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Tietojenkäsittelytieteen laitos
Institutionen för datavetenskap
Department of Computer Science

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Evaluation of education and degrees at the University of Helsinki 2001-2002
Evaluation of the Department of Computer Science

University of Helsinki

Department of Computer Science

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2.1. Planning, aims and contents of education

A. Description

In line with the Computer Science Department's strategy (2001 – 2003), the department offers an education that emphasizes the conceptual basis for computer science. The education programme is up-to-date and varied, producing experts for development and production posts in the industries and civil service, as well as scientists. Education at the Department is based on the established core computer science, but adapts to new needs of the evolving discipline. When compiling the education programme, international educational standards are followed by adhering to the so-called CR classification for computer science, maintained by ACM (the Association for Computing Machinery).

The teaching at the department is based on academic expertise: an abstract way of thinking; the ability to acquire and apply existing information; propensity for problem solving and for continuing learning. In putting together the education programme, the long-term needs of the information technology field are also taken into consideration.

In terms of professional life, the goal of the education is to give students the basic abilities needed in the main areas of the field; students learn the basic IT terminology and how to apply the most prominent methods of design, implementation and analysis in a creative way. The university profiling is seen in striving for universally applicable solutions. The truth of these solutions can be proved, their capacity and its limits are

known, and they can be modified to enhance their lives, making them function longer than originally planned. The department education programme emphasizes the key areas of computer science, but the degree requirements offer students a free choice of minor subjects, which enables specialisation in many different fields where computation methods can be implemented.

The accelerated development of computer technology, as well as its increasing use as an inherent part of society, gives the rise to new education needs. These needs consist of teacher training, minor subject training, supplementary education, and postgraduate studies aiming at R&D positions in the industries (the "industry licentiate education"). The aim of upgrading studies is to enhance the abilities of professionals already in the workforce.

The main fields of education and research at the department are the following.
- algorithm research, especially string matching algorithms and applications in computational biology
- adaptive and intelligent systems and their multi-disciplinary applications
- data communications and distributed systems, with a focus on the infrastructure of mobile computing
- software engineering and architecture
- analysing and managing large and intricate data warehouses, data mining
- techniques for new media applications, document management.

B. Evaluation

Major studies in computer science start with the *Cum laude approbatur* study module. Most of the education material is the same for all sub-programmes. The *Cum laude approbatur* study module forms the basis of the Bachelor's degree (120 credit units). A graduated Bachelor possesses a wide range of basic knowledge and skills in the field of computer science, which will enable him or her to take a position in the workforce as a member of development project teams.

For the Master of Science degree (160 cu), the *Laudatur* study module has to be completed. At this point, the sub-programmes and specialisation areas diverge, and the student will concentrate on some special area in computer science. At the *Laudatur* level, there is a sub-programme or specialisation area for each main education and research area at the department (please see item 2.1A).

Four sub-programmes have been determined in the department's degree requirements. Of these, the sub-programme Computer Science is the largest one, containing five specialisation areas corresponding to the research areas (specialisation in algorithms, specialisation in intelligent systems, specialisation in software techniques, specialisation in distributed systems and communications, specialisation in information systems). The other sub-programmes are: Applied Computer Science, Teacher in Computer Science, and Computer Mathematician.

A graduated Master is suited for positions as experts in specialised areas in the industries, or as managers of development projects. If the Master's degree has been completed successfully, it is a good basis for post-graduate studies, which traditionally focus on the subject of the *Laudatur* module of the Master's degree.

As part of the studies, general academic expertise is developed especially during seminars and teamwork (both in the course exercises and the lab work, as well as the Software Engineering Project). The ability to produce academic text is honed by the *Pro gradu* (Master's thesis), as well as the course Scientific Writing that pre-empts it. This course also gives basic skills in finding information from various sources (library, WWW). The teaching programme also contains optional courses in non-written expression, such as the course Digital Media Technology (2 cu), Human Computation: Slow and Ineffective? (1 cu) and How to Perform Successfully (1 cu), all courses given during the academic year 2000-2001.

The quality and amount of computer science education at schools varies so much that it cannot be utilized as a basis for education at the department. Thus students take the following courses as their first introduction to the subject: Introduction to the Use of Computers (2 cu) which teaches the use of computers and networks as well as the use of the most common office programs, Introduction to Programming (3 cu) which teaches general programming skills, and Programming in Java (2 cu). When the student has learned the basics of computing through these courses, he or she is prepared to move on to the actual academic education. With

the help of these generalised courses, the students are also brought on a par with each other regarding basic skills.

The department's teaching programme consists of fairly small modules with an emphasis on professionalism, conceptuality or theory. This creates a versatile degree structure, the elements of which are easy to keep up-to-date, and which enables quickly responding to changing needs in the field.

The strategy of the University of Helsinki emphasizes the development of adult education. At the moment, some of the department's lecturers give courses at the Open University. There is a need for expanding and varying the education, but the staff resources of the department do not quite meet even the current demands.

The department has taken a large role in the project of upgrading studies, instigated by the Ministry of Education. During the years 1999-2001, 199 students from other fields have been accepted for the upgrading studies programme: 40 students in 1999, 81 students in 2000, and 78 students in 2001.

The degree requirements and the teaching plan for each academic year are made up during the previous spring in instalments. First, the sub-programmes and the specialisation areas create their own internal teaching programmes, which are then combined into a uniform teaching programme by the Department Steering Committee. The degree requirements are checked at the same time. Thus the preliminary teaching programme is ready in the spring, and a detailed programme can be published in good time before the teaching starts. Larger changes (such as starting new sub-programmes or specialisation areas) are set in motion by the whole teaching staff during the previous autumn.

The department offers minor subject students the *Approbatur* study module (15-34 cu), the *Cum laude approbatur* study module (35-69 cu), and the minor *Laudatur* study module (at least 70 cu) in computer science. Those who have taken computer science as a minor subject can apply computer technology in other fields or take vocational positions in the IT industries (especially if they complete the minor *Laudatur* module). The contents of the minor subject study modules mainly concur with those of the major subject, with the exception of a few courses that support expertise or research in the IT field.

The most popular *Approbatur* and *Cum laude* courses are given each term, and some of them even several times during one term (the courses on the use of computers, programming, databases and data structures), and then some of these courses are mainly intended for minor subject students.

2.2. Practical organisation of education

2.2.1 Teaching and study culture

Instruction methods and modes of learning

Instruction is given in many different forms. Lecture courses are either six weeks long (2-3 cu), or one term (12-13 weeks, 4-5 cu). Typically, there are 2-4 lecture hours (one lecture hour is 45 minutes) and one exercise session of 2 hours per week. The students are given problems to solve, which are then treated during the exercise sessions (there are usually 10-20 students in an exercise group). During the basic studies, smaller groups are often formed during exercise sessions, and the problems are distributed among these groups. The group solves the problem as a joint effort, and the solution is then presented to the whole exercise group. The students try to bring out the essence of the problem, and at the same time, they can practice their skills in oral presentation. After the presentation, the instructor leads a discussion on it, and other interesting points may be taken up. Some courses also include essays and making computer programs.

The understanding of information given during lectures is deepened and made concrete in the lab work by implementing constructive programming and design tasks. The work is done as separate lab courses. The prerequisite is that the student has completed the lecture course that pre-empts the lab work. Instruction is given in small groups of 6-12 students. The students work independently (or

sometimes in pairs). The goal of the Software Engineering Project is to teach the student the methods, tools and documentation practices of software engineering, as well as project working in a team. Another aim is to demonstrate experimental and constructive R&D in the IT field. The software engineering project lasts one term, and there are 4-7 students in each group.

The students also participate in seminars (the seminar groups usually have 10-15 student members). The seminars are based on presentations and discussion, and each student is expected to give at least one oral presentation and to participate actively in the work and discussions of the group. The seminars meet once a week for one term, and usually yield 2 credits.

Scientific writing and the compilation of theses is taught during the course Scientific Writing. All lab work includes documentation, as well. Skills in scientific writing are also attested by the *Pro Gradu* thesis (Master's thesis). Further, the degree includes a maturity test, which students write on the basis of their thesis from the course Scientific Writing, or on the basis of their *Pro Gradu* thesis.

At some courses, students are required to write learning diaries, where they note what and how they have learned during the course.

Attendance is compulsory at some seminars and some exercise groups in courses at the *Cum laude approbatur* level. Attendance is encouraged by extra points, given for problems that students solve themselves.

The teacher sub-programme at the department has its own degree requirements. The sub-programme is in the charge of a professor, who is responsible for the teaching offered in this sub-programme.

Learning evaluation

To evaluate learning, written and oral exams (courses), written work (theses, essays, documents, learning diaries) and lab work (programming, program design) are used. In seminars, the evaluation is based on written and oral presentations as well as active participation in the work of the seminar group.

The criteria for passing are separately specified for each course. However, most courses give a certain number of points that can be gathered from the course exam, exercises, essays and solved exercise problems. The exams generally give 60-90% of all points. The points are scaled in correspondence with the grades, which are 1-, 1, 1+, 2-, 2, 2+, 3- and 3. (1=pass, 2=good, 3=very good).

The course exams are usually arranged once for a 2-3 credit course, and twice for a 4-5 credit course. For some lecture courses, an extra exam – a re-sit exam – is arranged, where the same competence is required as in the course exam.

The separate exam is formally independent of a lecture course. The exam is based on material given in the course description. Separate exams are arranged for three terms after a course has been lectured. Thus, for a course lectured in autumn, there can be a separate exam the following spring, summer and autumn term. If the course is given a year later, the third separate exam on it is held before the new lectures start.

Results, exams and solutions are published on the department bulletin board and on the intranet. Students can acquaint themselves with the grading of exams during the lecturers' office hours.

Tutoring and student counselling

Tutoring is arranged both by students and by teachers. In the student tutoring, first year students are divided into tutoring groups that are guided by elder students.

The aim of teacher tutoring is to promote the interaction between students and the department, to improve the level of grades, and to make students more committed to completing their degrees. Students are divided into tutoring groups at the beginning of their second year. The tutoring continues

for two years, and is included as 1 credit in the degree requirements of all major subject students.

In the tutor group, study counselling is given as well as a personal study plan for each student, to be followed up during the two years of tutoring. At group meetings, short presentations are given about computer science, minor subject studies and about learning to study. Discussions then ensue on the basis of the presentations, with the aim to develop an atmosphere for open discussion. In addition, the department (sub-programmes, research groups) is presented, along with the working environment (developing computer skills and maintaining them). Matters of general academic knowledge in the IT field and working life can also be discussed. The groups meet once a month for seminars or workshops. In addition, the students meet the tutor personally once each term.

The student counsellors use the study guide of the Faculty of Science as an aid in their work. The study guide is published each year and contains general information on the department (contact info, lecturers etc), degree requirements, and the recommended study plan for completing the degree in five years. The guide also gives the teaching offered, short course descriptions and a presentation of sub-programmes, postgraduate studies and research schools. In addition, students are given the Language Centre's study guide and a guide to social services.

The most important source of information for the student counsellors is the department www pages. They are the most current, because they are constantly updated. The main bulk of department web pages is now over 50,000 pages. The pages contain the study guide, course descriptions, information on when and where courses and exercise groups are arranged, exam schedules and, for many courses, lecture notes. There are detailed instructions on how to write the *Pro gradu* (Master's) thesis. In addition, there is information on sub-programmes, specialisation areas, the research school, the faculty, the department, research at the department, upgrading studies, the library, computers, international student exchange, and transferring credits. There are pages in English for foreign students.

Some courses have their own newsgroup for discussing matters involved with the course. The course descriptions and lecture schedules can also be found on the department bulletin board.

The department sends a welcoming letter to all new students. The letter includes the magazine dataBitti, a department publication aimed for upper secondary school pupils and first year undergraduates. There are pages among the department web pages for school pupils and orientation pages for new students. At the beginning of the academic year, the lecturers present the department and the teaching programme to the new students at an introduction session.

There are five student counsellors at the department (counsellors for the different levels, and one for foreign students). Each lecturer has regular weekly office hours during terms. The faculty study office makes reports, statements and motions on study matters.

Interaction and co-operation between students and lecturers

There is interaction and co-operation between lecturers and students, especially during exercise sessions. In addition, the interaction during teacher tutoring, lab work, the course Scientific Writing, the software engineering work, and during seminars is very intensive. There is "service desk" near the computer classes, where students doing their lab work can go for advice. The teachers have regular office hours. In addition, instruction on how to solve the exercise problems is arranged for first year students.

Lecturer co-operation in planning and implementing teaching

The lecturers usually arrange a meeting with the exercise group instructors once a week. At the meetings, the exercises of the week are discussed together with model solutions and the main points of the exercises. The lecturer chairs the discussion.

The lecturers of each sub-programme/specialisation area have a meeting each term to plan the following term and follow up on the past term. At the same time, the lecturers discuss issues like how to

develop teaching, what new courses should be included in the programme, and which courses should be excluded.

Credit unit measurement

The amount of credits given for each course follows the number of lectures and exercises, so the workload measurement is fairly exact.

Internationality

During the academic year 2000-2001, 10 exchange students visited the department. In addition, several foreigners are majoring or minoring at the department. The exchange students are usually among the top of their home departments and manage well at the computer science department courses. Some of the foreign students are not as fluent in English as might be wished. Foreign students usually take courses that are taught in English, at least during their first year. The department has an administrator of international affairs and a contact person for foreign students.

Credits earned abroad can be submitted for transferral, and it is one of the prerequisites of the exchange programmes that the credits earned abroad can be included in the degree. When applying for exchange, the student submits a study plan for approval, and when returning from the exchange, submits the courses he or she has completed for approval, when the course contents can be more closely analysed and matched to the department's own courses.

Pedagogical basis and outlook along with innovations and development projects

Innovations and development projects are described in detail in section 2.4 B.

2.2.2 Teaching and learning environment

Teaching material and tools

Course literature, lecture slides and lecture compendiums by the lecturers are used as teaching material. In 1999, the lecturers produced 7 lecture compendiums, and in 2000, 8 compendiums. In addition, in 1999, 7 teaching compendiums produced earlier were used, and in 2000 the compendiums produced during the two previous years. The department teachers have written or co-operated on the following course literature:

- Arto Wikla: Ohjelmoinnin perusteet Java-kielellä, OtaDATA 2001
- Tietotekniikan kehittämiskeskus TIEKE ry (kirjoittajat: Hannu Haapa-aho, Harri Hakulinen, Ari Hirvonen, Tiina-Kaisa Kupias, Harri Laine, Heljä Niinistö, Silja Räsänen ja Pekka Virkki) Olioiden maihinnousu, Suomen Atk-kustannus, Helsinki, 1997
- Mannila H., Räihä K.-J., The design of relational databases. Addison-Wesley, Wokingham, 1992
- Lokki H., Haikala I., Linnainmaa S., Mattila S., Susiluoto O.: Tietotekniikka, Tietotekniikan liitto, 1992
- Koskimies K., Paakki J.: Automating Language Implementation – A Pragmatic Approach. Ellis Horwood Books in Information Technology, 1990
- Sippu S., Soisalon-Soininen E.: Parsing theory, Volume 2 LR(k) and LL(k) parsing. (EATCS monographs on theoretical computer science; 20) Springer, Berlin, 1990
- Sippu S., Soisalon-Soininen E.: Parsing theory, Volume 1: Languages and parsing (EATCS monographs on theoretical computer science; 15) Springer, Berlin, 1988
- Ruohotie P., Tirri H., Nokelainen P. and Silander T.: Modern Modelling of Professional Growth Vol 1. Research Centre for Vocational Education. The OKKA Foundation for Teaching, Education and Personal Development, 1999.

For several years now, each course has had its own web page with information about the course. For many courses, both lecture notes and exercises can be found on the web. Lecturers post information on current events on the course web pages.

In addition to the traditional overhead projectors and boards for chalk and felt tip pens, computers and

data projectors are used as teaching aids. Besides in the Auditorium, three other lecture halls are equipped with computers, data projectors and, in some halls, a VCR. There are two multimedia carts to be booked from the building manager. The carts contain a laptop computer, a data projector and a VCR, among other things. Lecturers and exercise instructors often book the carts for their teaching. The students can also use the carts to demonstrate their exercise solutions.

Languages of teaching

The teaching in Swedish is limited to the course Introduktion till datorn som arbetsredskap. In addition, at the course on scientific writing, instruction can be given in Swedish according to need. Exercise documentation, theses and other written work may be done in Swedish. Lately, however, many Swedish-speaking students have wanted to write their *Pro gradu* thesis in English. All exam questions can be given in Swedish, if requested on time.

Usually, at least the *Approbatur* level course Introduction to the Use of Computers is given in English. In addition, several higher-level courses and seminars are given in English. Many courses have an exercise group in English if requested, and though the lectures are given in Finnish, there is usually course literature in English, or the lecture slides are in English, making it considerably easier for foreign students to follow the lectures. Exam questions can be had in English upon request. During the academic year 2000-2001, the department gave 2 courses in English and 3 seminars. In addition, students could attend exercises in English at 12 courses.

Utilizing teaching technology and developing new applications

The www has been used extensively at our courses. The courses have their own web pages and at some of the courses, both lectures and exercises are available on the web.

Web material has been used at the department for years. Professor Matti Mäkelä has had web material produced for his courses since 1996, for example. Mikko Mäkelä has developed his own web learning platform, Harri Laine created his award-winning SQL Trainer, the Jeliot algorithm animator was developed by a group headed by Jorma Tarhio and Erkki Sutinen, and Erkki Rautama is making www concept map applications. In 1998, Erkki Sutinen headed a group of students who taught Java programming to people at the Dar Es Salaam University through the web. In 1999 and 2000, Jaakko Kurhila headed a similar group, and the Marseilles University was at the receiving end.

Professor Henry Tirri has led the creation of the B-Course, a web course on Bayesian deductions, but also a functioning service where users can enter their own data sets.

The department also hosts the PAI project, funded by TEKES (the National Technology Agency), which in its first stage is focussed on developing an intelligent query program.

For more information, please see 2.4 B

Teaching and study periods during the academic year

There are three terms: autumn, spring and summer. In the autumn and spring terms, courses of 2 credits have been divided into two periods. Teaching is concentrated to mid-week, because these times are the most popular among students. Evening sessions are also arranged when possible. The exercise sessions are grouped around the lectures, and during the most popular times there can be several exercise sessions for the same course going on at the same time. Evening and weekend courses have been arranged for upgrading students. Morning lessons have not been very popular among the students, so morning lessons are seldom arranged. The lectures of the two first years are arranged so that there are no clashes with the courses of the Mathematics department that are compulsory for computer science students. When arranging the agenda, the distance of the department from other university institutions is also taken into consideration. Travelling between the institutions takes up quite some time. In the summer, lab work and the software engineering project can be completed. Through the Open University, the department's students have a possibility to complete first year courses during the summer. The department arranges separate exams during the summer.

Premises

The following premises can be used by the department for teaching: an Auditorium seating 250, three lecture halls seating 60, 8 exercise rooms seating 15-20 and 7 workshop rooms seating 10. One of the lecture halls and one of the exercise rooms belong to the department. In addition, the department has 11 computer classrooms of its own. Students have access to the computer classes 24 hours a day, every day of the year.

Overview of 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 3,100. 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 about 500 PCs (mostly Pentium III, more than half of them with flat TFT monitors) running Linux. Windows 2000 can be used as an alternative to Linux. More than 70 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, file servers and other functionally dedicated servers (mail, WWW, FTP etc.), and servers for different user groups. Linux is used almost entirely as the operating system for the servers. The centralized file servers utilize RAID technology and currently offer over 0.4 Tbytes of storage space. Together, these systems support a wide variety of services, languages and software tools including electronic mail and news, graphics and visualization tools, several typesetting systems, and relational database systems. Special attention has been paid to security and reliability.

Networking is based almost entirely on switched 100 Mbit/s Ethernet with an optical backbone. The mobile laptops can also utilize a departmental IEEE 802.11 type radio network, which currently has 12 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 establishments. The IT Department also offers a large modem and ISDN pool for remote access.

In addition, the department has access to a number of supercomputing facilities at the Center for Scientific Computing.

The national FUNET network is further connected to the Nordic University Network, Nordunet, with a 5 Gbit/s connection. The Nordunet has a 1.4 Gbit/s connection capacity to the United States as well as many high-capacity connections to the European network infrastructure.

Registration for courses and separate exams is made through a web-based registration system. If exercise and lab groups fill up quickly, their number is increased when possible. To support teachers in their work, a system for course bookkeeping has been developed. With the help of this system, most course bookkeeping is made at the department. The data from this system can be transferred automatically to the university study register.

Administrative services

The administrative services include computer help as well as the services of administrative staff and secretaries in planning teaching and keeping the study register.

Library

The Computer Science Department and IT Department library is in the same building as the CS Department, and is an administrative part of the Kumpula science library. The library contains a wide range of books, reports, conference papers and journals on computer science. The library is the largest computer science library in Finland, carrying 45,000 volumes. The amount is increased annually by 300-400 volumes and 225 journal subscriptions. Course books and other library volumes can be read in the library reading room, which seats 15. When students have completed at least 20 credits of computer science studies, they can apply for a library card. The library maintains a www database. Searches show all the available journals as well as 42,000 monograph headings that are classified according to the CR classification of ACM. The library maintains a web page with links to the journals and conference papers of key publishers. Some of the journals and conference papers are available online (e.g. ACM, IEEE, Academic Press, Springer, Elsevier, Wiley). The availability of journals and conference papers is ensured by the FinELib licence. The amount of paper copies has decreased since online availability has increased.

Consideration of special needs

Special need have been taken into consideration by such steps as making it possible to enter the building with a wheelchair. In addition, visually impaired, slowly writing and other impaired students are aided on the part of the university administration. Foreign students may have student counselling in English, and the exam question can be requested and answered in English.

2.2.3 Study progress

What seems to affect the progress of studies most is that students have jobs. The teacher tutors interview their students about their motivation to work. One of the main reasons students give for their working is the high cost of living in the larger Helsinki area. The housing expenses are seen as particularly high, and the study grants do not cover them. Around 55% of second year students have jobs, of them c. 15% are working fulltime. When they have studied longer, the amount of working students increases. This means that most of the students are in effect part-time students. This should be considered when calculating the ‘brute study time’.

The department tries to arrange group sessions in the evenings, so that it is easier for working students to attend. In addition to the teacher tutoring offered to students in their second and third year, students who have completed ten or less credits during their first year are contacted and offered tutoring to help accelerate their studies. Of these students, most have changed major subject from computer science to something else. The department has also contacted students with over 100 credits to encourage them to finish their *Pro gradu* thesis. The students usually react positively to contact from the department, which aims to encourage their studies.

Of the students who have registered with the department, only half continue to their second year, and half of these (25-30% of the starters) complete their Master’s degree. The figures vary somewhat according to the work market situation in the field. A total of over 20,000 credits are completed annually at the department. The figure approaches the total of credits completed in the whole Faculty of Theology, and continues to increase. Of the total amount of credits, about half consists of the studies of major subject students, c. 30% of minor subject students, and c. 20% of the studies of drop-outs. The university’s model for allotting funds only partly takes into consideration credits that are not included in a degree, which is reflected by the basic funding of the department. By our minor subject teaching alone, we would come third in a comparison of the total teaching at Faculty of Arts departments.

As a general note, it can be said that the department sees both the interruption and the prolongation of studies as a problem. By way of teacher tutors and other direct contacts with the students, the department tries to encourage students to finish their degrees, but the department’s options are limited in the face of the fluctuations in the work market and the high cost of living. On the other hand, the fact that so many students are hired in the early stages of their studies may reflect the high quality of education given at the department.

2.2.4 Values, qualities and atmosphere of the academic community

Staff skills and their maintenance

Present state and development of pedagogical skills and scientific competence

There is a shortage of teaching personnel, and it is difficult to find enough competent teachers for such a large body of students. Training opportunities are arranged twice a year, once for new teachers and once for all teachers. In addition, the staff is encouraged to participate in training arranged by the university.

Recruiting staff

There is a specific application procedure for permanent posts, and the structure of posts is developed to meet future needs. Teachers are mostly recruited among the students, and they are elected on the basis of proficiency and their ability to perform in front of an audience. The best part-time teachers are recruited for fulltime positions whenever possible.

The goal is to have everyone involved in teaching and research to participate in both. In connection with some tasks where teaching plays an important role, however, the research can be replaced by development of teaching contents and methods. Accordingly, some tasks that are more focussed on administration can differ from the above.

The well-being and commitment of staff

The permanent teaching staff of the department is very committed to the work, which is evident from the well-established teaching programme. With committed teachers, it has been possible to establish both a stable *Cum laude* study module of a wide range of subjects, and the sub-programme and specialisation area courses and seminars based on that. The key courses are arranged once a term or once a year.

An indicator of the ambience of the department (in teaching as well as other areas) is the award for high-quality activity that the department received from the University Senate in 2000. The award was given by a jury that visited the department and interviewed a large number of staff and students.

The drawback of the teaching staff's commitment to the department may be fatigue, especially seeing that in the field of computer science, the pressure coming from outside the department for increased and quicker education is hard. Attempts at preventing the fatigue include taking advantage of the total working time, which gives teachers the possibility to concentrate on their own research at times. Paid research leaves of one term have also been arranged.

In spite of the working hour arrangements, the burden of teaching is taking on unreasonable proportions. The department strategy states that the increase of the amount of teaching will stop at 15% above the present by the year 2002. To enable this, the amount of new students admitted to the department will be cut down, and the amount of minor subject students will be restricted to a level that is feasible for the teaching resources. The growth limits to upgrading studies will be evaluated on the basis of the experiences of the academic years 1999-2000 and 2000-2001.

The well-being and commitment of students

Student opinions are encouraged in the Steering Committee, and the student body has representatives in many project groups. The staff and student communities are fairly separate, but active students integrate into the department community fairly easily. The student organization TKO-äly and the student lounge add to the well-being of the students. In addition, teacher tutoring with its personal meetings helps students commit to the department.

Realization of faculty values and values presented in the university strategy

In the university strategy, the quest for knowledge and truth, a critical approach, creativity (research), autonomy, expertise, social influence, research ethics, education (multidisciplinary and interdisciplinary), internationality, equality, democracy and a sustainable development are the key values. These general values are being realized in the department teaching, both through established academic practices (please see 2.1) and by participating actively in the international academic world in strategically elected research areas. Students have access to a varied international education through their minor subjects.

In the department strategy, and in addition to the values of the university strategy, we emphasise scientific know-how, a high quality in research and teaching, the beneficial effect of our research and teaching on the national economy, and giving an education that will offer our students a wide range of choices on a future job market. One of the implementations of these goals is to require most of our major subject students to take an extensive course of mathematics as one of their minor subjects. Most of the research at the department has outside funding, with the funding and assignments coming from the industries, so that the research results are usually directly available for industrial use and a broader public. The proof of the relevance of the education at the department is that most of the students in their final years are working, and recent graduates have not had difficulties in finding positions on the job market (please see 2.3). One indicator of the high quality of research at the department is that it was graded 7/7, the highest possible, at the evaluation of research at Helsinki University in 1999.

2.2.5 Connection between basic studies and research

The course presenting Computer Science offers an exploration of various sub-fields in computer science, presented in lectures by experts in those fields. The presentations focus on fields where the department carries out research. A written exercise is part of the course.

Those working fulltime in research teams also lecture regularly, especially on matters in their own fields of expertise.

Undergraduates who have been successful at their studies for 2 – 4 years are entitled to apply to the research sub-programme, which aims at postgraduate studies. The students of this sub-programme mainly follow the same curriculum as other students, but they are recommended to take more mathematics than is required, and they are given more demanding exercises that require more innovation. Post-graduate studies are then carried out primarily within the graduate schools (HeCSE or ComBi). Optional courses are chosen according to department research foci. Many of the software engineering project subjects are initiated from the department's research teams. The thesis for the course in scientific writing and especially the *Pro gradu* thesis can be written on a subject from one of the research teams, and in that case, the student is hired to work for the team when writing the thesis. The department gives some students a *Pro gradu* grant, which enables fulltime concentration on the thesis work, and in this case the subject of the thesis is usually connected with research at the department.

2.2.6 Cooperation within the faculty, national and international cooperation

The sub-programme Applied computer science leads to a degree with more extended minor subjects than usual. The sub-programme gives the student a very wide choice of specialisation areas. The department co-operates with the bioscience departments, among others. Students can also specialise in language technology. The department is a member of the national network for language education (KIT), which offers a wide range of multidisciplinary studies in language technology.

The sub-programme for computer mathematicians is similar to applied computer science, with the extended minor subject mathematics. There are small differences in degree requirements. Teaching is given in co-operation with the Mathematics Department. In this sub-programme, computer science and mathematics are equally represented in courses, but the *Pro gradu* thesis is written in the field of the major subject.

The Department of Computer Science, the Helsinki University of Technology and the Helsinki School of Economics and Business Administration co-operate to offer their degree students a minor subject in software design and marketing. The minor is comprised by general courses in software technology, software engineering, business education, marketing and IT law, as well as a project exercise. Each course and the project are the responsibility of one of the universities.

The University of Helsinki is one of the universities in the so-called JOO programme, the flexible study rights scheme, along with the other universities in the greater Helsinki region as well as the universities of Tampere and Jyväskylä. The scheme enables students to apply for study rights at another university in subjects that are not taught at the home university. On the basis of the JOO scheme, the student can study separate courses or a whole minor subject study module.

The CS department and the Department of Education are members in the IQFORM project, a project to develop the evaluation and support of the quality of learning. As a tool for this, an interactive feedback system, the IQ-FORM software, is being developed. The software uses new intelligent techniques to support the learning process. IQ-FORM is one of the projects for teaching and support in studies at the Finnish virtual university, and is funded by the Ministry of Education.

The department co-operates with twelve upper secondary schools in the greater Helsinki region. The school pupils have the chance to attend basic courses at the department, and the studies will be credited to them if they enter the department as undergraduates. In 2000, 33 pupils, and in 2001, 23 pupils were accepted on their application to study at the department.

The department has co-operated with the University of Petroskoi for many years, now. The ambition is to develop the IT education at universities in the region, which is expected to eventually have a favourable impact on the Finnish industries, as well. A co-hosted research seminar is arranged annually in Petroskoi. The department has participated with 3-6 researchers each time. Accordingly, some post-graduate students have arrived from Petroskoi to Helsinki to complete their studies.

The department participates in the Socrates/Erasmus exchange programme of the European Union and in the Scandinavian Nordplus exchange programme. In the academic year 2000-2001, 9 of the department's students were studying abroad, and they can apply to have their studies accredited here. The department has a person in charge of international affairs and a foreign student advisor.

2.2.7 Organisation of minor subject teaching and studies

Many university departments restrict the number of minor students, so that our students cannot always take the minor subjects they want. The CS department has many minor subject students. In the year 2000, students from outside the Faculty of Science completed 1,652 credits at the department. This is a fourth of credits given to students from other faculties in the whole of the Science Faculty.

2.2.8 Practical training and other connections to working life

There is an industry professorship at the department for 2000-2004, half funded by the Ministry of Education and half by an industrial enterprise (at the moment, Nokia Research Center). The industry professor is a bridge between the university and the industries, with the aim to mutually exchange new information and the new requirements in the IT industries. It is also an ambition to create joint research projects and to recruit teachers from the working community to the department courses and exercises.

The department had 25 lecturers from outside the department in the academic year 2000-2001 (lecture courses, seminars, Information Technology: Now!).

Software design projects have also been made for outside clients. There are usually a couple of outside projects each term. The coming autumn, the outside projects will be in the majority. The Master's theses written for the industries in 2000 were above 40% of all Master's theses, and half of the theses written outside the department were written for Nokia.

The series of colloquia, Information Technology: Now!, where experts have presented their views on the

future in IT and the information society, has been arranged twice. Around half of the presenters have been representatives of the industries.

Students are encouraged to work in the field during summer. In addition, they can apply for government internships in IT tasks. Work experience can yield 2-6 credits. The amount of credits is determined by how long the student has worked and at what.

2.2.9 Post-graduate studies

It is recommended that post-graduate studies be carried out in one of the department research teams, for the student to benefit from the support of the group (expertise, contacts, funding). The subject for post-graduate studies can be found through discussions with professors and other researchers at the department. Formally, a student becomes post-graduate by registering with the professor in charge of the field of interest, agreeing with him or her about the field of the thesis (the subject is finalised as the work progresses), and about specialisation and minor subjects. All this is written down in the post-graduate schedule. Each post-graduate has a personal instructor. There were 74 post-graduate students in 2000; of them, 33 were in the graduate school HeCSE and 6 in the graduate school ComBi. Of the HeCSE students, 10 received Ministry of Education funding during the spring (total 70 months) and 12 during autumn (total 59 months).

The student and the instructor arrange the study schedule together. The goal is to complete a PhD degree in four years if studying fulltime. If the student has to work at the same time, the degree usually takes longer to complete. Students are recommended to enter one of the graduate schools in which the department participates.

The main part of the post-graduate studies consists of work on the licentiate or PhD thesis. In addition, the graduate student usually publishes (in co-operation with the instructor) results of his or her work in international forums while working on the thesis. The University of Helsinki also requires post-graduate students to complete 40 credits of other studies (*Laudatur* courses and seminars). Completing these credits as normal courses requires one year of work. Requirements at the Helsinki University of Technology are much more flexible; students are primarily encouraged to take courses that will help them in their research, and teachers may give credits for publications, for example, or for giving a seminar.

The HeCSE graduate school

HeCSE is the joint graduate school of the University of Helsinki and the Helsinki University of Technology, with the aim to make graduate studies more effective. The school invites applications annually, and the steering committee elects new students on the basis of qualifications and recommendations. The aim of the school is to offer the possibility of fulltime studies at universities within established research teams; thus it does not offer its own study modules with courses, instructors and teachers. The school can arrange funding for some students. The Ministry of Education channels funds for fulltime post-graduate studies through the school (there are annually 9 post-graduate students funded by the Ministry at the CS department). As long as the school has existed, the number of PhD degrees at the department has visibly increased.

There is no teaching programme or specified research area for the school. Research and post-graduate instruction is carried out in the research teams of the department. There are no joint criteria for the evaluation and grading of PhD theses. In general, the variety between Finnish universities in this matter is great.

The school regularly arranges a course in writing scientific English. Annually, a summer or winter school has also been arranged, offering the presentations of visitors as well as the students' own presentations on their field of research. When the school started out, students were supposed to take (compulsory) courses custom-made for them in the subject areas of the school's main research fields. These plans have gradually been discarded because of their impracticality, and the lack of interest among the students.

The leader of the school attempts to interview the students once a year. There is no other feedback system.

From the viewpoint of the students, the main benefit HeCSE has to offer is the partial funding of post-graduate studies. HeCSE has not effectively changed studying in any way. The progress of the student depends largely on the student him- or herself as well as on the research team and on the instructor.

The ComBi graduate school

ComBi is a joint (multidisciplinary) graduate school on computational biology, bioinformatics and biometry between the universities of Helsinki, Turku and Tampere. The school combines methods of computer science, mathematics and statistics with biology.

ComBi has arranged a course on scientific writing twice, and a course on scientific presentation once. The courses have been well received. Biology as the common field of application serves to connect students, but their methodological backgrounds are so different that arranging joint courses might prove difficult.

The school enables graduate students to meet each other primarily at seminars, which are arranged once or twice a year (there are students from several cities involved). How often students meet otherwise varies a great deal according to research team.

The instructor is the graduate student's only official tutor. In practice, it is possible that the instructor does not have enough time to support the student. There should be more senior researchers, who could participate in tutoring.

In ComBi, students are expected to present a schedule for the thesis work and annual reports on their progress. There are no actual criteria on what a good PhD thesis should be like. Apparently, it is assumed that each instructor may advice the student on this.

'Recruiting' for post-graduate degrees – alternatives in graduate studies

The graduate schools are primarily advertised as schools leading to a post-graduate degree. If an instructor can be found, post-graduate studies may be carried out in the traditional way (working at the department as teacher and/or researcher, or working elsewhere). Basically, the student and instructor work out the graduate studies schedule between themselves. For the department, the main concern is that the instructor is scientifically competent.

The absence of post-docs, who could act as sponsors and sounding boards for the post-graduate students in their work, seems to be one of the major weaknesses felt in the post-graduate community. The instructors are often too busy to contribute much in this way. Many of the research teams are too small to create a 'critical mass.' To increase the number of post-doc positions at the department, assistant doctors' positions have been created. Greater flexibility in the compulsory licentiate courses could give students more meaningful graduate studies.

2.2.10 Quantitative results

In the year 2000, 63 *Pro gradu* (Master's) theses and 64 basic degrees were completed. Usually, around 10% fewer degrees are completed than *Pro gradu* theses. Teacher tutoring has clarified that many students do not complete their minor subjects. In the year 2000, 20,559 credits were gained from a total of 7006 completed courses. According to polls, the greatest reason for not completing a degree is that the student is working alongside studying.

In the year 2000, three licentiates and five PhD's were completed.

2.2.11 Learning results

Please see appendix 1 for a list and grades of Master's theses in English and all licentiate and PhD theses that were accepted during the academic year 1999-2000.

Instructions for writers of *Pro gradu* theses and other written work

There are www pages for students taking part in the course Scientific Writing and for students who are writing their Master's thesis. The pages contain a great deal of information on research processes and thesis writing. For students about to start writing their *Pro gradu* thesis, seminars are arranged twice each term.

2.3. Evaluation and development of education

Feedback systems

Students are encouraged to give feedback on each course twice each term, at the end of each teaching period. The feedback system has been reworked for next year so that feedback can be given at any time of the course. Feedback is given anonymously with a www form. The teacher of a course may consult the feedback at any time, and when the course ends, all the feedback is summarized.

From students taking part in teacher tutoring, the department gathers feedback on separate forms. The person in charge of teacher tutoring summarizes the information gathered in this way. The teachers are also given direct feedback, e.g. from students taking part in the courses Scientific Writing, Software Engineering, and students writing their *Pro gradu* thesis.

Since 1996, the Helsinki University Career Services has carried out an investigation on how newly graduated students place themselves on the job market, on what they think of the level of education and how it could be developed. The following are the opinions of students who filled in the questionnaire in 2000. The theoretical and practical knowledge given in the education was seen as a good basis for the future of the student. The exercises and other courses were the best part of teaching. More guidance for the work on the Master's thesis is needed. More exercises and projects should be included in the education.

All the students who had completed their degree and had looked for a job, had found employment on graduating.

Evaluations and accreditations

The department was evaluated as part of the national evaluation of education in the IT field. This evaluation was carried out in 1998-2000. The evaluation comprised an outside evaluation and a self-evaluation.

The evaluation recommended a simplification of how the department is managed. The evaluators felt that the number of participants in some of the basic courses is alarmingly large. The department was recommended to increase co-operation with industrial and international partners. The panel of evaluators also recommended that the department develop the system for feedback on teaching. The technical implementation of the system has then been renewed so that teachers can read the feedback at once, and keep up with the feedback as the course proceeds. The department management has been developed so that each sub-programme and specialisation area has its own professor in charge.

The research carried out at the department was evaluated in 1999. The department received the highest possible grade, 7/7. Following the comments from the evaluators, the research into software technology has been set in focus.

The opinion of students on the feedback system

The feedback system works well and the students think it is important to have the possibility to give feedback. The feedback is encouraged in courses by including it in exercises and giving extra points for it.

Awards and rewards for teaching

There are several teachers at the department who have been rewarded for their skills as teachers. The student union at the university gave Teemu Kerola the award “An Award for the Best Teacher Teaching in a Foreign Language at the University of Helsinki 2000”. In 2000, Harri Laine was given an award for the best teaching technology at the University of Helsinki. In 1998, Arto Wikla was given the teaching technology award for his implementation of teaching technology for the course Introduction to Programming. In 1997, the same award was given to Jaakko Kurhila.

As an indication of the university’s appreciation of the department staff, members of the staff participate in the following project groups:

- Heikki Lokki: The Helsinki University Studies Committee – 31 December 2003
- Jaakko Kurhila: The Science Faculty Committee for Education Development – 31 December 2003
- Jaakko Kurhila: The Helsinki Virtual University Project
- Henry Tirri: The Ministry of Education project for education and research information strategy, ‘analysing learning environments’
- Jukka Paakki: the IT association project for vocational training

The University Senate has given the department an award of excellence in the year 2000.

Development practices and projects for the teaching plan

The degree requirements were renewed during the academic years 1998-1999 and 1999-2000. Two new sub-programmes were added to the computer science discipline. The general sub-programme from before was divided into the algorithms sub-programme and the sub-programme for intelligent systems. The software sub-programme was divided into the software engineering sub-programme and the distributed systems sub-programme. Many courses were divided into several courses (generally two). The requirements for the minor subject mathematics were cut back from 26 credits to 15. Other reformations include the teacher tutoring, which was started in 1997.

The department has decided to invest in new fields, such as the computer mathematician sub-programme and the minor subject software design and marketing, which were established in 2001, and in language technology.

Development projects

The department participates in the international virtual university project (TUeLip - Top Universities e-Learning International Project) sponsored by IBM, and in the virtual university project team at Helsinki University.

A new computer classroom for data communications education has been established in 2001, and it is being developed for teaching purposes at the moment. The department also has a robot for research purposes. It has also been used for teaching, e.g. in the software engineering project.

A team for developing teaching methods has been assembled at the department. The team tries to bring new teaching methods into the department. Among the plans are using innovative learning in basic level courses and a wider use of virtual education. In addition, the team is preparing the awards for good teachers (2 awards), the first ones to be given out in autumn 2001.

2.4. Future prospects and development plans for education

A. Contents of teaching

Of the computer science degree requirements, 46 credits are the same for all major subject students. This part of the requirements, which is fairly stable in contents, gives a conceptual and practical basis for later studies, which encompass 30-45 credits according to sub-programme. After the basic, common studies, the study contents are adapted along the lines of research interests at the department to enforce the specialisation areas represented by the research staff. In the swiftly changing field of computer science and information technology, the department makes good use of the possibility to vary the responsibilities of office holders that the current university administration model enables. This makes it possible to pool resources effectively.

New specialisation areas and practices have been supported by establishing the following offices:

- A Professor's chair for intelligent systems (5 yrs)
- An office for a university lecturer in web education (5 yrs)
- Language technology (Professor's chair 3 yrs, office for university lecturer 5 yrs)
- Offices for upgrading studies (1 Professor's chair 3 yrs, 2 offices for university lecturers 5 yrs)
- A Professor's chair in industry (5 yrs)
- Data strategy administration amanuensis office

B. Teaching methods

There is a high turnover of part-time teachers at the department, and training sessions are arranged for new teachers each term. More experienced lecturers teach the new ones about teaching practices at the department at these sessions. As part of many courses, the course assistants and the person in charge of the course meet regularly to discuss how best to teach the matter in hand.

The Computer Science department has used the web as support in teaching and studying for many years now. The first extensive www-based course material was created in 1996 and 1997. In the year 2000, with the office of university lecturer in web education, the whole department has been putting more effort in developing web education. Among the central activities there is participation in the university's virtual university project (chaired by vice-chancellor Raija Sollamo), and in the joint venture of computer science and technology departments at many European polytechnics and universities, the TUeLip (Top University e-Learning International program) project, the aim of which is to create web resources for basic courses. The courses are developed as a co-operation between several partners, and three teachers from the department are members of the project.

In practice, the internet and www are used as a part of each course. Each course has its own home page, and for some courses, there is an active newsgroup as a forum for interaction between students and discussions between students and teacher.

During the academic year 2001-2002, the first web courses will be held (all lectures can be substituted with online studies), and web-based learning environments will be used as platforms for workshops. The first web-based course (Introduction to Databases) has been implemented in co-operation with the Open University at the University of Helsinki.

The teaching methods of optional and *Laudatur* courses at the department vary, and for many courses, teaching aims at activating students. Exercises are done as teamwork, intensive seminars and poster seminars are arranged, and learning diaries are written.

The department has established a team to develop teaching methods, and to help teachers implement their innovations. The goal is to try out methods of investigative learning on courses with several hundreds of students. Another project to activate students is to arrange study circles in connection with courses.

On the basis of this self-evaluation, among other things, the department has planned the following measures to develop teaching:

- An advisory board with members from the industries to develop teaching
- Developing the feedback system further
- Increasing the teaching co-operation with HUT, HSE, business ventures
- Education customized for business ventures

- Developing the graduate schools: research methodology, courses that support the thesis process, developing the feedback system
- New, activating teaching methods (web education, investigative learning)
- Exercise guidance/study circles (especially for upgrading studies)
- Post doc positions for the guidance of post-graduate students (graduate schools)
- Support for the combining of studying and working
- More flexible forms of graduate studies
- A guide for post-graduate students (e.g. thesis criteria)

We especially want to emphasize the following development projects mentioned above:
- Individual support of learning (tutoring, study circles etc)
- A minor subject module of methodology
- Investigative and problem-based learning

2.5. Summary

Strengths

- The possibility to offer a wide range of subjects, great variation in minor subjects, the JOO agreement
- A stable degree structure and teaching programme (specialisation built on a solid foundation of basic studies)
- Teaching is taken seriously
- Some teachers have won awards for their work
- Tutoring, especially for 2nd and 3rd year students
- The utilization of software design education and project working in research
- The practical experience students have from working
- Co-operation with the world of business, especially in *Pro gradu* thesis work
- A state-of-the-art and extensive IT structure
- A good library
- Extensive and up-to-date instructions on the web
- Research on a top level in a few fields

Weaknesses

- The over-working of teachers, the lack of teachers, the fairly large amount of unexperienced part-time teachers
- The challenge of keeping teaching up-to-date; the field is changing rapidly and it is laborious to update teaching material
- The teachers' lack of pedagogic education
- Studies slowed down by work, inefficiency of distance learning
- Prolonged studies, interrupted studies
- Inefficient start for the first study year
- The small amount of graduate degrees
- The fairly weak image of the department among young people, especially compared to technology universities
- To keep the teaching programme in harmony with the needs of the industries
- Finding promising scientists at an early stage in their studies
- A clearer strategic focussing of teaching and research

Threats

- The lure of the industries and other universities; undergraduates, post-graduates as well as teachers leave, as do researchers

- The difficulty to recruit new, permanent teachers
- The scarcity of the basic funding and insecurity of additional funding, which hampers long-term planning
- Students have a snide attitude towards linear systematic degree studies
- Part-time studying for economic reasons
- The image of threats to the IT field causes a deterioration of the subject's image
- Upgrading studies are becoming a burden to the department
- Too many students compared with the number of teachers
- Staff fatigue

Opportunities

- Teaching methods that take into account the field and teacher profiles
- New activating teaching methods (investigative learning, web education)
- Encouraging students to commit to the department (tutoring, research school, image development)
- Integrating students into research teams and post-graduate studies at an early stage (research school, the graduate schools HeCSE and ComBi, the research institute HIIT)
- Integrating research projects into teaching
- Developing the co-operation with other universities and with the industries
- Expanding multi-disciplinary education
- Recruiting undergraduates; increasing visibility, co-operation with upper secondary schools, developing the screening process
- Increasing international student exchange
- Improving the status of the lower degree (BSc)
- Utilizing the industry professorship
- Making upgrading studies more efficient with the help of special arrangements
- Using the total work time (1,600h/yr) in a flexible way (teaching, research, administration)
- An increased wage level brought on by the new office administration structure and competence evaluation
- Greater emphasis on teaching experience when appointing teachers, developing motivating wage politics, making the work load more flexible
- Enlarging the teaching offered according to wider research interests

Appendix 1

A selection of Master's, Licentiate and Doctoral Theses 1999-2001

This appendix contains a list of all the Master's Theses written in English (64 theses) and the best one written in Finnish during 1999-2001 (1 graded laudatur out of a total of 109 theses). It also contains a list of all Licentiate (6 theses) and Doctoral Theses (11 theses) during 1999-2001.

Master's Theses

1999

- Kaisu Villa: Replication in a distributed configuration management system. mcl. C-1999-3.
- Markku Laukkanen: CORBA/SNMP based network management. cl. C-1999-6.
- Jahan Noor: Making objects persistent in a CORBA environment. cl. C-1999-7.
- Tony Jokikyyny: Computer supported software inspection process. cl. C-1999-8.
- Tuija Hurtta: The functionality of packet data access node in future wireless packet data networks. ecl. C-1999-11.
- Marko Perttilä: Expected behaviour of TCP and MDCP in GPRS environment. cl. C-1999-15.
- Paulius Meskauskas: Mobile agent-based intelligent network environment. mcl. C-1999-20.
- Marko Jokinen: A communication mechanism for component-based distributed computing. nsla. C-1999-21.
- Henri Sintonen: Business application concepts in WAP-environment. cl. C-1999-27.
- Jarno Tenni: Methods and a tool for controlled language specification. mcl. C-1999-29.
- Antti Hoikkala: Collaborative technologies for virtual workplace. cl. C-1999-33.
- Juha Makkonen: Lifespan of data in a warehouse. ecl. C-1999-38.
- Kimmo Lampinen: Design and implementation of an HTML-based online assistance system. mcl. C-1999-39.
- Antti Mettälä: Component based framework for creating process simulation WWW user interfaces. cl. C-1999-47.
- Arne Dybdahl: Animation with Excel. nsla. C-1999-50.
- Patrik Palm: Iconic indexing of images in PICSearch. mcl. C-1999-54.
- Hu Rui: Performance-oriented software engineering for E-commerce. nsla. C-1999-63.
- Timo Virtanen: Dimensioning GSM data services. cl. C-1999-64.
- Markus Stenberg: Evaluation of communication interfaces for distributed systems. mcl. C-1999-69.
- Martti Söderlund: Protocol testing with TTCN and ASN.1. mcl. C-1999-70.
- Frans Tuomela: Protocols of media gateway controller. ecl. C-1999-71.
- Jukka Manner: TCP over GPRS - performance analysis. ecl. C-1999-72.

2000

- Olli Pihlajamaa: Profiling organisational processes for successful workflow management. mcl. C-2000-10.
- Jan Lindström: Experimental performance evaluation of RODAIN concurrency control and scheduling. ecl. C-2000-13.
- Timo Patrikka: Protocol testing of OSPF in the DX 200 system. cl. C-2000-14.
- Ilkka Autio: Mapping real-world environments with an autonomous robot. ecl. C-2000-17.
- Tero Kauppinen: IP over Bluetooth. ecl. C-2000-20.
- Matti Heikkurinen: Software process development in a medium-sized software project. mcl. C-2000-24.
- Eeva Vuorinen: The impact of XML in e-commerce. mcl. C-2000-27.
- Tero Mäkelä: Charging and billing in GRPS. mcl. C-2000-28.
- Jonne Soininen: Mobile IP in the 3rd generation cellular networks. cl. C-2000-30.
- Jani Månsson: Location-based services in wireless local area networks. mcl. C-2000-34.

- Jussi Vuorento: The effects of power control in bluetooth networks. ecl. C-2000-35.
- Mari Rahkila: Capacity testing of real time database system for telecom use. 3/3. C-2000-37.
- Sami Perttu: Combinatorial pattern matching in musical sequences. l. C-2000-38.
- Rasmus Nybergh: Interconnection networks for DX200. mcl. C-2000-41.
- Vera Izrailit: Optimization of pattern matching expressions in a functional language. cl. C-2000-42.
- Simo Lankinen: Usability criteria of an online software process guide. mcl. C-2000-45.
- Ykä Huhtala: Finding similar time series in a large collection of sequence data. mcl. C-2000-47.
- Henry Freedman: Agent technology in software. cl. C-2000-51.
- Mikko Koivisto: Sukulaisriskien laskenta ja käyttö geneettisten mallien arvioinnissa (Computing and using relative risks in the evaluation of genetic models In Finnish) l C-2000-52.
- Sasu Tarkoma: User dialogue management in the FIPA architecture. mcl. C-2000-56.
- Tommi Martikainen: Quality service in Internet protocol suite for mobile terminals. ecl. C-2000-59.
- Jan Bäckström: Deploying telecommunications services over an IP network. cl. C-2000-62.
- Joanna Uusikartano: Security issues in GPRS legal interception. cl. C-2000-63.
- Jani Boström: Providing value-added services for corporate users in 3G networks. mcl. C-2000-64.
- Andrei Gurtov: TCP performance in the presence of congestion and corruption losses. ecl. C-2000-67.
- Tomi Päiväniemi: Combining inference methods for Bayesian networks. mcl. C-2000-69.

2001

- Panu Kuhlberg: Effect of delays and errors on TCP-based wireless data communication. ecl. C-2001-7.
- Pasi Sarolahti: Performance analysis of TCP enhancements for congested reliable wireless links. ecl. C-2001-8.
- Teemu Head: Techniques for application integration. cl. C-2001-13.
- Toni Poikela: OSA framework implementation in 3G IN. cl. C-2001-18.
- Hui Zheng: Runtime memory usage estimation from UML diagrams. mcl. C-2001-21.
- Jens Hendrén: Software development renewal from customer specific projects to product development. cl. C-2001-22.
- Teemu Tonteri: A statistical modeling approach to location estimation. ecl. C-2001-26.
- Miro Lehtonen: Semi-automatic document assembly with structured source data. ecl. C-2001-30.
- Mia Haarala: Gathering and managing information for centralised user profiles for utilisation in third generation mobile services. cl. C-2001-36.
- Paula Silvonen: Correcting and unifying domain-specific texts. mcl. C-2001-37.
- Janne Teinilä: Performance analysis of a large database in a customer relationship management system. mcl. C-2001-43.
- Mika Pennanen: Agents in virtual home environment. mcl. C-2001-45.
- Liisa Paasiala: Estimating software project effort. ecl. C-2001-46.
- Jaakko Vuolasto: A framework for electronic dictionaries. mcl. C-2001-49.
- Jussi Laukkanen: An evaluation of IPv6 transition mechanisms in implementation of UMTS Internet access. ecl. C-2001-50.
- Jukka Wallenius: Applying neural networks in information retrieval. ecl.
- Anne Vanhala: Prepaid services in GPRS. nsla.

Licentiate Theses

2000

- Matti Luukkainen: Timed semantics of concurrent systems. ecl. C-2000-4.
- Jaakko Kurhila: Individualization by software advisors in computer-supported special education. mcl. C-2000-7.

- Kirsti Äystö: Kolmiulotteisen kappaleen etsiminen tietokannasta tiheysjakauman perusteella. (Searching for three-dimensional objects in databases using density distributions. In Finnish) cl. C-2000-23.

2001

- Jan Lindström: Optimistic concurrency control methods for real-time database systems. mcl. C-2001-9.
- Päivi Hurri: Hypertekstien samankaltaisuuden tunnistaminen (Identifying similar hypertexts. In Finnish.). mcl. C-2001-12.

Doctoral Theses

1999

- Mika Klemettinen: A knowledge discovery methodology for telecommunication network alarm databases. mcl. A-1999-1.
- Juha Puustjärvi: Transactional workflows. mcl. A-1999-2.
- Juha Kärkkäinen: Repetition-based text indexes. ecl. A-1999-4.

2000

- Pirjo Moen: Attribute, event sequence, and event type similarity notions for data mining. mcl. A-2000-1.
- Barbara Heikkinen: Generalization of document structures and document assembly. mcl. A-2000-2.
- Pekka Kähkipuro: Performance modeling framework for CORBA based distributed systems. ecl. A-2000-3.
- Kjell Lemström: String matching techniques for music retrieval. mcl. A-2000-4.
- Timo Karvi: Partially defined Lotos specifications and their refinement relations. mcl. A-2000-5.

2001

- Juho Rousu: Efficient range partitioning in classification learning. mcl. A-2001-1.
- Kimmo Fredriksson: Rotation invariant template matching. In press.
- Marko Salmenkivi: Computational methods for intensity models. In press.

Grading

L	*Laudatur*
Ecl	*Eximia cum laude approbatur*
Mcl	*Magna cum laude approbatur*
Cl	*Cum laude approbatur*
Nsla	*Non sine cum laude approbatur*
A	*Approbatur*

Appendix 2

Statement to be appended to the Computer Science Department's self-evaluation report

TKO-äly ry
Student organization for students of computer science
Department of Computer Science, PO Box 26 , 00014 University of Helsinki
Phone +358 9 191 44509
E-mail: TKO-aly-nobles@Helsinki.FI

Teaching and studying

Methods of teaching

One of the strengths of the computer science department is that teaching is often done in small groups, such as exercise groups and project workshops. Individual instruction is given in project courses and the course Scientific Writing.

Forms of learning

There is sufficient teaching. All courses may be taken as lecture courses or as tutorials, and most of the compulsory basic courses are lectured each term.

Completing a course by taking a separate exam works well, because exams for the same course can be taken several times during the year. However, students are not encouraged to complete courses by taking separate exams.

Exercises play a central part in learning computer science, and exercises are seen as very useful. If students are given extra points that affect the grade for exercises, it encourages completing the exercises. Some optional special courses offer alternatives to the traditional exercises.

Stipulation of credits

Courses that include practical project work are often laborious in proportion to the number of credits they give.

Internationality and bilingualism

Student exchanges have increased, both for foreigners coming to Helsinki and students going abroad from Helsinki. The student exchange at the department is well organized and it is easy to find a place abroad. Studies completed abroad are well accepted.

Grading

The criteria for grading are mostly published on the web, and after an exam there is usually a feedback session, where students can acquaint themselves with the grading. The feedback sessions are not always advertised very well.

The grading of exams sometimes goes over the time limit of one month, even for smaller courses.

Study counselling

Student counselling and study support

There is student counselling on offer for those who actively seek it out.

Most students work along with studying from their second year or so. The lack of evening classes may slow down some working students.

Commencing studies

The great amount of students admitted each year may make it difficult to take the first year courses. The new form of intensive course structure for the course Introduction to the Use of Computers may make it easier to get started, as may the changes made to the orientation session for new students.

Teacher tutoring

Many students think the individual guidance sessions with the tutor are more helpful than the larger meetings. Tutoring offers students information and may help the student commit to completing the degree. Students are required to make a written study schedule, which helps outline the studies and clarify personal goals.

Advancement of studies

It is generally the student’s own fault if he or she interrupts his or her studies, which is usually done voluntarily. The chances to find a job are good even without a degree, for example, and that can be an incentive to leave without a degree.

Some courses may create a bottleneck, suspending studies for a while, which may decrease student motivation.

Teaching and studying environmant

Information and materials

The information of the department is easy to obtain, with the extensive web pages that are kept up-to-date. When teaching compendia and the slide material from lectures is available on the web, it is easier to complete exercises. Information is usually easy to find on the department web pages.

The study programme is published on the web in good time before each term, and it is updated regularly. The department has posted instructions on how to write a Master's thesis and how to complete project work on the web.

Compendia of the material of several courses are sold at a facile price.

Tools for teaching

The tools used for teaching are up-to-date. The use of data projectors and computers is common at both lectures and exercise sessions, which makes it easier to follow e.g. programming exercises.

Languages of teaching

There is a sufficient amount of teaching in English. On the basic level, exercise sessions are arranged in English at least once a year, and project instructors give guidance in English if necessary. Many *Laudatur*-level courses are lectured in English if there are foreign student attending.

There is no teaching in Swedish except the course Introduktion till datorn som arbetsredskap (Introduction to the Use of Computers) and one group for the course Scientific Writing. Sometimes exercise groups are given in Swedish.

Terms

Study scheduling is made more flexible with the possibility to have credits awarded in the middle of terms. Sometimes the courses lasting only half a term, which were introduced as part of the degree reformation, can be too intensive.

The lab courses and software engineering project, which demand intensive work, can be taken during the summer, giving students a better chance to concentrate their efforts.

Facilities

There is a sufficient amount of state-of-the-art computers in the department's computer classes.

The department library is very good and there are reading hall copies of all the important course books. Course books can be taken out as evening or weekend loans. Sometimes, the staff keeps the books to themselves for inordinately long periods.

Students have study rooms and a room to rest in.

Teaching staff

The teaching at the department is of good quality. The department has several very good teachers who have been rewarded for their teaching skills. The lecturers are competent scientifically and give expert lectures.

For the students it is good that there are also young part-time teachers and assistants at the department. Especially at exercise sessions, the ambience is better and freer when the instructor can imagine themselves in the students' place and can remember what was difficult for a student.

Students in the department community

The students could be more committed to their studies at the department. Raising respect among students and improving the department's image in comparison with other institutions are challenges the department should meet.

The commitment to the department is improved when the department offers work to students before they have graduated. Students are recruited as part-time teachers, and students can integrate into the research teams before graduating.

Co-operation

The co-operation with the industries does not show in teaching, there are few guest lecturers from business ventures, and only at special courses. The students have sufficient contacts with the industries through working.

The mathematics and computer science departments have a great deal of students in common, but the co-operation between the departments is fairly insignificant, at least in teaching. Thus this common body of students is a possibility that could be utilized more.

Computer science is a useful minor subject for students in many disciplines. The amount of minor subject students has not been restricted too much at the department. Minor subject students may bring new viewpoints with them to the department.

Training for the working life

It is easy for students of computer science to get work experience. In addition to the jobs in the private sector, there are apprenticeships funded by the government that the department can help in procuring. The research teams at the department take summer

apprentices.

The quality of the degree

The degrees offered at the department have a high quality and are compatible both in a national and an international context. The matter to be taught should not be trivialised to enable more degrees, but the requirements should be kept at the present level. The study modules are well structured and form a clear continuum. The degrees generally offer good qualifications for the working life.