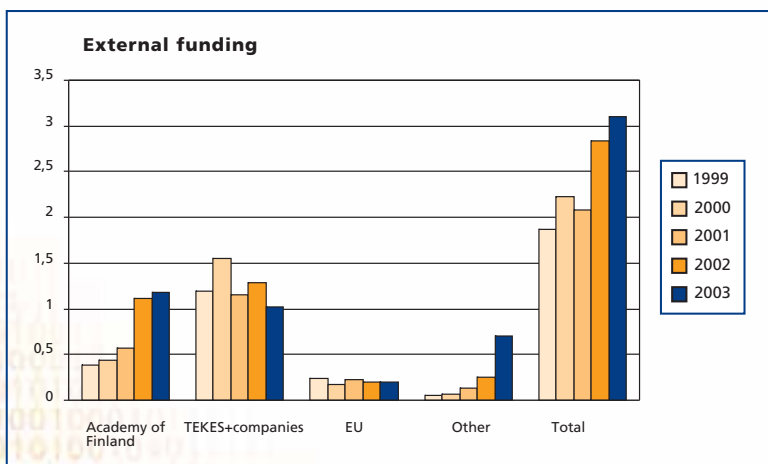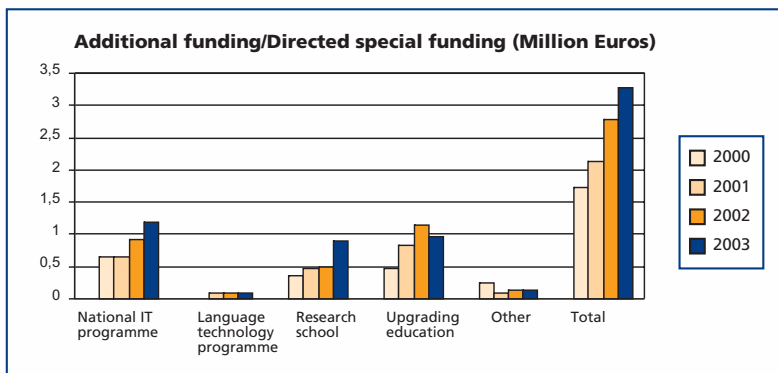
External funding

Implemented external funding
(Million Euros)

Source		2001	2002	2003
Academy of Finland		0,57	1,11	1,18
TEKES		0,60	0,30	0,36
Companies		0,56	0,98	0,66
EU		0,22	0,20	0,20
Other national funders		0,13	0,25	0,70
	Other state funding		0,21	0,70
	Foundations and trust funds		0,04	0,00
Total		**2,08**	**2,84**	**3,10**

Implemented additional external funding
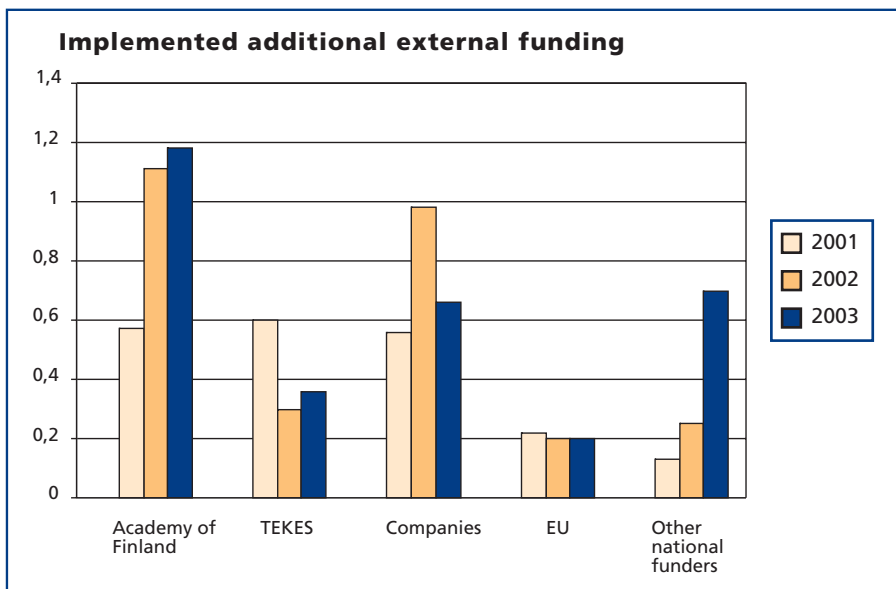
Publications

Publications	1998	1999	2000	2001	2002	2003
Monographs	0	3	0	0	4	2
Journals	10	11	8	6	22	23
Conference articles	64	46	49	49	46	68
Other publications	54	49	50	42	74	41
Total	128	109	107	97	146	134

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Publications 2003

Legend:
- Monographs
- Journals
- Conference articles
- Other publications
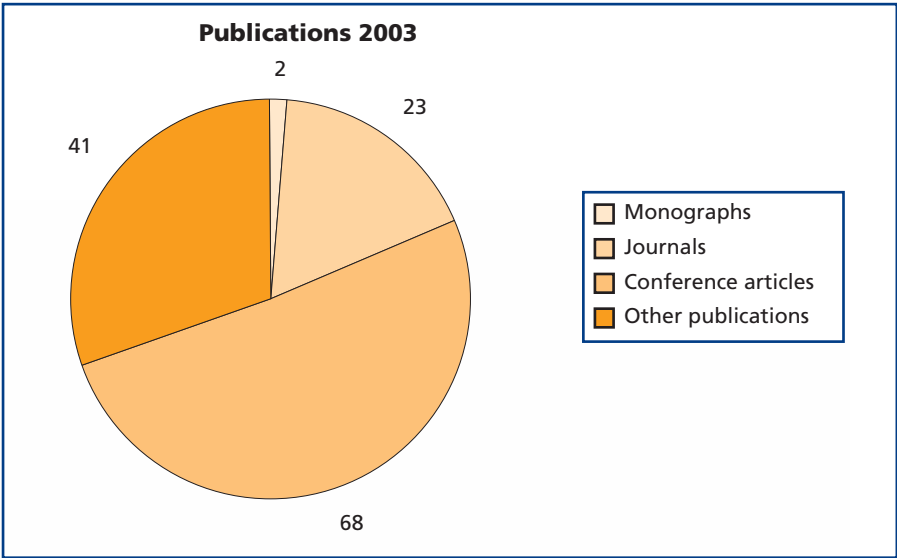
Studying and Teaching

Student body

	1998	1999	2000	2001	2002	2003
Admission quota	270	270	270	235	235	235
Freshman registrations	279	258	267	243	264	197
Students chosen on the basis of earlier studies	55	42	61	61	82	33
Upgrading students	–	40	81	78	71	–
All registered students	1793	1982	2110	2230	2351	2364
Female students percentage	21	22	20	20	19	19

Teaching	1998	1999	2000	2001	2002	2003
Completed credits	17863	21345	20554	22004	20512	19841
Teachers in person-years	43	47	60	54	63	65
Credits/person-years	415	401	343	408	326	305
Students/person-years	42	43	35	41	37	36

Master's theses, degrees and post-graduate degrees
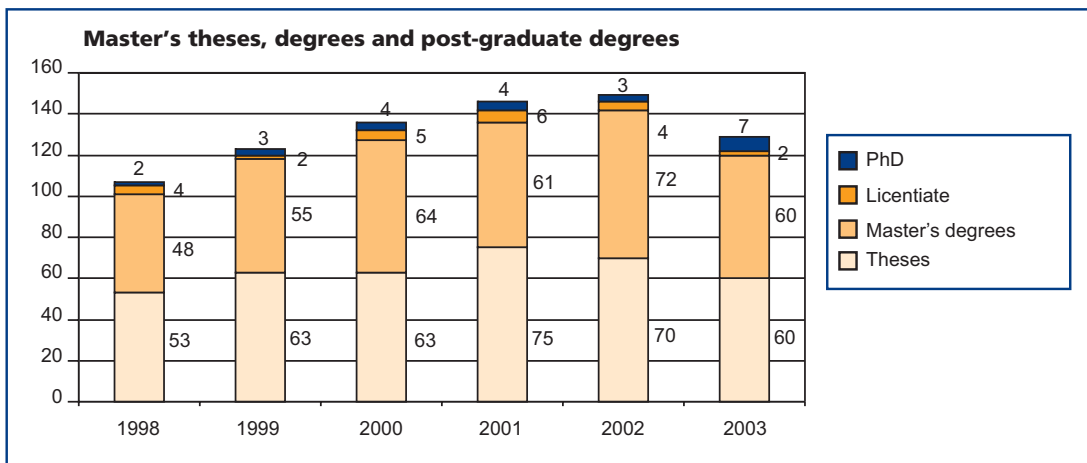
Degrees

Master's theses and degrees	1998	1999	2000	2001	2002	2003
Theses	53	63	63	75	70	60
Master's degrees	48	55	64	61	72	60

Postgraduate degrees	1998	1999	2000	2001	2002	2003
Licentiate	4	2	5	6	4	2
PhD	2	3	4	4	3	7

3. EDUCATION

3.1 Computer science

3.1.1 Algorithms

The specialisation area studies the algorithmic and theoretical aspects of formulating and solving computational problems in different application areas. The focus is on discovering efficient solutions for specific problems. The interaction between theory and practice is also of central interest. The application of well-motivated algorithms to real-world problems is within the scope of the area.

The basic teaching in the algorithms specialisation area offers courses aimed at all students of computer science. The courses teach the basic algorithms and data structures, with exercises in applying mathematical deduction to computer science problems. The specialised courses of the area develop the students' knowledge of methods in algorithmics and computer science theory. Students can choose a subject from one of the on-going research projects or one of the focus areas, such as computer graphics or combinatorial optimisation.

The contact persons in Algorithms:
Professor Jyrki Kivinen
Academy Professor Esko Ukkonen

Teaching (in Finnish):
http://www.cs.helsinki.fi/algoritmit/

Research (in English):
http://www.cs.helsinki.fi/research/fdk/

On the research front the current main focus areas are combinatorial pattern matching and its applications in computational biology, theory and practice of machine learning with interest in the application of the methods to data mining, data structures for biological databases, and computational geometry. An analytical approach to diverse problems is the common factor in the many different research projects within the specialisation area.

3.1.2 Intelligent Systems

The specialisation area of Intelligent Systems studies issues related to the design and analysis of computational methods for adaptive and intelligent systems. The area covers several fields in computer science such as artificial intelligence, computational intelligence, artificial life and search methods. Future information technology will include more and more adaptive components both in hardware and software and therefore many of the methods studied are core components for future systems.

The curriculum of the Intelligent Systems area contains a wide variety of special courses, which typically require as prerequisites good programming and problem solving skills and a solid analytical background. Studies of automating intelligent behaviour by necessity have

to draw ideas from many sciences, and thus the studies in many cases are multidisciplinary in nature. In addition to the methodological courses on the three basic concepts of the field - probability, information and decision-making - other suitable courses can be selected either from more applied topics (robotics, string matching, data mining) or from the general introductions such as artificial intelligence and machine learning. A research seminar in Intelligent Systems and

Contact persons in Intelligent Systems:
Professor Henry Tirri
Professor Petri Myllymäki

Teaching (in English):
http://cosco.hiit.fi/Teaching/

Research (in English):
http://cosco.hiit.fi

the course "Graphical Models" are intended for postgraduate level studies. Post-graduates are recommended to take multidisciplinary studies in cognitive science, neurocomputing (in cooperation with Helsinki University of Technology) and theoretical philosophy.

The research in the Intelligent Systems area is focused on issues related to deep foundational issues in modelling and learning , and their applications to various fields from engineering to social sciences and medicine. Most of the research is associated with the Complex Systems Computation Group (CoSCo), which studies theoretical and applied topics in probabilistic and information-theoretical modelling and stochastic search methods. Current ongoing projects have applications e.g. in user profiling and personalisation, adaptive learning environments, autonomous satellite diagnosis systems, telecommunications and next generation search engines.

3.1.3 Software Engineering

The specialisation area of Software Engineering studies methods, techniques, and tools to systematically develop large and complex software systems of high quality. The area covers not only technical issues, but also managerial and co-operative aspects of team and project work as well as the business dimension of software products.

The curriculum of the specialisation area is rather broad, containing courses and seminars in all of the dimensions of software engineering mentioned above. There are four obligatory basic courses in the curriculum: Software Engineering, Software Engineering Lab, Software Architectures, and Software Processes and Quality. On top of these, special courses and seminars can be selected on topics such as programming languages, compilers, software testing, software performance, user interfaces, and software project management. The importance of the software business perspective has been taken into account by offering a minor subject on this topic, in co-operation with Helsinki University of Technology and Helsinki School of Economics and Business Administration.

The research in software engineering is focused on one of the cornerstones of software quality, the software design phase and the related technical artefact of software architectures. Currently ongoing research projects develop techniques and tools to early measurement and assurance of the quality of a software system in its design phase, before entering the implementation and testing phases. Modern object-oriented techniques, most notably design patterns, application frameworks and the UML modelling language, play an important role in the techniques and tools developed in the research projects.

The contact persons in Software Engineering:
Professor Jukka Paakki
Professor Inkeri Verkamo

Teaching (in Finnish):
http://www.cs.helsinki.fi/ohjelmistot/

Research (in English):
http://www.cs.helsinki.fi/research/roosa/

3.1.4 Distributed systems and data communication

The specialisation area of Distributed Systems and Data Communication studies how systems can be divided into independently working parallel parts, and how these parts communicate with each other. The research concentrates on examining the basic components and the protocols of communication between such systems. The goals of the group are twofold. On one hand, tools based on theory are developed for analysing and modelling systems. On the other hand, more powerful services are developed for the application platform based on operating systems, data communication, distribution algorithms and effective information management solutions.

Graduates from this specialisation area are familiar with the operational principles of computer equipment, and on the basis of this knowledge, they can evaluate the suitability of different system and data communications solutions for different purposes. In addition, they know the verification and specification methods needed to ensure the proper functioning of the systems, and are able to evaluate the performance of them. If there are no suitable systems available, they have learned to specify and implement the functions needed.

Supported by the long-term research carried out in the NODES group, the specialisation area offers in-depth education in new data communication technology and mobile computing in the form of specialised courses and seminars. There is also specialised teaching in other areas, such as middleware, data security and verification methods.

The needs of foreign students have been taken into account by arranging exercise sessions in English for several of the introductory courses. Some of the special courses in data communications have been taught completely in English, along with some seminars. In autumn 2003, a two-day seminar on wireless data communication was arranged for the post-graduate students of the specialisation area. The issues discussed at the seminar were connected with the research of the students. In spring 2003, the post-graduates had already met some of the researchers of the specialisation area to discuss future research issues.

Project leader Lea Kutvonen and the researchers of the Pilarcos team

In 2003, the research in distributed systems and data communication had four focus areas: The research projects of the mobile and nomadic computing group are concerned both with the protocols of wireless data communication and with applications utilizing wireless communication. Quality-of-service issues in heterogeneous environments have been central topics. The open distributed software systems group develops middleware services to support inter-organizational cooperation and networking. Partners in the cooperation are application components, which have been developed independently and which are under separate autonomous authorities, so the system must be capable of automatic contract negotiations, among other features. This work entails both conceptual development and constructive testing.

The operating system enhancements group currently focuses on real-time systems with high availability requirements.

Formal specification and verification of distributed systems is studied in the group on modelling of concurrent systems. There search methods of the group are based on process algebras, temporal logic and automata theory. The results are applied to software engineering tools.

Contact persons in distributed systems and data communication:
Professor Kimmo Raatikainen
Tiina Niklander, PhLic

Teaching (in Finnish):
http://www.cs.helsinki.fi/hajautetut/

Research (in English):
http://www.cs.Helsinki.FI/research/nodes/

3.1.5 Information Systems

The specialisation area of Information Systems studies methods, techniques, and tools needed in manipulating large volumes of data, often implemented as a database, frequently also using structured representations such as XML. The education in the specialisation area covers database management, text and document management, information retrieval, and data mining.

The courses of this specialisation area are designed to teach conceptual and physical data models, choosing the data management methods best suited to specific problems, and implementing challenging data systems. In addition, the Laudatur-level courses give instructions on such issues as how to analyse large data collections and on designing systems to manage text collections. More specific subareas are covered by seminars on varying topics.

The contact persons in Information Systems:
Professo Hannu Toivonen
Professo Helena Ahonen-Myka
ProfessoSeppo Sippu

Teaching (in Finnish):
http://www.cs.helsinki.fi/info/

Research:
http://www.cs.helsinki.fi/research/fdk/
http://www.cs.helsinki.fi/research/doremi/

The research in information systems is strongly focused on data mining and document management, including language technology. Techniques of analyzing and mining data from various sources for useful information are the key research topics. The research includes both method development and applications, for instance in gene technology, ecology, telecommunication, and publishing industry. Research in the database area is focused on recovery and concurrency control. Computer-aided teaching environments have been developed for database courses

Antoine Doucet is a researcher in the Doremi team

3.2 Teacher in computer science

The sub-programme for teachers educates information technology teachers.
In addition to junior and secondary school and college, vocational schools and the educational units in private enterprises also need IT teachers. The curriculum contains a pedagogical component (35 cu), which lessens the required advanced computer science studies. The studies in pedagogy are typically carried out during one academic year of full-time study.

Students majoring in computer science can apply to the teacher sub-programme by separate application. The annual quota is ten persons. However, due to the surprisingly large number of applicants, 11 students were accepted to the teacher sub-programme in year 2003. Two students graduated as information technology teachers in 2003.

The course Computer Uses in Education is compulsory for this sub-programme. In addition, the course IT for Teachers is intended for students in this sub-programme. Other courses, seminars and the subject for the Master's thesis may be chosen from the area of another sub-programme.

In 2003, the department participated in planning the new Science and Mathematics (Luonnontieteet ja Matematiikka, LUMA) centre. The purpose of the centre is to support the teaching of physics, chemistry, mathematics and information technology in schools by arranging special classes for pupils and their teachers. The centre will commence operations in spring 2004 at the Kumpula campus, where all the departments of the above-mentioned subjects will be located from August 2004. In computer science, such interdisciplinary co-operation seems natural, since IT teachers typically teach another mathematically oriented subject as their second subject.

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Contact person for the sub-programme:
Professor Matti Nykänen

Teaching:
http://www.cs.helsinki.fi/opettaja/

LUMA:
http://www.helsinki.fi/LUMA/

3.3 Applied computer science

The sub-programme Applied Computer Science is meant for students who want to specialise in some specific application area.

Every student has an individual study plan. Applied research is pursued in e.g. the Semantic Computing project group that belongs to the sub-programme, as well as several project teams in other sub-programmes, e.g. within the algorithm research, machine learning, biocomputing, computational linguistics and data mining groups.

The contact person for the sub-programme:
Professor Eero Hyvönen

Teaching:
http://www.cs.Helsinki.fi/sovellettu/

3.4 Computer mathematician

The sub-programme for computer mathematicians resembles the sub-programme for applied computer science with a large minor in mathematics. The teaching is implemented in co-operation with the Department of Mathematics.

Teaching in mathematics and computer science are equally important in this sub-programme. The only difference is the Pro gradu (Master's thesis), which is written on the student's major subject. The aim is a balanced whole where the courses in mathematics and computer science support each other, forming a basis for different work tasks where one needs, on the one hand, deep mathematical knowledge, and on the other hand, the ability to solve problems with the help of a computer.

Contact person of the sub-programme:
Professor Eero Hyvönen

Teaching:
http://www.cs.Helsinki.fi/matemaatikko/

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3.5 Bioinformatics and computational biology

Computational methods have become increasingly important in such modern natural sciences as molecular biology, genetics and ecology.

The sub-programme for bioinformatics and computational biology educates developers of such methods, as well as experts in the management and processing of biological information. They are employed as experts in computational methods in research institutions and in the industries.

The courses in this sub-programme have much in common with such specialisation areas as algorithms and information systems. These specialisation areas offer courses and seminars that answer to the needs of students in bioinformatics. In 2003, the first compulsory course for the bioinformatics sub-programme, called Introduction to bioinformatics, was given at the cum laude level.

Together with the professor in charge of the sub-programme, students who apply to the sub-programme plan such a minor subject module in natural sciences that it supports their choice of specialisation inside the sub-programme. One example of a suitable minor subject is the approbatur degree in genetic bioinformatics (15 cr) offered by the Department of Biosciences.

The department has participated in developing the new educational programme in biotechnology, which will start in the academic year 2004-2005 at the new Faculty of Biosciences. The role of the department in this educational programme will be to offer applicable minor studies in computer science to students who are majoring in some natural science, and who are interested in the applications of that science.

The professor in charge of the sub-programme during autumn 2003 was Professor Matti Nykänen. From spring 2004, the professor in charge will be Professor Samuel Kaski, who will be inaugurated on 1 March, and whose field is data analysis.

Teaching and research (in Finnish):
http://www.cs.helsinki.fi/bioinformatiikka/

3.6 Minor in software business

The Department of Computer Science, Helsinki University of Technology and the Helsinki School of Economics offer their major subject students the possibility to take software business as a minor subject. This minor subject module consists of general courses in software engineering, software production, business skills, marketing and computer legislation, as well as a project in the field. Of the students at the department, 15 at the most are chosen for this minor subject module annually.

3.7 Graduate schools

3.7.1 HeCSE

The Helsinki Graduate School in Computer Science and Engineering is a postgraduate programme jointly offered by the Helsinki University of Technology (HUT) and the University of Helsinki (UH). It is mainly intended for students wishing to pursue their graduate studies full time, aiming to complete their PhD degree in four years. For these students, HeCSE offers the possibility of financial support and some other benefits such as special courses.

HeCSE incorporates the following laboratories and departments:
the Laboratory of Computer and Information Science (HUT),
the Laboratory for Theoretical Computer Science (HUT),
the Laboratory of Information Processing Science (HUT),
the Laboratory of Telecommunications Software and Multimedia (HUT),
the Software Business and Engineering Institute (HUT)
and the Department of Computer Science (UH).
The doctoral school collaborates with HIIT (Helsinki Institute for Information Technology) and with the Finnish Academy Centres of Excellence FDK (From Data to Knowledge) and the Neural Networks Research Centre. All of these units belong to the departments and laboratories encompassed by HeCSE.

Students can choose any area represented by the professors as their specialisation area. The focus areas of HeCSE are:
- learning and intelligent systems, especially modern data analysis and its applications, as well as neural networks;
- theoretical computer science, especially modelling and verification based on formal methods, and computational logics;
- software engineering for future networks, especially ubiquitous computing, the Internet, wireless data communications, security and multimedia, and in connection with them, the main software tools, technologies and methodology, like software engineering and usability research.

During the four-year period that started in 2003, Professor Henry Tirri is in charge of HeCSE. In 2003, the post-graduate school funded 23 doctoral students (9 from HU and 14 from HUT). In addition, there are students in HeCSE who are funded by projects or by teaching.

Additional information in English: http://www.cs.helsinki.fi/hecse/

3.7.2 ComBi

The Graduate School in Computational Biology, Bioinformatics, and Biometry (ComBi) is a postgraduate program jointly offered by the University of Helsinki, the Helsinki University of Technology, the University of Turku and the University of Tampere. The Department of Computer Science at the University of Helsinki coordinates the school. The research goal of ComBi is to develop computational, mathematical, and statistical methods for biological sciences. To that end, ComBi will educate PhDs with high-quality methodological expertise. In their thesis work the students are expected to apply this expertise to computational, data analysis or modelling problems in biology or in some related field. The thesis projects are carried out in cooperation with one or more research groups in the application area (such as biochemistry, molecular biology, microbiology, ecology, evolution research and systematics, geography, public health).

Computational biology is a new field of research which develops methods and software implementations for computational problems in molecular biology, biotechnology, and genetics. Bioinformatics refers to the development and use of (molecular) biological databases. Biometry investigates statistical modelling problems related for example to genetic mapping, to the genetic and environmental risk factors of complex diseases, or to the spreading of infectious diseases. Further topics include population dynamics and numerical taxonomy of ecological and genetic phenomena.

More information (in English): http://www.cs.helsinki.fi/combi/

3.7.3 KIT Graduate School

Contact person:
Professor Helena Ahonen-Myka

Teaching (in Finnish):
http://www.ling.helsinki.fi/kit/tutkijakoulu/

The KIT graduate school is a multidisciplinary, nation-wide graduate school for human language technology-related PhD studies. The graduate school is part of the emerging Nordic cooperation in the field of language technology researcher training. The school has started in 2002 and finances 5 students. A few other students financed by other funding participate in the activities of the school.

3.8 Other education

3.8.1 Upgrading studies

A temporary programme for upgrading studies in computer science started in the autumn of 1999. It is a computer science Master's programme for persons who have already completed a degree in another subject. The last students were accepted into the programme in the separate entrance exam held in 2002.

The students were divided into tutor groups and individual plans for accepting their earlier studies were drawn up. Each group has a supervisor who guides the students to set up individual study plans. The extra evening and weekend courses as well as the study circles make the studies more flexible.

Additional information: http://www.cs.helsinki.fi/muuntokoulutus/

3.8.2 The co-operation with upper secondary schools

The department has co-operated with upper secondary schools in the Helsinki region since the academic year 1999-2000. Originally, this started in 1999 with six schools in Helsinki. At the moment, there are 14 schools participating in the programme.

In practice, the pupils of the co-operating schools may participate in the first major courses in computer science after being accepted to the programme through an entrance exam. This gives the pupils a chance to familiarise themselves with one of the academic fields before they start their actual academic studies. It is also a way of recruiting and motivating the pupils to choose computer science as their field and the department as their study place after the upper secondary studies. The goal of this cooperation for both the institution and the schools is to even out the difference between being an undergraduate and being a school pupil, and to make the transition from school to university studies easier. From the point of view of the pupils, the main goals are to clarify study interests and career goals, to motivate upper secondary studies, and to take responsibility for their own studies. For the schools, the objective is to promote their profile, to make use of the expertise of scientists, and to increase the cooperation between school and university teachers.

In spring 2003, 19 pupils from eight schools participated in the entrance exam, and 15 of them were accepted. In addition, of the pupils that had started in 2002, five announced that they wanted to continue for a second academic year. During 2003, upper secondary school pupils completed a total of 65 credits.

School pupils also compete in information technology in both national and international competitions. The Department of Computer Science is in charge of the practical arrangements on a national level during years 2002-2005. The aim of the competitions is to enhance and deepen the interest of pupils in information technology, especially when it comes to planning and implementing algorithms. The IT teaching at schools mostly concentrates on teaching practical skills, and not such scientific and technical approaches.

The national competition is called Datatähti (Data star), which the department arranges in co-operation with the Ministry of Education and MAOL ry (the association for teachers in mathematical sciences). The pupils who are successful in the competition are awarded a place to study at either the Department of Computer Science at the University of Helsinki, at the Department of Information Technology at the University of Turku or the Department of Computer and Information Sciences at the University of Tampere. On an international level, competitions are held for the Baltic area as well as the world-wide IT Olympics. A Finnish team is sent to both competitions. The Datatähti competition finds gifted pupils for a training group that are invited to the department for two training camps. A coach chooses the national team on the basis of their work at the training camp. In 2003, five lower secondary school and 11 upper secondary school pupils were chosen for the Datatähti finals from the preliminaries. A total of 14 pupils attended the training camp.

Professor Matti Nykänen is in charge of the competitions and the training at the department.

Additional information about the school co-operation:
http://www.cs.helsinki.fi/abinfo/lukiot.html

Additional information about the competitions:
http://www.cs.helsinki.fi/matti.nykanen/datatahti/

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3.8.3 The language technology network

The term human language technology or natural language processing means using linguistics for information technology applications processing natural languages. Some fields of application are the use of spoken language for computer user interfaces, computer-aided language education, writing accessories (spell-checkers, grammar checking, etc), data mining and document management, automatic translation, speech recognition and production, interactive network applications, mobile communications technology and electronic dictionaries.

The Department of Computer Science is a member of the nation-wide language technology education network (Kieliteknologian opetus, KIT). This network enables extensive and multidisciplined language technology studies in several universities. Students may take language technology as a large minor subject (with one other minor) in the Applied Computer Science sub-programme, or as a normal minor in the Computer Science sub-programme. The language technology courses at the department teach students how to design systems for managing texts. In addition, they are taught computational methods for isolating applicable information about real language use in language data. To mention an example, data on some words often occur together, from which we may draw the conclusion that they are idioms.

Contact person:
Professor Helena Ahonen-Myka

Teaching (in Finnish):
http://www.cs.helsinki.fi/u/hahonen/ktekno/

Research:
http://www.cs.helsinki.fi/research/doremi/

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4. RESEARCH

4.1 Research units

4.1.1 From Data to Knowledge - FDK

The staff of the Centre of Excellence in front of the department in Vallila

The From Data to Knowledge research unit (FDK) develops computing methods for forming useful knowledge from large masses of data. The unit is multidisciplinary, combining in its research groups expertise in algorithmics, statistical methods and application fields such as bioinformatics and human language processing. The unit was appointed a Centre of Excellence of the Academy of Finland for a six year period starting from 1 January 2002.

The FDK unit is a co-operation between the University of Helsinki and the Helsinki University of Technology (HUT). Academy Professor Esko Ukkonen is the director of the unit, and Professors Helena Ahonen-Myka, Tapio Elomaa, Jaakko Hollmen (HUT), Heikki Mannila (Basic Research Unit/HIIT) and Hannu Toivonen are members of it. In 2003 the personnel of the unit consisted of about sixty researchers and postgraduate students.

The core competence area of the unit is algorithmics for data analysis. The unit's areas of expertise on an international level are combinatorial pattern recognition and string matching on the one hand, and machine learning and data mining on the other. The unit emphasizes in its activities the interaction between theory development and practical applications. Our goal is to find research problems, whose conceptual basis and solution algorithm have a wider application potential. We are not content with just tailoring some general-purpose approaches (as, for example, the so-called genetic algorithms) for the problem in hand. Rather, the goal is to develop and analyse original algorithms using the wide technical arsenal of algorithmics.

The unit functions as four closely connected main projects. The same persons are active in several projects. This facilitates internal communication and the utilisation of expert knowledge for different applications.

The theme of the main endeavour, Project I, is data mining and machine learning. The project develops original concepts and algorithms to strengthen a core area of the unit. We aim at results in theoretical basic research. The relevance of the results is tested in various applications. Text databases and document collections as well as event sequences in telecommunication networks are examples of the data we use. Information-filtering from the Internet and other human language technology belong to the area of this project as well as using machine learning in image analysis.

Project II specialises in computational biology applications. It studies the methods for medical genetics and for analysing data on genomics, proteomics, and metabolisms. The spectrum of collaborators is wide ranging from UCLA to the European Bioinformatics Institute and to several Centres of Excellence in Finland. We develop computational methods for example for locating the genetic basis of multifactorial diseases as well as for synthesizing gene regulatory networks from data. The latest research focuses on such areas as haplotypes, mapping the overall architecture of genes and computing metabolic fluxes.

Project III deals with combinatorial pattern-recognition and information retrieval. Included are both algorithm theory and applications. The main research questions include approximate pattern matching, efficient index structures, and the synthesis of patterns from data. Applications are several. One subproject considers the retrieval and analysis of symbolically encoded music, for example.

Project IV focuses on computational structural biology. The main task is to construct three-dimensional computer models for biological macromolecular complexes, from electron micrographs, for example. Interesting sub-structures are found in the models with the help of generalisations of the methods of Project III.

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In addition to the basic research and doctoral education, the FDK unit also wants to serve as an algorithm 'atelier' which develops computational solutions to new problems in different fields. The unit is always in search for new partners who could pose computational problems in the forefront of the research.

Contact person of the unit:
Academy Professor Esko Ukkonen

http://www.cs.helsinki.fi/research/fdk/

Main publications in 2003:

M. Koivisto, M. Perola, T. Varilo, W. Hennah, J. Ekelund,
M. Lukk, L. Peltonen, E. Ukkonen and H. Mannila:
An MDL method for finding haplotype blocks and for estimating
the strength of haplotype block boundaries. Pacific Symposium
on Biocomputing 2003, pp. 502-513, World Scientific 2003.

J. Makkonen, H. Ahonen-Myka, and M. Salmenkivi:
Simple Semantics in Topic Detection and Tracking.
To appear in Information Retrieval 7, 3-4 (2004), 347-368.

V. Mäkinen, G. Navarro and E. Ukkonen: Approximate matching of
run-length compressed strings. Algorithmica 35 (2003), 347-369.

J. Rousu, A. Rantanen, H. Maaheimo, E. Pitkänen, K. Saarela and
E. Ukkonen: A method for estimating metabolic fluxes from
incomplete isotopomer information. In: Computational Methods in
Systems Biology (CMSB 2003), Lecture Notes in Computer Science 2602,
pp. 88-103, Springer-Verlag 2003.

Th. Schlitt, K. Palin, J. Rung, S. Diekman, M. Lappe and A. Brazma:
From gene networks to gene function. Genome Research 13 (2003),
2568-2576.

Research projects in 2003:

Data mining and algorithmic machine learning
- Bassist
- DoReMi
- Paleoecological Data Analysis
Computational biology and bioinformatics
- Integrated computational methods for genomic, proteomic and
  metabolic modeling (ICOMIC)
- A global molecular approach in the study of microbial stress
Combinatorial pattern-matching and information retrieval
- C-BRAHMS
Computational structural biology
- Structure, compilation and dynamics of biological macromolecular complexes

International visits in 2003:

Visits to the unit:

Jean-Francois Boulicaut, INSA, Lyon
Bruno Crémilleux, Université de Caen
Professor Luc De Raedt, Albert-Ludwigs-Universität, Freiburg
Alexander Hinneburg, Institut für Informatik, Universität Halle-Wittenberg
Professor Mohammed Zaki, Rensselaer Polytechnic Institute,
Troy, New York
Professor Gad M. Landau, University of Haifa
Marie-France Sagot, PhD, INRIA Rhone-Alpes, Lyon
Stefan Burkhardt, PhD, Max-Planck-Institut für Informatik, Saarbrücken

Visits from the unit:

Antoine Doucet, Université de Caen
Juha Kärkkäinen, Max-Planck-Institut für Informatik, Saarbrücken
Juha Muilu, European Bioinformatics Institute, Hinxton, UK
Juha Muilu, IBM e-business solutions center, LaGaude, France
Veli Mäkinen, Universidad de Chile, Santiago
Evimaria Terzi, Università degli Studi di Milano
Juho Rousu: Marie Curie Individual Fellowship,
Royal Holloway University of London

4.1.2. Helsinki Institute for Information Technology HIIT

The Helsinki Institute for Information Technology (HIIT) is a joint research unit of the University of Helsinki and Helsinki University of Technology. The unit aims at significantly enhancing strategic research in the field of computer science, while improving the co-operation between the University of Helsinki and the Helsinki University of Technology. HIIT consists of two units: the Advanced Research Unit (headed by Martti Mäntylä), which works in co-operation with the industries and functions primarily at the University of Technology, and the new Basic Research Unit (headed by Heikki Mannila) that started operations at the beginning of the year 2002. The Basic Research Unit functions primarily in the facilities of the Computer Science Department, which will move from Vallila to the new Kumpula campus in summer 2004. Part of it operates at the Helsinki University of Technology in Otaniemi. The Basic Research Unit (BRU) carries out first-rate basic research in the field of computer science, in close co-operation with end-users in other disciplines and in the industries. The main research areas of the unit are data analysis, adaptive computing and computational neuroscience.

Contact person of the research unit:
Professor Heikki Mannila (heikki.mannila@cs.helsinki.fi)

http://www.cs.helsinki.fi/hiit_bru/
http://www.hiit.fi/

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Kari Laasonen, Mika Raento and Hannu Toivonen are researchers in the Context team

Main publications in 2003

F. Geerts: Expressing the box cone radius in the relational calculus with real polynomical constraints. Discrete and Computational Geometry 30, 4(2003), pp. 607-622.

D. Gunopulos, R. Khardon, H. Mannila, S. Saluja, H. Toivonen, and R.S. Sharma: Discovering all most specific sentences. ACM Transactions on Database Systems 28 (2): 140-174, 2003.

H. Toivonen, A. Srinivasan, R.D. King, S. Kramer, and C. Helma: Statistical evaluation of the predictive toxicology challenge 2000-2001. Bioinformatics 19 (10): 1183-1193, 2003.

A. Gionis and H. Mannila: Finding recurrent sources in sequences. RECOMB 2003 in W. Miller, M. Vingron, S. Istrail, P. Pevzner, and M. Waterman (eds), pp. 123-130.

M. Koivisto, M. Perola, T. Varilo, W. Hennah, J. Ekelund, M. Lukk, L. Peltonen, E. Ukkonen, and H. Mannila: An MDL method for finding haplotype blocks and for estimating the streght of haplotype block boundaries. In Pacific Symposium on Biocomputing 2003 (PSB'03), R.B. Altman, A.K. Dukner, L. Hunter, T.A. Jung, and T.E. Klein (eds), World Scientific 2002, pp. 502-513.

Research projects in 2003:

Data Mining for gene mapping
Segmentation algorithms
Context
NAPS
Spatial data analysis for onomastics

International visits in 2003

Visits to the unit:

Professor Foto Afrati, Software Engineering Laboratory, National Technical University of Athens
Professor Luc De Raedt, Albert-Ludwigs-Universität, Freiburg
Alexander Hinneburg, Institut für Informatik, Universität Halle-Wittenberg
Manfred Jaeger, Institut for Datalogi, Aalborg Universitet
Assistant Professor Mohammed Zaki Rensselaer Polytechnic Institute, Troy, New York

Research visits from the unit:

Evimaria Terzi, Università degli Studi di Milano

4.2 Research groups

4.2.1 Complex Systems Computation Research Group - CoSCo

The CoSCo research group investigates computational issues related to complex systems, focusing on prediction and model selection tasks. The research areas addressed include stochastic modelling and data analysis - especially with Bayesian networks and related probabilistic model families, such as finite mixture models and Bayesian multinets - information theoretical approaches to inference (MDL/MML), theoretical and empirical validation of on-line prediction algorithms, case-based reasoning (CBR), and stochastic optimisation algorithms, such as simulated annealing and genetic algorithms. The work has both a strong basic research component, being at the intersection of computer science, information theory and mathematical statistics, and an applied component where the results are applied in multiple disciplines from social sciences, criminology, ecology and medicine to industrial engineering. Recent focus areas in the applied research include personalisation for the Internet, diagnostics for space satellites, next generation search engine techniques and modelling for location-aware services. The CoSCo team has excellent international research contacts to all the leading projects on probability modelling in the world, and the team co-operates actively with several leading researchers abroad.

In general, the CoSCo team benefits from a rare combination of theoretical competence with top-level programming skills. As a concrete demonstration of this, CoSCo has developed the unique B-Course service (http://b-course.cs.Helsinki.fi), a sophisticated tool for state-of-the-art data analysis on the web. In Spring 2003, version 2.0 of B-Course was published, enabling goal-oriented data analysis for classification problems. Another Internet service published by the team in 2003 analyses the voting carried out by Members of Parliament. This tool, illustrating the possibilities of modern methods for data analysis, is available at http://cosco.hiit.fi/eduskunta/. The team's tools for E-learning (see http://cosco.hiit.fi/edutech/) have been further developed during 2003, and they are increasingly being used for teaching at the department, as well as at other universities.

In 2003, the team kept up the maintenance of the server www.mdl-research.org, representing the more theoretical activities of the group. This site compiles the main results of research on the Minimum Description Length (MDL) theory developed by Jorma Rissanen. Rissanen himself has been actively co-operating with the team.

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CoSCo is affiliated with Helsinki Institute for Information Technology's
(HIIT) Advanced Research Unit
(http://www.hiit.fi).

Contact persons:
Professor Henry Tirri
Professor Petri Myllymäki

http://cosco.hiit.fi

Main publications in 2003

H.Wettig, P.Grünwald, T.Roos, P.Myllymäki, H.Tirri,
When Discriminative Learning of Bayesian Network Parameters Is Easy.
Pp. 491-496 in Proceedings of the 18th International Joint Conference on
Artificial Intelligence, edited by G.Gottlob and T.Walsh. Morgan Kaufmann, 2003.

P.Kontkanen, W.Buntine, P.Myllymäki, J.Rissanen, H.Tirri,
Efficient Computation of Stochastic Complexity.
Pp. 181-188 in Proceedings of the Ninth International Workshop on Artificial
Intelligence and Statistics, edited by Christopher M. Bishop and Brendan J. Frey.
Society for Artificial Intelligence and Statistics, 2003.

W.Buntine, S.Perttu, Is Multinomial PCA Multi-faceted Clustering or
Dimensionality Reduction?. Pp. 300-307 in Proceedings of the Ninth International
Workshop on Artificial Intelligence and Statistics, edited by C.M. Bishop and B.J. Frey.
Society for Artificial Intelligence and Statistics, 2003.

M.Miettinen, J.Kurhila, P.Nokelainen, P.Floréen, H.Tirri,
EDUCOSM - Personalized Writable Web for Learning Communities.
Pp. 37-42 in Proceedings of the ITCC 2003 Conference, Las Vegas, USA, April 2003.

H.Wettig, J.Lahtinen, T.Lepola, P.Myllymäki, H.Tirri,
Bayesian Analysis of Online Newspaper Log Data.
Pp. 282-287 in Proceedings of the 2003 Symposium on Applications
and the Internet Workshops.
IEEE Computer Society, Los Alamitos, California, 2003.

Research projects in 2003

DeepC: Computationally Efficient Methods for Deep Computing
MINOS: Minimum Description Length Modeling in Computer Science and Statistics
PRIMA: Proactive Information Retrieval by Adaptive Models of Users' Attention and Interests
PROSE: Scalable Probabilistic Methods for Next Generation Internet Search Engines
SIB: Search-ina-Box
WIRNE: Personalized Location-Dependent Services in Wireless Networks
Cepler: Computationally Efficient Probabilistic Learning and Reasoning
BIDMA: Multivariate Biological Data Analysis

International visits in 2003

Henry Tirri acted as Visiting Professor at both Stanford and Berkeley in the USA, making several visits at these universities.

4.2.2 Networking in Open Distributed Environments - NODES

The NODES group has been formed to stimulate and coordinate research on distributed and networked systems and applications. The group's scope of interests includes concurrency, data communication software, and distributed systems. The current research focus lays on the design and development of infrastructure for mobile computing, on performance evaluation of distributed and networked systems, and on open distributed software architectures and services. The research projects co-ordinated by NODES can be further divided into four sub-groups: mobile computing and wireless data communications; open distributed systems; operating systems; and formal specification and verification.

In mid-October 2003 the group celebrated the ten-year anniversary of research into mobile computing and wireless data communications; the first meeting of the project was held in September 1993. The original goal was to create convenient access from a portable computer through a wireless wide-area network (i.e. GSM) to the Internet. Currently, the group focuses on issues of quality of service in connection with the IP protocol. The projects IIP Wireless and IIP Mixture study these issues. The research project TranSat, on its part, develops improvements to TCP over satellite links. Under the auspices of the ANWIRE project, the group has participated in academic co-operation in Europe. During 2003, the project group arranged three workshop meetings and one summer school, where members of our group participated as both audience and speakers.

The Open distributed software systems group develops middleware services to support inter-organizational co-operation and networking. Partners in the co-operation are application components, which have been developed independently and which are under separate autonomous authorities, which means that the system must have facilities for publishing services, for automatic negotiations about agreements, and for internal management to fulfil the agreements. Middleware services must conceptually be capable of working in parallel on several application platforms.

In the Operation systems enhancement group, the active project investigates the capabilities of Linux in environments where high availability and timeliness are required.

Formal specification and verification of distributed systems is studied in the Modelling of concurrent systems group. The theoretical results of the group are based on process algebras, temporal logic, and theory of automata. The results are applied to software engineering tools. Several post-graduates are active in the project group. In September 2003, the projects and post-graduates working on wireless data communications held a two-day seminar that focused on some research issues in more detail.

As many as six former members of the project groups defended their doctoral theses in 2003.

Contact person for the project group:

Professor Kimmo Raatikainen

http://www.cs.helsinki.fi/research/nodes/

Main publications in 2003

T. Malinen & M. Luukkainen:
Fairness in automata theoretic model checking.
Proceedings of the Estonian Academy of Sciences. Physics, mathematics
52(2003):4, 394-412.

R. Popescu-Zeletin, S. Arbanowski, I. Fikouras, G. Gasbarrone,
M. Gebler, S. Henning, H. van Kranenburg, H. Portschy, E. Postmann,
& K. Raatikainen: Service architectures for the wireless world.
Computer communications 26(2003):1, 19-25.

P. Sarolahti, M. Kojo & K. Raatikainen:
F-RTO: an enhanced recovery algorithm for TCP retransmission
timeouts. Computer communication review 33(2003):2, 51-63.

D. Wisely, H. Aghvawi, S.L. Gwyn, T. Zahariadis, J. Manner,
V. Gazis, N. Houssos & N. Alonistioti:
Transparent IP radio access for next-generation mobile networks.
IEEE wireless communications magazine 10(2003):4, 26-35.

A. Gurtov & R. Ludwig: Responding to spurious timeouts in TCP.
In: IEEE INFOCOM 2003, the Conference on Computer Communications,
22nd Annual Joint Conference of the IEEE Computer and Communications
Societies, 30 March - 3 April 2003, Hyatt Regency San Francisco,
California, USA, pp. 2312-2322.

Research projects in 2003

IIP Mixture
IIP Wireless
Transat
ANWIRE
Pilarcos
web-Pilarcos
nsrtLinux

International visits in 2003

Andrei Gurtov, University of California, Berkeley
Professors Timo Alanko and Kimmo Raatikainen, Finnish Data Processing Week,
Petroskoi
Professor Kimmo Raatikainen, researchers Markku Kojo and Jukka Manner
participated in the meetings for standardization co-operation:
IETF: San Francisco, Wien, Minneapolis
OMG: Orlando, London
W3C XML Binary Infoset Workshop: Palo Alto
WWRF: Zürich, New York
Many of the post-graduate members participated in international schooling:
The ANWIRE summer school "Wireless Internet: network
architectures, quality of service, services and applications", Lissabon.
Berkeley - Helsinki Summer School on Telecommunication Software
Architectures, Berkeley (arranged in co-operation)

Guests:

Professor Iouri Bogoiavlenski, University of Petrozavodsk
Researcher Lars-Olof Burchard, Technische Universität Berlin
Doctoral student Cristiano di Flora, Università di Napoli

4.2.3 Research Group on Object-Oriented Software Architectures - ROOSA

The ROOSA research group studies software architectures, and especially their object-oriented paradigms, and develops methods and tools for architecture-based software engineering. In year 2003 the group has concentrated on further improving the tools and reporting the results in publications as well as theses and their manuscripts. In addition, the project group had the main responsibility for a large international conference on software engineering, "The fourth joint meeting of the European Software Engineering Conference and ACM SIGSOFT Symposium on the Foundations of Software Engineering (ESEC/FSE 2003)", held in Helsinki on 1-5 September 2003.

Contact person for the project group:
Professor Jukka Paakki
Professor Inkeri Verkamo

http://www.cs.helsinki.fi/research/roosa/

Main publications in 2003:

J. Viljamaa: Reverse engineering framework reuse interfaces.
Software engineering notes 28(2003):5, 217-226.
(Proc. Joint 9th European Software Engineering Conference (ESEC) &
11th ACM SIGSOFT Symposium on the Foundations of Software Engineering
(FSE-11), Helsinki, Finland, September 1-5, 2003.)

J. Gustafsson: Software quality evaluation in the design phase.
In: Modernin informaatioteknologian menetelmätutkimusta:
STKV '2001-2002 konferenssijulkaisu = Advances in methods of modern
information technology: proceedings of FDPW '2001-2002 (Petroskoin
yliopiston vuosittainen suomalaisen tietojenkäsittelyn viikko
2001-2002). Petroskoi: Petroskoin yliopisto, 2003, pp. 57-66.

J. Taina, J. Paakki & R. Kauppinen:
RITA - a framework integration and testing application.
In: Modernin informaatioteknologian menetelmätutkimusta:
STKV '2001-2002 konferenssijulkaisu = Advances in methods of modern
information technology: proceedings of FDPW '2001-2002 (Petroskoin
yliopiston vuosittainen suomalaisen tietojenkäsittelyn viikko
2001-2002). Petroskoi: Petroskoin yliopisto, 2003, pp. 150-158

Research projects in 2003:

Techniques for UML-Based Software Development (UML++)
Framework Integration and Testing Application (Rita)

4.2.4. Document Management, Information Retrieval and Data Mining - Doremi

The Doremi research group is active in the areas of document management, information retrieval, data mining and human language technology. The group has developed methods for document assembly, event detection and tracking, data retrieval from XML documents, text mining, and question-answering systems.

In 2003, the team finished the project TYTTI (the Knowledge Worker's Workstation), which was financed by The National Technology Agency in Finland. The main research issues of the project were document assembly and event detection and tracking. The research on document assembly considered the production of tailored documents from existing documents and document fragments. Typical applications include product manuals where a manual may be tailored to correspond to a certain customer-specific product configuration. In our approach a graphical assembly interface for an end user is dynamically generated based on a simple description of the possible target manuals. When the needs of a company change, the necessary changes can be made solely to the user manual descriptions, which does not require any programming skills.

Event recognition and tracking entails two problems: discovering events and following up on the happenings. The method for event discovery tries to decide whether a new item from the news flow relates to an earlier reported event or not. The method for event tracking ties a new item to events that have been detected previously. These problems have been addressed by extracting locations, proper names, temporal expressions and normal terms from documents, and these so-called semantic classes have been assigned weights that have been set by reading the news documents in a teaching set, where they were already classified according to their contents. Furthermore, the project has proposed new similarity measures, based on semantic classes, for comparing news items. The methods for event recognition and tracking have been included in the journalist's workstation developed by the TYTTI project. Other components of the workstation are the news editor (an XML editor) and a retrieval interface to a database of news stories. The research on event recognition and tracking continues as Juha Makkonen actively works on his PhD thesis in the subject. The goals include taking into account how the features of a news item change as events progress.

In text mining, the group develops data mining techniques for finding regularities in texts. The research has resulted in methods for finding all maximal word sequences with at least a given frequency in a document collection. The Doremi team has then used word sequences as a condensed content descriptor in information retrieval. In 2003, the project group participated with its own system for the first time in the international project "Initiative for the Evaluation of XML retrieval (INEX)", which aims to produce a broad testing environment and evaluation methods for information retrieval in XML document collections. The results from our system seem wholly comparable to those of other systems.

A new project started in 2003, Mobile and Multilingual Maintenance Man (4M), is a co-operation between the University of Helsinki and several project groups at the Helsinki University of Technology, as well as VTT Information Technology (the national technology research centre). The project is a part of the FENIX project on interactive computing, funded by TEKES (The National Technology Agency in Finland). The 4M project aims at developing a knowledge support system that communicates with natural languages to aid maintenance workers repairing machinery. The Doremi team is in charge of developing methods for producing knowledge from text documents, e.g. to extract concepts of machine ontology and different instructions from the user manuals of the machinery. In addition, the team is researching information retrieval that will fit on a small screen and give exact results while utilising the ontologies and previous discussions.

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Contact persons of the project group:

Professor Helena Ahonen-Myka
University Lecturer Greger Lindén
PhD researcher Marko Salmenkivi

http://www.cs.helsinki.fi/research/doremi/

Main publications in 2003

Aunimo, L., Heinonen, O., Kuuskoski, R., Makkonen, J.,
Petit, R., and Virtanen, O. Question answering system for
incomplete and noisy data - Methods and measures for its evaluation.
Proceedings of the 25th European Conference
on Information Retrieval Research, Pisa, Italy, April 14-16, 2003,
Lecture Notes in Computer Science 2633, p. 193-206, Springer 2003.

Doucet, A., Aunimo, L., Lehtonen, M., and Petit, R.
Accurate retrieval of XML document fragments using EXTIRP.
To appear in the Proceedings of the Second Annual Workshop
of the Initiative for the Evaluation of XML Retrieval (INEX 2003),
December 15-17, 2003, Schloss Dagstuhl, Germany, 2003.

Makkonen, J., Ahonen-Myka, H., and Salmenkivi, M.
Topic detection and tracking with spatio-temporal evidence.
Proceedings of the 25th European Conference
on Information Retrieval Research, Pisa, Italy, April 14-16, 2003,
Lecture Notes in Computer Science 2633, p. 251-256, Springer 2003.

Makkonen, J. Investigations on event evolution in TDT.
Proceedings of Human Language Technology (HLT-NAACL)
2003 Student Workshop, May 2003, Edmonton, Canada, pp. 43-48.

Makkonen, J., Ahonen-Myka, H., and Salmenkivi, M.
Simple semantics in topic detection and tracking.
Information Retrieval 7,3-4(2004), p. 347-368.

Research projects in 2003

Knowledge Worker's Workstation (TYTTI)
Doremi Text Mining
Evaluation of XML information retrieval (HELINEX)
Mobile and Multilingual Maintenance Man (4M)

International visits in 2003

Helena Ahonen-Myka
State University of Petrozavodsk
Université de Caen, Laboratoire GREYC
Antoine Doucet
Université de Caen, Laboratoire GREYC

Guests:

Bruno Crémilleux
Université de Caen, Laboratorie GREYC

4.2.5 The Semantic Computing Research Group SeCo

In 2003, the Semantic Computing research group (SeCo) consisting of 16 members has been focusing its research on the technologies and applications of the semantic web. The team works at both HIIT (Helsinki Institute for Information Technology) and at the Department of Computer Science. There were four research projects in SeCo in 2003. The Semantic web, i.e. Intelligent index services project studied how the contents of distributed databases can be merged with a semantic portal. Concept-based information retrieval and a semantic system of recommendation were other issues considered by the project. Using the university museum's database of photographs an information retrieval method and the application Promoottori were developed. Promoottori searches and browses photographs according to their semantic contents. The system was inaugurated at the opening of the new facilities of the University museum. The methods and their implementations were further improved in the MuseoSuomi system, and its first demonstration was completed during the year. MuseoSuomi is a semantic portal and publication channel for the collections of Finnish museums to be published on the semantic web.

In autumn 2003, two new projects were started; Ontologies of the Finnish Semantic Web and Intelligent Web Services. Ontologies of the semantic web is a national research project to develop broad Finnish open-source ontologies and the maintenance tools and applications for them. The project is a part of the Fenix research programme of Tekes, and comprises 16 different partners. The Intelligent Web Services project is also a part of the Fenix research programme, and four partners participate in it. The research focuses on combining the semantic web and web services in service directories like the yellow pages.

In addition, in 2003, the SeCo research group participated in the European AdaNets project as the partner of Nokia Oyj. This project studied content-based mobile services.

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Leader and contact person of the research group:

Professor Eero Hyvönen

http://www.cs.Helsinki.FI/group/seco/

Main publications in 2003

E. Hyvönen, M. Junnila, S. Kettula, S. Saarela, M. Salminen, A. Syreeni, A. Valo, K. Viljanen: Publishing Collections in the "Finnish Museums on the Semantic Web" Portal -- First Results. Paper presented at the symposium Arts and Humanities in the Digital Domain: Towards Web based Culture and Science, Salzburg, Austria, Oct. 6-7, 2003. Proceedings of XML Finland 2003, Oct. 30-31, 2003, Kuopio, Finland.

E. Hyvönen, A. Valo, K. Viljanen, M. Holi: Publishing Semantic Web Content as Semantically Linked HTML Pages. Proceedings of XML Finland 2003, 30-31.10.2003, Kuopio, Finland.

E. Hyvönen, S. Kettula, V. Raatikka, S. Saarela, K. Viljanen: Finnish Museums on the Semantic Web. Proceedings of WWW2003, Budapest, poster papers, 2003.

E. Hyvönen, K. Viljanen, A. Hätinen: Yellow Pages on the Semantic Web. Proceedings of WWW2003, Budapest, poster papers, 2003.

E. Hyvönen, S. Saarela, K. Viljanen: Ontology Based Image Retrieval. Proceedings of WWW2003, Budapest, poster papers, 2003.

Research projects in 2003

Semantic Web / Intelligent index services
Ontologies of the Finnish Semantic Web
Intelligent Web Services
AdaNets

International visits in 2003

Eero Hyvönen participated in the evaluation panel for the Digital Enterprise Research Institute (DERI) in Ireland at the invitation of Ireland Science Foundation.

4.3 Research projects

Algorithms

Project: **Networking and Architecture for Proactive Systems – Algorithmics (NAPS)**
Period: January 2003 – December 2005
Researchers: Patrik Floréen, Jukka Kohonen
Funding: The Finnish Academy: the PROACT research project

The project is a part of the Networking and Architecture for Proactive Systems (NAPS) consortium, and is implemented as a co-operation between the Basic Research Unit at HIIT and the Theoretical Computer Science unit at the Helsinki University of Technology (Professor Orponen). Modern algorithm research has produced a set of advanced tools for such issues as approximate solutions for combinatorial optimisation problems, the efficient computing of network flow and other network features, speeding up algorithms with the help of randomness, and the development and analysis of computational methods in online situations where input is added gradually during computation. Though traditional algorithm development is already a mature research area, the demands of a pro-active environment – especially in systems like mobile ad-hoc networks – emphasize design parameters that the literature has only lately paid attention to. The project has focused on two issues in 2003:

(1) Topology control in ad-hoc networks when the transmit power of energy-restricted nodes is adjusted dynamically during computation and the goal is to maximize the network lifetime in multicasting. The results have been published in the following articles:

P. Floréen, P. Kaski, J. Kohonen and P. Orponen: "Multicast time maximization in energy constrained wireless networks." Proceedings of the DIALM-POMC Joint Workshop on Foundations of Mobile Computing (DIALM-POMC 2003) at MobiCom 2003,   ACM, 2003, 50-58. In addition, a more detailed version has been written and offered for publication.

(2) The energy-aware and balanced gathering of data and placing of transmission nodes in sensory networks. An article presenting the results has been sent to a conference.

Project: **Space4U**
Period: July 2003 – June 2004
Researchers: Patrik Floréen, Andrei Popescu (July-August '03), Otso Virtanen August '03
                    – June '04)
Funding: Nokia Research Center

The project is research-on-demand. Space4U is an ITEA project (EUREKA), which is a continuation of the ROBOCOP-project. HIIT/BRU participates in the Terminal management part of this project as the sub-contractor of Nokia. This part of the project develops context-aware selection of software components in mobile phones. During year 2003, the group has concentrated on studying the mechanisms for enabling context-awareness in the ROBOCOP architecture, and on considering how context-switches can be noted. Software development on top of the Linux system is part of the project work.

Intelligent systems

Project: **Computationally Efficient Probabilistic Learning and Reasoning - (Cepler)**
Period: January 2003 – December 2004
Researchers: Petri Kontkanen, Tomi Silander, Jorma Rissanen
Funding: The Finnish Academy

The main motivation for this work is the need to develop methods for constructing computationally intelligent models from sample data and expert domain knowledge.

The constructed models will be used for solving predictive (regression, classification) and explorative (data mining, visualization) modelling tasks.

Although the advantages of probabilistic models have been largely recognized, the approach has often been neglected as a theoretically correct, but computationally infeasible methodology. The purpose of this research is to develop computationally efficient methods for probabilistic modelling.

During year 2003 the project focused on Bayesian and information-theoretical measures, with which the complexity of the models to be learned can be adjusted automatically on the basis of the information in the data. Some of the results will be implemented as part of the public B-Course data analysis server.

Project: Computationally efficient methods for deep computing - (DEEPC)
Period: July 2000 – December 2003
Researchers: Henry Tirri, Wray Buntine, Jorma Rissanen, Tomi Silander, Teemu Roos, Petri Nokelainen, Miikka Miettinen, Tommi Mononen, Hannes Wettig
Funding: The Finnish Academy (the MaDaMe research programme)

The research focuses on three linked areas: Deep modelling (prediction and data mining with very large data sets), Deep optimization (computationally efficient optimization of complex multivariate cost functions) and Deep view (interfaces for understanding high-dimensional data). In deep modelling, the research focuses on learning network models (the so-called Bayesian networks and causal networks) from data. Deep optimization considers computationally efficient methods for finding models. Deep view has developed three-dimensional visualization methods to visualize models. The project has implemented the data analysis server B-Course (http://b-course.hiit.fi), with which the methods developed in the project have been disseminated to be used by other researchers, as well. The feedback on B-Course has been positive and its source code has been released to the MIT, among others, for the development of a specialised data analysis service. A new version of the B-Course service was published in year 2003. This version contained an analysis of the classification tasks. In addition to the general tool in B-Course, the research group has studied the above-mentioned theoretical and practical research issues in real examples from partners in the project. Some application areas are error diagnostics for satellites (ESA), ecological modelling (RKTL), localising mobile agents (Ekahau), data visualisation (BayesIT), development of pharmaceuticals (Kibron) and adaptive user interfaces for new learning environments (Helsinki University Department of Education).

Software engineering

Project: Techniques for UML–Based Software Development - (UML++)
Period: May 2001 – December 2004
Researchers: Juha Gustafsson, Topias Mattila
Funding: The Finnish Academy

The project develops methods for the measurement of software quality at the design level, and the Maisa tool to support these methods. The quality measurement is based on pattern-matching and computing the software metrics from the system's architectural description given in UML. In 2003, the research has focused on evaluating the size and performance of software.

Project: Framework Integration and Testing Application - (Rita)
Period: July 2001 – June 2005
Researchers: Raine Kauppinen, Antti Tevanlinna, Juha Taina
Funding: Nokia Research Center, Tekes

The project develops methods and tools for the testing of framework-based software systems and for verifying the quality of testing with new forms of code coverage criteria. In 2003 the research has concentrated on specifying a testing process suitable for software frameworks and on developing the prototype of a testing tool supporting that process.

Distributed systems and data communication

Project: Improving Internet Protocols for Wireless links (IIP Wireless)
Period: January 2002 – March 2003
Researchers: Kimmo Raatikainen, Markku Kojo, Tuomas Kulve, Simone Leggio, Oriana Riva, Jarno Saarto
Funding: Tekes, Nokia Research Center, Nokia Hungary, Sonera

The objective of the IIP-Wireless project is to measure the TCP performance implications of those link characteristics that are typical for wireless wide-area links as well as to design and implement new experimental TCP performance enhancements and analyse the impact of the enhancements. The results will be contributed to the Internet Engineering Task Force (IETF). In addition, a real-time software emulator called Seawind is developed further during the project. Seawind enables measurements of real protocol implementations in modelled networking environments. This emulator provides a rich set of ways to define transfer characteristics typical for wireless links, including delays and errors. The software also has the means to conduct large sets of experiments in an automatic fashion. Tools for analysing measurement data have been integrated into the Seawind software.

Project: Transport Protocol and Resource Management for Mobile Satellite Networks (TranSat)

Period: October 2001 – February 2004

Researchers: Kimmo Raatikainen, Markku Kojo, Davide Astuti, Laila Daniel, Aki Nyrhinen

Funding: (ESA) Alcatel Space

The aim of the project is to develop the operation and performance of Internet transport protocols in a satellite environment. The project focuses on two main fields:

1) The enhancement of TCP protocols by improving the TCP sender and receiver algorithms, and to improve the support offered to the transport level at link level

2) The enhancement of resource management for the satellite link, and on the IP level, the coupling of differentiated package treatment (IP QoS) to the differentiated services offered by a satellite link. In 2003 the project work focused on the detailed design and prototype development of the key features of the TranSat architecture. In addition, experimentation was carried out to determine the performance effects of the implemented solutions.

Project: Improving Internet Protocols for Heterogeneous Traffic on Wireless Links (IIP Mixture)

Period: March 2003 – February 2005

Researchers: Kimmo Raatikainen, Markku Kojo, Tuomas Kulve, Simone Leggio, Oriana Riva, Jarno Saarto

Funding: Tekes, Nokia Research Center, TeliaSonera Finland

The IIP Wireless project studies the function of the TCP protocol in a wireless environment. The IIP Mixture project is a follow-up to the IIP Wireless project, but the focus has moved to Internet solutions that enable the most heterogeneous traffic possible using different applications over wireless links. The main question is how different competing communication classes (mixed communication) behave and how their behaviour can be managed with the help of separate handling of packages that influence the QoS of the IP protocol. Special emphasis is laid on the co-operation between active queue management and the handling of DiffServ packages, and the best way of ordering them while taking into account the QoS of 3G architectures and how different applications should implement the protocol at application level to make operations as efficient as possible at the transport level. The project works on further developing the TCP protocol and algorithms to suit a wireless environment (2.5G and 3G) better. The development of the Seawind network emulator also continues. By the end of year 2003, the software had been licensed to fifteen universities and research institutes. In 2003, the project focused on three main activities:

1) The analysis of and experiments on Internet Instant Messaging and e-mail protocols

2) Research on the performance of HTTP1.1-type communications and its competitor TCP and UDP mixed communications

3) IETF contributions.

Furthermore, the project has modelled wireless links for research on Internet relay protocols in co-operation with the ICSI/ICIR research unit at Berkeley.

Project: Academic Network for Wireless Internet Research in Europe (ANWIRE)

Period: September 2002 – August 2004

Researchers: Kimmo Raatikainen, Tiina Niklander, Markku Kojo, Jukka Manner, Sasu Tarkoma

Funding: The EU Commission

ANWIRE is a thematic network established mainly by academic institutions from various EU countries acting in two main overlapping tracks: Wireless Internet and Reconfigurability. In both areas ANWIRE aims at i) organising and co-ordinating parallel actions in key reaserch areas, in order to encompass research activities towards the design of a fully integrated system; and ii) promoting and disseminating solutions in order to make them available to the research and industrial community. During the year 2003 members of the ANWIRE project published several papers in multiple journals and conferences. The ANWIRE project also organised one summer school about wireless communication and three workshops about the main themes of the project. Please see http://portal.anwire.org/ for more information on the project.

Project: Production and Integration of Large Component Systems with
                Web services technologies (web-Pilarcos)
Period: February 2003 – December 2004
Researchers: Lea Kutvonen, Toni Ruokolainen, Juha Haataja, Janne Metso, Ilja Ponka.
Co-operation: researchers from VTT, Elisa and SysOpen.
Funding: TEKES, VTT, Elisa, SysOpen, Tellabs

In an increasingly globalised society organizations are becoming more and more dependent on their ability to network with several different partners at the same time. This is why the success of organizations depends on their information systems being able to co-operate logically and technologically. Especially in the area of logistics we can save considerably by dynamic managing of networks, as forehand information on the flow of goods can be relayed more cost-effectively and exactly. The Pilarcos projects develop middleware solutions to support the management of inter-organizational distributed applications by reflective methods. The organizational systems must be able to manage the semantic and technical features of their services intelligently to form networks of them, and to monitor and adapt the network function during performance. Web-Pilarcos builds prototypes of middleware services and demonstrates their applications to gain user experience.

Information systems

Project: Gene mapping and diagnostics: computational tools for new high-throughput
                laboratory technologies (ALTTI)
Period: January 2003 – February 2005
Researchers: Hannu Toivonen, Päivi Onkamo, Bart Goethals, Petteri Hintsanen, Petteri Sevon,
                Lauri Eronen
Funding: Tekes, partner organizations

The laboratory methods for biotechnology are developing quickly. With the help of new techniques large amounts of genetic data can be produced for e.g. case referent sets gathered for epidemiological purposes. The analysis of such sets is no longer efficient or even possible with the old methods. The project develops new computational methods for such situations. A focal research point is a situation where only patient and referent case genotypes are available, without relatives, or just pooled genotypes where the tests from several individuals have been pooled and genotyping has been made directly from these pooled tests. The aim is to find the disease associations (predisposition genes) in this data, but also to determine haplotypes for a haplotype analysis. The project also develops methods for selecting optimal gene character sets for both diagnostic tests and to make association-mapping more efficient. The results include new methods as well as prototype software for genetics laboratories. During year 2003, the project has developed new methods for gene mapping using genotypes, for determining haplotypes and for haplotype analysis. The method descriptions have been accepted for publication during year 2004.

Project: Context recognition by user situation data analysis – (Context)
Period: January 2003 – December 2005
Researchers: Hannu Toivonen, Kari Laasonen, Mika Raento
Funding: The Finnish Academy

This project studies the characterisation and analysis of user contexts, and the adaptation of context data in pro-active computing. Such issues as how users perceive their contexts, how automatic conclusions from context data are drawn, and how context data can be transmitted to users interactively are under consideration. One practical sample application is the determination and description of availability data and the use of it in mobile computing. The project is a co-operation with the Applied Research Unit at HIIT. During year 2003, the project has mainly focused on automatically refining location data into individually meaningful units, using especially the cell information from the GSM network, among others. Another focal issue has been the prediction of user destination (article accepted for publication). Together with ARU, the project has studied the effect of context on schoolchildren's mobile phone use through user tests.

Project: Coordination of the Research Programme on Proactive Computing – (PROACT)
Period: February 2002 – May 2006
Researchers: Greger Lindén, co-ordinator
Funding: The Finnish Academy

This is not a project per se, but rather the co-ordination of the PROACT research programme. The Basic Research Unit at HIIT acts as co-ordinator. The leader of the programme is Professor Heikki Mannila and programme co-ordinator is University Lecturer Greger Lindén. The goal of the co-ordination is to promote co-operation between the projects that are part of the programme, as well as international co-operation with other research programmes, to arrange seminars and to inform both the general public and the Academy about the programme. Furthermore, the programme supports post-graduate studies and post-graduates in the field. The co-ordinating body has participated in preparing the programme and choosing projects in year 2002. During the programme (2003-2005), the co-ordinators will follow the work of the projects, visit the projects and build networks between the projects and, at the end of the programme, they will take part in evaluating the programme and planning possible further activities. During the whole programme, the co-ordinating body will act as secretary for the programme group and keep in contact with both funding and utilising bodies. The co-ordinators also maintain the website for the research programme: www.aka.fi/proact

Project: Knowledge Worker's Workstation – (TYTTI)
Period: March 2000 – June 2003
Researchers: in 2003: Marko Salmenkivi, Juha Makkonen, Miro Lehtonen, Oskari Heinonen, Martin Fluch
Funding: TEKES, Nokia, Alma Media, Vaisala, Lingsoft, Sanoma-WSOY

The project aims at building tools for professional knowledge workers (e.g. journalists, technical writers), including tools for creating, accessing, and assembling structured (XML) documents. In addition, the project studies tools for detecting and tracking events in newsfeed. As a result, the project has produced a prototype of a journalist's workstation, a dynamic user interface for compiling product manuals, and methods for detecting and tracking news events. The prototype for a journalist's workstation includes a tailored XML editor that is easy to use and an information retrieval interface to an article database. Continuous search is also available: the system always interprets the current text in the editor as a query and retrieves articles that are linked with the current query at brief intervals from a collection of articles. The product manuals compiled by a technical writer need to be tailored to correspond exactly with the product delivered to a client. During the compiling process the technical writer determines which parts are to be included. The project has developed a component that dynamically generates a graphical user interface of a given simple content description. When products change, technical writers can easily update the content description themselves and produce new user interfaces. The updating does not require programming skills. The methods for detecting and tracking news events follow event chains in the real world, which are reflected in news stories. The approach developed in the project extracts expressions of time and place, proper names and other meaningful terms in news stories. The similarity of two news stories can be compared with respect to time, place etc. Finally the comparisons are combined for an overall evaluation of whether the stories have to do with the same event. The methods have been tested on American standard collections and the results are promising. The research continues in Juha Makkonen's PhD thesis work.

Project: Mobile and multilingual maintenance man – (4M)
Period: August 2003 – July 2007
Researchers: Reeta Kuuskoski, Helena Ahonen-Myka. Co-operation project, other partners: HU/language technology, HU/Department of Translation Studies, HUT/TAI research centre, HUT/Sober IT/usability group, HUT/knowledge engineering, VTT Tietotekniikka
Funding: Tekes, partner organizations

The project aims at developing a prototype of a knowledge support system that helps maintenance personnel in mending different equipment. The basic structures of different machines are fed into the system along with data on typical problems and their solutions. The knowledge is structured with the help of ontologies. Furthermore, an event database of earlier solutions and other text-based background information, such as user manuals, are available. Special goals include developing a user interface that converses in a natural language. The contents of the conversation of the user interface is managed part-

ly by ontologies. It combines several unstructured data sources with a strictly structured ontology knowledge to ensure that the system remains up to date. The project team at the Department of Computer Science concentrates on producing answers from the background information if a straight answer cannot be produced on the basis of the ontologies. The team also produces pre-processing methods to identify the concepts of the ontologies and to denote them in the background information. The annotation helps in finding the exact answer to questions in real-time problem situations.

Project:	**Initiative for the evaluation of XML retrieval – Team University of Helsinki – (HELINEX)**
Period:	February 2002 – December 2005
Researchers:	Lili Aunimo, Antoine Doucet, Miro Lehtonen, Renaud Petit, Kai Hendry
Funding:	Department of Computer Science

The project team participates in the international project for the evaluation of XML information retrieval, INEX, whose goal it is to develop a broad testing environment and evaluation methods for information retrieval from XML document collections. Annually, large document collections are made available and a set of search queries chosen from suggestions made by the project teams. The teams use search systems that they have developed to find the answers to the queries, and each team tests its own answers for correctness. Finally, the approaches are compared to see which have given the best results. In 2003, the team participated in the INEX project with their own system, EXTRIP (EXacT coverage IR based on static Passage clusters), for the first time. Issues that the team paid special attention to when developing the system include the forming of answer units of suitable size, utilising common text phrases and extending queries on the basis of the answers.

Project:	**Doremi Text Mining**
Period:	January 2001 – December 2003
Researchers:	Antoine Doucet, Helena Ahonen-Myka, Marko Salmenkivi, Juha Makkonen, Kai Hendry, Kaisa Kostiainen
Funding:	The Finnish Academy

This project has developed a text-mining method for finding regularities in text documents. One example of such regularities is maximal common sequences of words. In addition to just the words, the possible hierarchic XML structure can be taken into account. In year 2003, we have concentrated on finding maximal common sequences of words in large text collections, and on utilising common sequences of words as document descriptions in data mining. Finding maximal common sequences of words is computationally laborious, so the project team has developed a method that first clusters a large document collection into smaller clusters, then finds the common sequences of words in each cluster separately, and finally combines the results. The result is always an approximation of the actual maximal common sequences of words, but that is sufficient for the most part. The clustering method has been used in the EXTIRP information retrieval system, developed by the
HELINEX project, where the document descriptors also contain common word sequences. In this context, similarity measures for the descriptors have also been developed to take special features of the word sequences into consideration. Descriptors where the documents are described as a set of separate words are most commonly used. The project research continues in Antoine Doucet's PhD thesis work.

Applied computer science

Project:	**National Finnish Ontologies**
Period:	September 2003 – August 2005
Researchers:	Markus Holi, Tomi Kauppinen, Tuomas Korpilahti, Mirva Salminen
Funding:	AAC Global Oy, AlmaMedia Oyj, TietoEnator Oyj, Connexor Oy, Leiki Oy, M-Cult ry, The Finnish National Board of Antiquities, Kiasma, The Finnish Museum of Photography, The Finnish Centre for Technical Terminology, The Finnish National Gallery, Tekes

The project is working on a pilot system for the distributed development of nationally meaningful ontologies of the semantic web. The goal is to move from present-day key word methods towards using the semantically more fruitful ontology techniques for indexing and search functions. This will enable more user-friendly and exact information retrieval, the semantic interoperability of data systems and intelligent services on the Web. Using ontologies creates new business opportunities and allows more efficient utilisation of valuable data contents than before. The technology is being applied in concrete case applications, whose usability will be evaluated through testing.

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Project: Intelligent Web Services
Period: August 2003 – July 2005
Researchers: Mikko Apiola, Mikko Laukkanen, Petri Lindgren, Kim Viljanen
Funding: Fonecta Oy, TeliaSonera Oyj, TietoEnator Oyj, Tekes

This project develops the technology of intelligent web services by enhancing present-day web services and workflow technologies with the product and service descriptions of the semantic web technologies. The goal is to produce significantly more useful interactive web services for the end user. The technology is being developed under the auspices of a pilot project that combines a yellow-pages-like product and service index with a functional web service for the business world and public administration. The new technological platform brings new business opportunities, and enables more efficient use of public services and business data on the web.

Project: Semantic web: Intelligent index services
Period: January 2002 – December 2003
Researchers: Miikka Junnila, Suvi Kettula, Samppa Saarela, Mirva Salminen, Ahti Syreeni, Arttu Valo, Kim Viljanen
Funding: Nokia Oyj, TietoEnator Oyj, Espoo City Museum, The Finnish Board of Antiquities, Helsinki University Museum, the Antikvaria group

The project develops technologies for producing intelligent semantic indexes and the distributed use of them on the web. The idea is to apply the Semantic Web concept and its XML-based higher-level standards, such as W3C and RDF(S). With this new approach, we can produce significantly more useful services for data networks than before. The new services create new business opportunities on the one hand, and a more efficient use of public services and business data on the web on the other hand. The technology will be applied through concrete case applications, consisting of the semantic image search system Promoottori, the national MuseoSuomi portal, and its interface adapted for mobile use.

Bioinformatics

Project: Structure, assembly and dynamism of biological macromolecular complexes Period: January 2000 - December 2005
Researchers: Tuomas Ojamies, Taneli Mielikäinen, Janne Ravantti
Funding: The Finnish Academy

The project develops computational methods for modelling biological macromolecules like e.g. viruses. During this past year we finished a new algorithm for reconstructing three-dimensional density distribution and its prototype implementation. In addition, a method for searching common substructures in density distributions based on geometric distribution was developed. The method is invariant to translation, rotation and to some degree even scaling.

Project: Integrated computational methods for genomic, proteomic and metabolic modelling (ICOMIC)
Period: August 2000 - December 2003
Researchers: Juho Rousu, Ari Rantanen, Esa Pitkänen, Katja Saarela, Kimmo Palin
Funding: The Finnish Academy

The main goal of the project is to develop computational methods and computer software for the integrated analysis and modelling of 'massive' measurement data on genomes, proteomes and metabolisms. We have focused especially on computing so-called metabolic fluxes on the basis of incomplete isotopomeric measuring data. With this goal in mind we developed a new type of algorithm to compute a solution in closed form and not on simulation as the methods were before. We also developed methods to vary the given metabolism network with the aim to find the most suitable network for the measuring data. The results are fairly promising and the research continues within new projects.

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Project: **A global molecular approach in the study of microbial stress**
Period: August 2000 - December 2003
Researchers: Teemu Kivioja, Veli Mäkinen
Funding: The Finnish Academy

The aim of the project is to develop software and the algorithms for it to analyse, visualise and model gene expression measurements and electrophoresis gel patterns that have been produced by biologist partners of the project. The main result of the project was the development of new test design algorithms and software for a new type of gene expression measurement developed at VTT Biotechnology. In addition, the project studied efficient algorithms for point patterns needed in the data analysis of two-dimensional electrophoresis. New solutions based on character string methods and dynamic programming were developed for this end. The project was a co-operation with VTT Biotechnology and it was a part of the Finnish Academy Life2000 programme.

Project: **Content-Based Retrieval and Analysis of Harmony and other Music** Structures
                (C-BRAHMS)
Period: January 2002 - December 2006
Researchers: Kjell Lemström, Veli Mäkinen, Anna Pienimäki, Mika Turkia
Funding: The Academy of Finland

The goal of the C-BRAHMS project is to develop efficient methods for the computational problems of content-based searches, matching and analysis in music. The research has so far concentrated on searches in large, symbolic music databases. During 2003, several efficient algorithms were developed in the project. The algorithms were based on various techniques; dynamic programming, bit parallelism, and a new geometric method developed by the project.

This new approach supports several features in the problem area, such as polyphony in music, transposition-invariance and the need to ignore some notes (like various ornamental notes). Additional information at the address http://www.cs.helsinki.fi/group/cbrahms/, including the demo-version of a search engine developed in the project and the implemented search algorithms.

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5. SERVICES

5.1 Administration

Department management in 2003

The following persons were members of the department steering committee in year 2003:

Steering committee ordinary members	deputies
Professor Jukka Paakki, chair	Professor Kimmo Raatikainen
Professor Seppo Sippu	Professor Timo Alanko
Professor Henry Tirri	Professor Tapio Elomaa (until 31 Jul 2003)
Lecturer Auvo Häkkinen	Professor JyrkiKivinen(from 1 Aug 2003)
Lecturer Harri Laine	Lecturer Teemu Kerola
University Lecturer Tiina Niklander	Special researcher Jan Lindström
Student Sampo Lehtinen	Lecturer Markku Kojo
Student Antti Mattila	Student Seija Törmälehto
Student Marko Saaresto	Student Nuutti Rintala
	Student Joonas Muhonen

Secretary: Office Manager Päivi Karimäki-Suvanto

A new steering committee was elected for the period 2004-2006.

The department administration offers its staff and students services for the management of personnel, teaching, financial, research and general administration. It is also part of the administrative services to support the department steering committee and chairman in the preparation and implementation of issues in their jurisdiction. The University Regulations of the University of Helsinki were amended in 2003, bringing new duties, especially to the steering committee.

The teaching administration is responsible for matters concerning teaching at the department and manages student counselling.

The personnel administration manages employment issues and well-being in the workplace. This unit also organizes education for the personnel. The most noteworthy education of 2003 was the tailored portfolio course for the department staff. Measured in person-years, the staff at the department increased 2.5 person-years from the previous year.

The financial administration unit is responsible for managing finances and counselling on financing at the department, as well as assist the department management in financial planning and reporting. The research administration unit, for its part, supports projects that operate on additional funding at the department with financial planning and reporting services and assisting them in writing funding applications. During 2003, 56 different projects were active at the department.

The general administration assists the department management in drawing up different accounts and reports, offers the department staff language consultation and translation services, clerical services for the students, as well as internal and external PR and information services.

The departmental administration has been active in developing new tools for the administration. In 2003, software for generating the teaching programme directly from a database as well as for computing the salaries of part-time teachers were produced and implemented. Another software for archiving images and documents was developed to meet the needs of the administrative units. All in all, nine persons (8.8 person-years) were employed in the administrative team at the end of 2003.

5.2 Library

Administratively, the department's library is part of the Kumpula Science Library, but during spring 2004 it is still located in the same premises as the department in Vallila. The library will move to Kumpula in summer 2004 when the whole department is relocated there, and will be incorporated with the Kumpula Science Library.

The library is the largest computer science library in Finland. At the end of year 2003, there were circa 44,000 monography titles, and circa 600 monographs were accumulated during the year. The library takes 200 journal subscriptions.
In 2003 the library used about 53,000 euros for acquisition of new material.
All holdings in the library are catalogued in the national library systems (HELKA/LINDA) and classified according to the ACM Computing Classification System (CCS). In addition to printed material, the library has access to the electronic services offered by FinELib, including journals and conference proceedings by major computer science publishers, such as ACM, IEEE, Elsevier, Academic Press, Springer-Verlag, and Kluwer.

Traditionally, the Computer Science Library has been a departmental library serving its own clientele only, i.e. academic university personnel and more advanced computer science students. Since the library was administratively incorporated with the Kumpula Science Library in 2001, however, the collections were made freely available to all users, and a new lending policy was adopted in accordance with the general lending rules of the university libraries.

The library is also responsible for the distribution and sale of the department's hard copy publications (such as PhD theses and course material). Paper copies of reports are available from the library, and their electronic versions are accessible through the department's FTP server. The library has two full-time employees, a librarian and a secretary.

5.3 Computing facilities

The department is dedicated to providing a wide range of advanced high-quality computing facilities for use by computer science faculty and students. The number of users of these facilities is about 4,350. The facilities are operated by a technical staff who are not only responsible for the installation and maintenance of the systems, but who also assist faculty and students in the use and development of software systems for research projects.

Our workstation network consists of more than 500 PCs (at least Pentium 4 level, most of them with flat TFT monitors) running Linux. Windows 2000 or Windows XP can be used as an alternative to Linux. More than 100 of the workstations are mobile laptops that can join and leave the network dynamically.

The general computing facilities include a farm of servers: general-purpose computers, a computing cluster, file servers and other functionally dedicated servers (mail, WWW, FTP etc.), and servers for different user groups. The centralised file servers utilise RAID technology and currently offer over 1.5 Tera-bytes storage space. Together, these systems support a wide variety of services, languages and software tools including electronic mail and news, graphics and visualisation tools, several typesetting systems, and relational database systems. Special attention has been paid to security and reliability. The rising amount of spamming has been a cause of concern, as it has increased from c. 75 % to over 90 % of all e-mail during year 2003. Due to effective preventive measures, the amount of spam that reaches the users has been kept at a minimum. In spite of their prevalence in the world, viruses and worms have not been able to cause problems at the department, thanks to virus control and the filtering of mail viruses.

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Networking is based on switched 100 Mbit/s Ethernet with an optical backbone. The mobile laptops can also utilise a departmental IEEE 802.11b type radio network which currently has 15 base stations. In the Linux (and UNIX) environment NFS is used to share common resources. On the Windows side, Samba (a Linux-hosted LAN Manager Server) is utilized. The workstations are used as tools for software development, in research and on all levels of teaching.

The network of the department is connected through a firewall to the university backbone network, giving access to general-purpose UNIX computers at the University IT Department as well as to the FUNET wide area network that links Finnish universities and research institutions. The national FUNET network is further connected to the Nordic University Network, Nordunet, with a 5 Gbit/s connection. Nordunet has a 2.5 Gbit/s connection capacity to the United States as well as many high-capacity connections to the European network infrastructure.

The IT Department also offers modem, ISDN and ADSL connections for remote access. In addition, the department has access to a number of supercomputing facilities at the Finnish IT Center for Science (CSC).

APPENDICES

Publications in 2003

Algorithms

Peer-reviewed journal articles

I. Autio & T. Elomaa:
Flexible view recognition for indoor navigation based on Gabor filters and support vector machines.
Pattern recognition 36(2003):12, 2769-2779.

J. Kärkkäinen, G. Navarro & E. Ukkonen:
Approximate string matching on Ziv-Lempel compressed text.
Journal of discrete algorithms 1(2003):3/4, 313-338.

K. Lemström & J. Tarhio:
Transposition invariant pattern matching for multi-track strings.
Nordic journal of computing 10(2003):3, 185-205.

K. Lemström & L. Hella:
Approximate pattern matching and transitive closure logics.
Theoretical computer science 299(2003), 387-412.

D. Meredith, K. Lemström & G. A. Wiggins:
Algorithms for discovering repeated patterns in multidimensional representations of polyphonic music.
Journal of new music research 31(2002):4, 321-345.

V. Mäkinen:
Compact suffix array: a space-efficient full-text index.
Fundamenta informaticae 56(2003):1/2, 191-210.

V. Mäkinen, G. Navarro & E. Ukkonen:
Approximate matching of run-length compressed strings.
Algorithmica 35(2003), 347-369.

R. Nock, T. Elomaa & M. Kääriäinen:
Reduced error pruning of branching programs cannot be approximated to within a logarithmic factor.
Information processing letters 87(2003):2, 73-78.

Conference papers

T. Elomaa & J. Rousu:
On decision boundaries of naïve Bayes in continuous domains.
In: Knowledge discovery in databases: PKDD 2003, 7th European Conference on Principles and Practice of Knowledge Discovery in Databases, Cavtat-Dubrovnik, Croatia, September 22-26, 2003, proceedings.
Berlin: Springer 2003 (LNAI vol. 2838) pp. 144-155.

P. Floréen, J. Kohonen, P. Kaski & P. Orponen:
Multicast time maximization in energy constrained wireless networks.
In: DIALM-POMC'03. Proc. 2003 Joint Workshop on Foundations of Mobile Computing, co-located with MobiCom 2003 Conference, September 19, 2003, San Diego, California, USA, pp. 50-58.

J. Kivinen, M.K. Warmuth & B. Hassibi:
The P-norm generalization of the LMS algorithm for adaptive filtering.
In: 13th IFAC Symposium on System Identification, 27-29 August, 2003, Rotterdam, The Netherlands, pp. 1755-1760.

J. Kivinen:
Online learning of linear classifiers.
In: Advanced lectures on machine learning. Machine Learning Summer School 2002, Canberra, Australia, February 11-22, 2002, revised lectures. Berlin: Springer 2003 (LNAI vol. 2600), pp. 235-257.

M. Kääriäinen & T. Elomaa:
Rademacher penalization over decision tree prunings.
In: Machine learning: ECML 2003. 14th European Conference on Machine Learning, Cavtat-Dubrovnik, Croatia, September 22-26, 2003, proceedings.
Berlin: Springer 2003 (LNAI 2837), pp. 193-204.

K. Lemström & V. Mäkinen:
On minimizing pattern splitting in multi-track string matching.
In: Combinatorial pattern matching. 14th annual symposium, CPM 2003, Morelia, Michoacán, Mexico, June 25-27, 2003, proceedings.
Berlin: Springer 2003 (LNCS 2676), pp. 237-253.

K. Lemström, V. Mäkinen, A. Pienimäki, M. Turkia & E. Ukkonen:
The C-BRAHMS project.
In: ISMIR 2003. Proc. 4th International Conference on Music Information Retrieval, October 26-30, 2003, Baltimore, Maryland, USA, pp. 237-238.

K. Lemström & G. Navarro:
Flexible and efficient bit-parallel techniques for transposition invariant approximate matching music retrieval.
In: String processing and information retrieval. 10th international symposium, SPIRE 2003, Manaus, Brazil, October 8-10, 2003, proceedings. Berlin: Springer 2003 (LNCS 2857), pp. 224-237.

V. Mäkinen, G. Navarro & E. Ukkonen:
Algorithms for transposition invariant string matching (extended abstract).
In: STACS 2003, 20th Annual Symposium on Theoretical Aspects of Computer Science, Berlin, Germany, February 27 - March 1, 2003, proceedings.
Berlin: Springer 2003 (LNCS vol. 2607), pp. 191-202.

V. Mäkinen, G. Navarro & E. Ukkonen:
Matching numeric strings under noise.
In: Proceedings of the Prague Stringology Conference '03.
Praha: Vydavatelstvi CVUT 2003 (Chech Technical University, Department of Computer Science and Engineering. Research report), pp. 99-110.

H. Tamm & E. Ukkonen:
Bideterministic automata and minimal representations of regular languages.
In: Implementation and application of automata. Proc. 8th international conference, CIAA 2003, Santa Barbara, CA, USA, July 16-18, 2003. Berlin: Springer 2003 (LNCS 2759), pp. 61-71.

E. Ukkonen, K. Lemström & V. Mäkinen:
Geometric algorithms for transposition invariant content-based music retrieval.
In: ISMIR 2003. Proc. 4th International Conference on Music Information Retrieval, October 26-30, 2003, Baltimore, Maryland, USA, pp. 193-199.

E. Ukkonen, K. Lemström & V. Mäkinen:
Sweepline the music!*
In: Computer science in perspective: essays dedicated to Thomas Ottmann. Berlin: Springer 2003 (LNCS 2598), pp. 330-342.

J. Veijalainen, V. Terziyan & H. Tirri:
Transaction management for M-commerce at a mobile terminal.
In: Proc. 36th Annual Hawaii International Conference on
System Sciences, 6-9 January 2003, Big Island, Hawaii, pp. 89-98.

PhD theses and technical reports

P. Floréen, G. Lindén (eds.):
Context-aware scenarios: course on context-aware computing 2003.
(University of Helsinki, Department of Computer Science. C-2003-70).

P. Floréen, G. Lindén (eds.):
Context-aware methods: course on context-aware computing 2003.
(University of Helsinki, Department of Computer Science. C-2003-71).

V. Mäkinen:
Parameterized approximate string matching and
local-similarity-based point-pattern matching.
(University of Helsinki, Department of Computer Science.
A-2003-6). Ph.D. thesis.

J. Rousu:
Optimal multivariate discretization for naive
Bayesian classifiers is NP-hard.
(University of Helsinki, Department of Computer Science.
C-2003-8).

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E. Ukkonen: Mihin algoritmeja tarvitaan?
Tieteessä tapahtuu 2003:7, s. 19-22.

Intelligent systems

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J. Rousu, L. Flander, M. Suutarinen, K. Autio, P. Kontkanen & A. Rantanen:
Novel computational tools in bakery process data
analysis: a comparative study.
Journal of food engineering 57(2003):1, 45-56.

H. Tirri: Search in vain:
challenges for Internet search.
Computer 36(2003):1, 115-116.

J.Rissanen,
Complexity of Simple Nonlogarithmic Loss Functions. IEEE Transactions on Information Theory 49 (2003) 2 (February),   476-484.

J. Rissanen,
Complexity and Information in Data, Chapter 15, in ENTROPY, edited by A. Greven, G. Keller, and G. Warnecke. Princeton University Press, Princeton and Oxford, 2003.

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W. Buntine:
Intelligent open source search.
In: Intelligent and computer systems: complex systems in E-business.
Proc. A of the 6th International Multi-Conference Information Society
IS 2003, 13-17th October 2003, Ljubljana, Slovenia, pp. 9-12.

W. Buntine & S. Perttu:
Is multinomial PCA multi-faceted clustering or dimensionality
reduction?
In: AI & Statistics 2003. Proc. 9th International Workshop on
Artificial Intelligence and Statistics, pp. 300-307.

W. Buntine, P. Myllymäki & S. Perttu:
Language models for intelligent search using multinomial PCA.
In: Proc. ECML/PKDD - 2003, First European Web Mining Forum, 22-26
September 2003, Cavtat-Dubrovnik, Croatia, pp. 37-50.

P. Kontkanen, W. Buntine, P. Myllymäki, J. Rissanen & H. Tirri:
Efficient computation of stochastic complexity.
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Artificial Intelligence and Statistics, pp. 181-188.

J. Kurhila, M. Miettinen, P. Nokelainen, P. Floréen & H. Tirri:
Peer-to-peer learning with open-ended writable web.
In: ITiCSE 2003. Proc. 8th Annual SIGCSE Conference on
Innovation and Technology in Computer Science Education,
June 30-July 2, 2003, Thessaloniki, Greece, pp. 173-177.

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Joint annotation and knowledge building in collaborative
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November 7-11, 2003, Phoenix, Arizona, USA, pp. 2249-2252.

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EDUCOSM - personalized writable web for learning communities.
In: Proc. ITCC 2003 International Conference on Information
Technology: Computers and Communications, April 28-30, 2003,
Las Vegas, Nevada, pp. 37-42.

P. Nokelainen, J. Kurhila, M. Miettinen, P. Floréen & H. Tirri:
Evaluating the role of a shared document-based annotation tool in
learner-centered collaborative learning.
In: Proc. 3rd IEEE International Conference on Advanced Learning
Technologies, 9-11 July 2003, Athens, Greece, pp. 200-203.

P. Nokelainen, P. Ruohotie, M. Miettinen, J. Kurhila & H. Tirri:
The role of inservice teachers' motivation, learning strategy
and social ability profiles in CSCL environment.
In: Society for Information Technology & Teacher Education
14th International Conference 2003, March 24-29, Albuquerque,
New Mexico, USA (SITE 2003), pp. 1518-1522.

H. Wettig, P. Grünwald, T. Roos, P. Myllymäki & H. Tirri:
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Bayesian analysis of online newspaper log data
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J. Viljamaa:
Reverse engineering framework reuse interfaces.
Software engineering notes 28(2003):5, 217-226.
(Proc. Joint 9th European Software Engineering Conference (ESEC) &
11th ACM SIGSOFT Symposium on the Foundations of Software Engineering
(FSE-11), Helsinki, Finland, September 1-5, 2003.)

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J. Gustafsson:
Software quality evaluation in the design phase.
In: Modernin informaatioteknologian menetelmätutkimusta:
STKV '2001-2002 konferenssijulkaisu = Advances in methods of modern information technology: proceedings of FDPW '2001-2002 (Petroskoin yliopiston vuosittainen suomalaisen tietojenkäsittelyn viikko 2001-2002). Petroskoi: Petroskoin yliopisto, 2003, pp. 57-66.

J. Taina, J. Paakki & R. Kauppinen:
RITA - a framework integration and testing application.
In: Modernin informaatioteknologian menetelmätutkimusta:
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E. Hyvönen (toim.):
Ohjelmistoliiketoiminta. Porvoo, WSOY 2003.
248 s.

E. Hyvönen:
Johdatus ohjelmistoalaan.
Teoksessa: Ohjelmistoliiketoiminta.
Porvoo, WSOY 2003, s. 1-7.

A. Wikla:
Ohjelmoinnin perusteet Java-kielellä. 4. täyd. p.
Espoo, OtaDATA 2003. 294 s.

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A. Gurtov:
Eliminating Aborted Data Delivery over Cellular
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A. Gurtov & R. Ludwig:
Lifetime Packet Discard for Efficient Real-Time Transport over Celullar Links.
ACM Mobile Computing and Communications Review, 7(4):32-45, October 2003.

T. Malinen & M. Luukkainen:
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R. Popescu-Zeletin, S. Arbanowski, I. Fikouras, G. Gasbarrone, M. Gebler, S. Henning, H. van Kranenburg, H. Portschy, E. Postmann,
& K. Raatikainen:
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13. Toni Laturi: Tuotteenhallinta rinnakkaisessa ohjelmistokehityksessä. (C-2003-57).

14. Teemu Paajanen: Ohjelmistoprojektien aikatauluongelmat. (C-2003-7).

15. Sirpa Paakki: Java-koodin regressiotestaus. (C-2003-64).

16. Timo Puronen: Integrating Symbian OS and proprietary OS telephony functionalities. (C-2003-42).

17. Riitta Rossi: Henkilökohtaisen ohjelmistoprosessin omaksuminen. (C-2003-68).

18. Petri Savolainen: Generatiivinen ohjelmointi C++-kielellä. (C-2003-78).

19. Antti Tevanlinna: Testauksen analysointityökalut. (C-2003-51).

20. Harri Forsgren: Tietoturvaprotokollien automaattinen verifiointi säieavaruusmenetelmällä. (C-2003-69).

21. Miika Turkia: Secure software engineering process. (C-2003-34).

Distributed systems and data communication

22. Olli Aalto: Measured delay performance of IP bearer over GPRS. (C-2003-19).

23. George El-Khouri: A load balancer for location requests in GSM location systems. (C-2003-17).

24. Kimmo Hämäläinen: Tietoturvan ja -suojan uudet XML-tekniikat.(C-2003-33).

25. Ping Jing: Research on virtual private network solutions.(C-2003-59).

26. Markku Karppinen: Hajautetun järjestelmän hallinta politiikkojen avulla. (C-2003-29).

27. Juha Kervinen: Cross-organisational authentication and authorisation infrastructure, the Shibboleth approach. (C-2003-63).

28. Tuomas Kulve: Analysis of concurrent TCP and streaming traffic over a wireless link. (C-2003-50).

29. Risto Loimakoski: Value-added services and their security in the GSM networks. (C-2003-1).

30. Indrek Peri: IP QoS in ad hoc wireless networks. (C-2003-2).

31. Valtteri Rahkonen: Hybridipalomuuri operaattoriverkkoihin. (C-2003-47).

32. Jarno Saarto: WWW traffic performance in wireless environment. (C-2003-35).

33. Markku Suistola: Content management over heterogeneous IP networks. (C-2003-28)

34. Kalle Tammisto: Mobile packet core -verkon mittaus ja tilastointi. (C-2003-11)

35. Markku Vähäaho: Arkkitehtuurikuvauksia hyödyntävä meklaus. (C-2003-77).

Information systems

36. Pekka Tapio Aalto: Kuormantasaus rinnakkaistietokannassa. (C-2003-25).

37. Jari Petteri Harjula: Sähköpostin suodattaminen sisältöperusteisin menetelmin. (C-2003-56).

38. Jaana Heino: Automated detection of epidemics from the usage logs of a physicians' reference database. (C-2003-54).

39. Lincoyan Kekki: Tiedonhaku tekstidokumenttikannoista ja sanastojen käyttö. (C-2003-27).

40. Suvi Lassila: Digitaalisten kirjastojen ja perinteisten kirjastojen käyttöliittymät. (C-2003-60).

41. Kari Lehmussaari: Utilizing data mining techniques for user profiling in mobile internet (C-2003-62).

42. Jarmo Lehtimäki: Merikotkan talvikannan koon mallintaminen Markovin mallilla. (C-2003-67).

43. Panu Nissinen: XML/XSLT myymäläketjun raportoinnissa. (C-2003-22).

44. Sami Paavola: WWW-sivustojen tiedonhallinta. (C-2003-26).

45. Kimmo Parkkinen: Uudelleenkäyttö sovelluskehityksessä. (C-2003-41).

46. Jaakko Pesonen: Rakenteenkuvauskielen ja lopputallennustavan vaikutus olemassaolevan dokumenttikokoelman rakenteistamiseen. (C-2003-61).

47. Andrei Radu Popescu: A study of R-tree based spatial access methods. (C-2003-18).

48. Ilkka Rinne: Helsingin yliopiston web-sivuston käyttöliittymän ongelmat ja sivuston kehittäminen. (C-2003-49).

49. Minna Romppanen: Tietoturvallisuuden arviointi. (C-2003-6).

50. Toni Strandell: Open source database systems: systems study, performance and scalability. (C-2003-31).

51. Juha Tolvanen: Kansainvälistämisen ja paikallistamisen menetelmät ohjelmistotuotannossa. (C-2003-36).

52. Tiina Tuovinen: Tietokannan jatkuva uudelleenjärjestely. (C-2003-53).

53. Susanna Turkki: XML-dokumentin tallentaminen natiiviin XML-tietokantaan. (C-2003-58).

54. Minna Vasankari: Sovelluskehittimet relaatiotietokantasovellusten käyttöliittymien suunnittelussa ja toteutuksessa. (C-2003-45).

55. Sami Vuorio: Transaktioiden eristyneisyysanomaliat ja niiden välttäminen. (C-2003-37).

Teacher in computer science

56. Perttu Filppula: Opiskelijalähtöiset opetusmenetelmät tietojenkäsittelytieteen verkko-opetuksessa. (C-2003-38).

57. Panu Vartiainen: Using metadata and context information in sharing personal content of mobile users. (C-2003-16).

Applied computer science

58. Heli Koukku: Toimittajan työn helpottaminen tietotekniikan keinoin. (C-2003-48).

59. Jenni Löytynoja:Järjestelmäintegraatio ja sen mahdollisuudet Yritys A:ssa. (C-2003-79).

60. Mika Norismaa: Java-sovellukset rajoittuneissa päätelaitteessa. (C-2003-30).

61. Tommi Nyqvist: Atlastyyppisen aineiston luokittelu ja luokittelumenetelmien vertailu. (C-2003-3).

62. Piia Osmala: Suomenkielistä puheentunnistusta hyödyntävän puhelinpalvelun käyttöliittymän kehittäminen. (C-2003-65).

63. Tarja Rauste: Sosiaalisuus agenttipohjaisissa oppimisympäristöissä. (C-2003-10).

64. Leena Rinne: Webin käytön louhinnan menetelmien hyödyntäminen yrityksissä. (C-2003-80).

65. Anita Satukangas: Yksikkö- ja integrointitestauksen menetelmät ja mittarit. (C-2003-39).

Department of computer science, personnel

Name	Position
Ahonen-Myka, Helena	Professor
Alanko, Timo Olavi	Professor
Astuti, Davide Nicola	Researcher
Aulaskari, Ismo Matti Ilmari	Intern
Aunimo, Lili Annika	Researcher
Autio, Ilkka Kalevi	Doctoral Student
Borras Garcia, Juan Carlos	Researcher
Daniel, Laila Puthuvilayil	Researcher
Doucet, Antoine	Researcher
Elomaa, Tapio Paavo	Professor
Eloranta, Satu Merja	Senior Assistant
Erkiö, Hannu Heikki Antero	Lecturer
Eronen, Lauri	Researcher
Eskola, Jukka Mauno Paavali	Assistant
Florén, Patrik Bertel Johan	University Lecturer (leave of absence 01.01.-31.12.03)
Fluch, Martin Georg	Research Assistant
Geetrs, Floris	Researcher
Guionis, Aristides	Researcher
Goethals, Bart	Researcher
Gourtov, Andrei Valeryevitch	Assistant, Researcher
Gupta, Rashi	Doctoral Student
Gustafsson, Juha P	Researcher
Haataja, Juha-Pekka	Research Assistant, Researcher
Haavisto, Juhani	Amanuensis
Haiminen, Niina Susanna	Researcher
Hakli, Raul Aleksi	University Lecturer
Hautakangas, Ville Uolevi	IT Designer
Heino, Jaana	Researcher
Heinonen, Jarkko Oskari	Assistant (hy)
Hendry, Kai Ian	Research Assistant
Hintsanen, Kai Petteri	Researcher
Huhmarniemi, Saara Lea	Researcher
Huovinen, Marja Pirita	Amanuensis
Huvio, Eero	Researcher
Hyvönen, Eero Antero	Professor
Hyvönen, Saara Annele	Researcher (leave of absence 01.01-16.09.03)
Häkkinen, Auvo Antero	Lecturer
Inenaga, Shunsuke	Researcher
Jaakkola, Jani Ensio	IT Specialist
Jokela, Mikael	IT Specialist
Karimäki-Suvanto, Päivi Helena	Office Manager
Karlstedt, Mika	Researcher
Karp, Elina Essi	Research Assistant
Karvi, Timo	University Lecturer
Kauppinen, Raine Krister	Research Assistant, Researcher
Kauppinen, Tomi	Research Assistant
Kerola, Teemu Tapani	Lecturer, Doctoral Assistant
Kivinen, Jyrki Tapio	Professor
Kivioja, Teemu Juhani	Doctoral Student, Researcher
Kohonen, Jukka	Researcher
Kojo, Markku Panu Ilari	Lecturer, Researcher
Kollin, Jussi Jalmari	Research Assistant, Researcher
Kopilahti, Tuomas	Researcher
Kostiainen, Kaisa	Researcher
Kujala, Teija Elisabeth	Researcher
Kulve, Tuomas Ilmari	Research Assistant
Kurhila, Jaakko Elias	University Lecturer
Kurtén, Ulla Marina	Translator
Kutvonen, Antti Petri Heikki	IT manager
Kutvonen, Lea K	Professor
Kuuppelomäki, Päivi A	Assistant (leave of absence 01.01.-20.11.03)
Kuuskoski, Reeta	Researcher
Kyrö, Jaakko Henrikki	Research Assistant
Kärkkäinen, Juha	Doctoral Assistant (leave of absence)
Kääriäinen, Matti Tapani	Doctoral Student
Laakso, Sari Anneli	University Lecturer
Laasonen, Kari Tapani	Specialiced Researcher
Laczak, Zbigniev Olaf	Teacher, full-time
Lahti, Olli Pekka	Assistant
Lahtinen, Jussi Mika Antero	Researcher
Laine, Harri Juha Matias	Lecturer
Lamberg, Peter Klas-Erik	Researcher
Latva-Koivisto, Antti Mikael	University Lecturer
Leggio, Simone	Researcher
Lehtinen, Sami Antti Johannes	IT Designer
Lehtonen, Miro Petteri	Doctoral Student
Leino, Antti Pekka	Researcher
Leinonen, Jani Kristian	Research Assistant
Lemström, Kjell Michael Bernhard	Doctoral Assistant
Lepola, Tuomas Kalle Robert	Doctoral Student
Lindén, Greger Johan Kenneth	Specialiced Researcher, University Lecturer (leave of absence 01.03.-31.12.03)
Lindgren, Jussi Tapio	Specialiced Researcher
Lindström, Jan Peter	Assistant (leave of absence 01.01.-31.12.03)
Lokki, Heikki Kristian	Lecturer
Lonardi, Marja-Liisa	Research Secretary
Lounasmeri, Lotta Inari	Information Officer
Lukk, Margus	Researcher
Luukkainen, Matti Juhani	University Lecturer, Doctoral Assistant
Majuri, Minna Elisabet	IT Designer
Makkonen, Juha Antero	Doctoral Student
Malinen, Tuomo Antti	Assistant
Manner, Jukka Martti Johannes	Researcher, University Lecturer
Mannila, Heikki Olavi	Research Director
Marttila, Topias	Researcher

Name	Title
Marttinen, Liisa	Lecturer
Metso, Janne	Research Assistant
Mielikäinen, Taneli Johannes	Doctoral Student
Miettinen, Miikka	Researcher
Moen, Pirjo Hannele	University Lecturer
Mononen, Tommi J M	Assistant
Myllymäki, Petri Jukka	Professor
Mäkinen, Veli	Researcher, Doctoral Assistant
Mäntyniemi, Samu Henrik Petteri	Doctoral Student
Niklander, Pekka	IT Specialist
Niklander, Tiina Soile Tuulikki	University Lecturer
Nokelainen, Petri Jouni Krisitan	Researcher
Nurmi, Otto P	Professor
Nykänen, Matti Johannes	Professor
Nyrhinen, Aki Matias	Research Assistant
Ojamies, Petri Tuomas	Researcher
Oksanen, Inka Anriikka	Planning Secretary
Onkamo, Päivi Anneli	Researcher
Paakki, Jukka Pekka	Professor
Palander, Sirkka Sinikka	Department Secretary
Palin, Kimmo Juhani	Doctoral Student, Researcher
Pasanen, Tomi Armas	University Lecturer
Perttu, Sami Petri	Doctoral Student
Petit, Renaud	Researcher
Pichugin, Dmitry	Research Assistant
Pienimäki, Anna Pauliina	Researcher
Piitulainen, Jussi Olavi	University Lecturer
Pitkänen, Esa	Researcher
Pohjalainen, Pietu	Teacher, full-time
Ponka, Ilja Mikael	Research Assistant
Popescu, Andrei Radu	Research Assistant
Päiväniemi, Tomi	Doctoral Student
Raatikainen, Kimmo Eero Enok	Professor
Raatikka, Vilho Tapani	Assistant, Researcher
Raento, Mika Petteri	Researcher
Rajamäki, Ella Lynoure Susanna	IT helpdesk
Rantanen, Ari Juhani	Researcher
Rastas, Pasi Miika Antero	Researcher
Rauhala, Mikko Johannes	Assistant; Teacher, full-time
Rinta-Mänty, Janne Petri J	Teacher, full-time
Riva, oriana	Researcher
Roos, Teemu Teppo	Doctoral Student
Rousu, Juho Heikki	Doctoral Assistant (leave of absence 01.07.03-)
Ruokolainen, Toni Henrik	Research Assistant
Rytkönen, Anni Helmikki	Lecturer
Saarela, Katja Maaret Regina	Doctoral Student
Saarikoski, Harri Matti Tapani	Researcher
Saarinen, Janne Armas	Information Officer
Saarto, Jarno Kalervo	Researcher
Saijos, Jani Mikael	Research Assistant
Salmela, Elina Tuulikki	Doctoral Student
Salmenkivi, Marko Johannes	Research PhD
Salmi, Joni Mikael	Teacher, full-time
Sevon, Petteri	Doctoral Student, Researcher
Silander, Tomi	Researcher
Sillanpää, Mikko Juhani	Research PhD
Sippu, Seppo Sakari	Professor
Siren, Jouni Leo Tapio	Assistant
Siven, Reijo	Planner
Strandell, Toni Peter	Researcher
Suontaa, Katriina Taru-Marja	Department Secretary
Suoranta, Timo Kalevi	Research Assistant
Taina, Juha Tapani	Researcher
Tamm, Hellis	Researcher
Terzi, Evimaria	Doctoral Student
Tevanlinna, Antti Jussi	Research Assistant
Tirri, Henry Rainer	Professor
Toivonen, Hannu Tauno Tapani	Professor
Tuohiniemi, Turjo Kasperi	Teacher, full-time
Tuominen, Heikki Juhani	Researcher
Tuovinen, Antti-Pekka	Professor
Turkia, Mika	Research Assistant
Ukkonen, Esko J	Academy Professor
Ukkonen, Karo Johannes	Researcher
Uronen, Pekka Anton	Doctoral Student
Valo, Samuli	IT Designer
Valorinta, Jenni Maria	Teacher, full-time
Vasko, Kari Tapani	Researcher
Verkamo, Aino Inkeri	Professor
Vettenranta, Pasi Tapio	IT Designer
Vihavainen, Juha Kalevi	Lecturer
Wikla, Arto Henrik	Lecturer
Viljamaa, Antti Jaakko	Assistant
Viljamaa, Jukka Mikko	Assistant
Virtanen, Otso Juho Tapio	Researcher
Vähäaho, Markku Tapani	Research Assistant
Vähäkangas, Teemu Taneli	Researcher
Väisänen, Tiina Tuulikki	Research Secretary (leave of absence 26.07.-31.12.03)

Department of computer science
Part-time Teachers* 2003
Name

Airamaa, Kimmo Kalevi
Ajalin, Teemu Antero
Alanko, Lauri Emil
Alm, Olli Markus
Aulaskari, Ismo Matti Ilmari
Bäckman, Kai-Peter Gunnar
Campadello, Stefano
Heimola, Mikko Juhani
Heiskanen, Jukka Sakari
Helin, Heikki Juhani
Hohtio, Jani Mikael
Huhmarniemi, Saara Lea
Hyppänen, Riku Mikko
Häkkinen, Auvo Antero
Iso-Markku, Juho Viljami
Jokinen, Olli Markus
Jokisalo, Kirsi Maria
Junnila, Miika Johannes
Kaiponen, Jan Markus
Kivenheimo, Jari Petri Päiviö
Korpela, Marianne Kristina
Kujala, Veli-Matti Johannes
Laakso, Karri-Pekka Antero
Laamanen, Heimo
Laasonen, Kari Tapani
Laine, Harri Juha Matias
Lamsal, Pradip
Lindholm, Heikki Olavi
Lindström, Jan Peter
Mansikka, Harri
Narayanan, Krishnan
Nenonen, Jaakko Pekka
Nikiforow, Roman
Nunez, Alfons
Nurro, Antti Jaakko Juhani
Olin, Mikko Tapani
Pelkonen, Tiina Maria
Pohjalainen, Pietu
Puustinen, Ismo Henrik Mikael
Puustjärvi, Juha P
Raento, Mika Petteri
Rajala, Tommi
Ranta, Juha
Romppainen, Mikko Olavi
Ruohomaa, Sini Susanna
Räisänen, Hannu Juhani
Saaristo, Jaakko Olavi
Salo, Pauli Juhani

Saura, Asko Juhani
Sidoroff, Teemu
Simola, Pekka Juhani
Sjöblom, Teemu Ilkka Tapio
Teuho, Juho Erkki
Tienari, Martti Johannes
Toivonen, Jarkko
Tuohiniemi, Turjo Kasperi
Vainio, Vesa
Valo, Arttu Manu Ensio
Viljanen, Kim Erik Antti
Vornanen, Heimo Johannes Henrikki
Ågren, Lassi

*This list of persons contains the names of part-time teachers who have not held any other positions at the department during hte year 2003.