Master Program Guide 2008-2009 Computer Science and Engineering

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1. The Department and Master programs

The Department of Mathematics and Computer Science (W&I) at the *Technische Universiteit Eindhoven* (TU/e) offers undergraduate (Bachelor of Science), graduate (Master of Science) and postgraduate courses in Applied Mathematics and Computer Science.
The Mathematics Division focuses on Discrete Mathematics, Stochastics and Optimization, and Scientific Computing and Analysis. The Computer Science Division (CS) is mainly concerned with Specification and Verification, Algorithms and Visualization, Software and Systems Engineering, Information Systems, and Security. Department members take part in numerous research projects, cooperating with other universities and commercial enterprises, both nationally and internationally.

The Mathematics and Computer Science Department offers four Master of Science degrees: Industrial and Applied Mathematics (IAM) in the Mathematics Division, and three in the Computer Science Division:

- Computer Science and Engineering (CSE),
- Business Information Systems (BIS), in cooperation with the Department of Technology Management,
- Embedded Systems (ES), in cooperation with the Department of Electrical Engineering.

In addition, two special Master of Technological Design (PDeng) programs, viz. Mathematics for Industry and Software Technology, which are exemplary because of the Mathematics and Computer Science Department's emphasis on applications, are also offered.
This master program guide applies to the Master of Science in Computer Science and Engineering program and is intended for all CSE students. A master program guide is also available for the Master of Science in Business Information Systems, in Embedded Systems and in Industrial and Applied Mathematics.

Suggestions for improvements, amendments or changes can be directed to the editor, E.F.Kaasschieter@tue.nl.

2. academic administration

2. Academic Administration

2.1 Academic administration of the department

The structure of the academic organization is based on the Academic Administration Structure Modernization Act (MUB), as implemented in the academic year 1997-1998. A student may contribute to the improvement of the academic organization as a member or advisor on the Department Board, the Study-program Committee or the Department Council. Participation in these organizations offers special privileges, such as facilities for oral instead of written exams or extra opportunities for taking examinations outside regular scheduling.

Important organizations:

- The Department Board (*Faculteitsbestuur*);
- The Study-program director (*Opleidingsdirecteur*);
- The Study-program Committee (*Opleidingscommissie*);
- The Examinations Committee (*Examencommissie*);
- The Department Council (*Faculteitsraad*);
- The CS Division and Professors (*Capaciteitsgroep en Hoogleraren*);
- The CS Division Board (*Capaciteitsgroepsbestuur*);
- The Department Office (*Faculteitsbureau*);
- The Student Council (*Studentenraad*).

2.1.1 Department Board

The Department Board appoints a study-program director for each master program. The study-program director is mandated to develop, organize and implement the master program. Although some authority is delegated to the study-program director, the Department Board retains final responsibility for each graduate program. This means that the study-program director must report to the Department Board. The Department Board establishes the education and examination regulations (OER) and the program budget, and oversees the implementation of the master program. The Department Board is comprised of three members: the dean and chairperson, the vice-dean and the managing director. A study advisor also participates in the board meetings. Other attendees at the board meetings are the division chairs, the policy advisors, and the department secretary.

The current members of the Department Board are:
Dean: prof.dr. K.M. van Hee.
Vice-dean: prof.dr. A.M. Cohen.
Managing director: mr.drs. P.M.L. Tijssen.

2.1.2 Study-program director

Every year the study-program director outlines in the OER the academic program and policies, including the program structure and curriculum. He develops the program curriculum in close consultation with the teaching staff. The Study-program Committee advises the study-program

director on long-term strategies and policies on academic principles and goals, and on the exit qualifications of the Master degree. The study-program director is in charge of the development and implementation of a quality management system. The Study-program Committee advises the study-program director on his curriculum and quality plans. In addition, the study-program director advises the Division Board on the academic program. Whenever necessary, he also advises the Division Board on quality improvement and performance of the academic staff.

The study-program director relies on the Department Office for administrative and managerial support. The Department Office also advises the study-program director on academic issues. The study-program director for CSE is prof.dr.ir. J.F. Groote, and the study-program assistant director is dr.ir. M.L.P. van Lierop.

2.1.3 Study-program Committee

The OCI (*Opleidingscommissie informatica*) is the Study-program Committee for the Computer Science Division. The OCI is appointed by the Department Board and is comprised of six members.

The tasks of the OCI are:

- to advise the study-program director and the Department Board on issues relating to the OER;
- to annually evaluate the implementation of the OER:
- to advise on all issues relevant to the academic program.

The current members of the OCI are:
Staff members: dr. A.T.M. Aerts, prof.dr. J.C.M. Baeten (chairperson) and dr. C. Huizing.
Student members: F.F.J. Hermans, I. van der Linden and C. Tankink.

2.1.4 Examinations Committee

The Department Board appoints faculty members to sit on the Examinations Committee. The Examinations Committee is responsible for the organization and coordination of exams and all ensuing activities. The Examinations Committee appoints all examiners in accordance with the Higher Education and Research Act (WHW), article 7.12.

The Examinations Committee establishes exam rules of conduct applicable to both students and examiners. These rules and regulations on proper behavior also stipulate disciplinary measurements and sanctions in case of violation.

The following are currently appointed members of the Examinations Committee:
Chair: prof.dr. K.M. van Hee.
Secretary: dr. E.F. Kaasschieter.
Members: prof.dr.ir. W.M.P. van der Aalst, prof.dr. J.C.M. Baeten, prof.dr. M.T de Berg, prof.dr. P.M.E. De Bra, prof.dr. M.G.J. van den Brand, prof.dr. S. Etalle, prof.dr.ir. J.F. Groote, prof.dr. K.M. van Hee, dr. J.J. Lukkien and prof.dr.ir. J.J. van Wijk.
Advisors: dr. C.J. Bloo, dr.ir. M.L.P. van Lierop and dr. J.C.S.P. van der Woude.

2.1.5 Department Council

The Department Council is an important link in the decision making process. The Department Council exercises advisory and approval rights on issues concerning the responsibility areas of the Department Board. The Department Board must obtain the aforementioned approval on all decisions concerning adaptation or other amendments to the department regulations and the OER. The Department Council is comprised of 5 staff members and 5 elected student members.

The following currently sit on the Department Council:
Staff members: ir. M.A.A. Boon, dr. H.J. Haverkort, ir. J.C.H.W. in 't panhuis, ir. D.A. Roozemond, and M.A.C.M. de Wert.
Student members: T.A. Delissen, M. Hendriks, F.F.J. Hermans, B.J.A. Laarhoven, and I. van der Linden.

2.1.6 CS Division and professors

The general tasks of the CS Division are:

- to contribute to the preparation and implementation of the educational and exam programs;
- to contribute to the research programs;
- to contribute to the interdepartmental and inter-university education and research programs.

In addition, the CS Division Board aims to come to agreement with the study-program director on issues of quantity and quality of academic staff.

The tasks of the professors are:

- to develop their assigned research areas;
- to advise the study-program director on the contents of the educational program.

Division secretary:
M.M.W.G. van den Bosch-Zaat, telephone number (040)(247) 5010.

Section Algorithms and Visualization (AV)

Visualization (VIS) Group:
Full professor: prof.dr.ir. J.J. van Wijk.
Part-time professor: prof.dr.ir. R. van Liere
Assistant and associate professors: dr. C. Huizing, dr.eng. A.C. Jalba, dr.ir. A.C. Telea, and dr. M.A. Westenberg, dr.ir. H.M.M. van de Wetering.
Technical staff: E. Melby.
VIS Group secretary:
M.M.W.G. van den Bosch-Zaat, telephone number (040)(247) 5010.

Algorithms (ALG) Group:
Full professor: prof.dr. M.T. de Berg.
Part-time professor: prof.dr. K.I. Aardal.
Assistant and associate professors: dr. H.J. Haverkort, dr. B. Speckmann, and dr. A. Wolff.
ALG Group secretary:
A.D. Volkers, telephone number (040)(247) 5155.

Section Information Systems (IS)

Databases & Hypermedia (DH) Group:
Full professor: prof.dr. P.M.E. De Bra.
Part-time professors: prof.dr.ir. G.J.P.M. Houben, prof.dr. J. Paredaens.
Assistant and associate professors: dr. A.T.M. Aerts, dr. T.G.K. Calders, and dr. M. Pechenizkiy.
Technical staff: dr.ir. H.M.W. Verbeek.
DH Group secretary:
M.A. van Buul, telephone number (040)(247) 2733, M. Kemper, telephone number (040)(247) 2602.

Architecture of Information Systems (AIS) Group:
Full professors: prof.dr.ir. W.M.P. van der Aalst and prof.dr. K.M. van Hee.
Assistant and associate professors: ir. W.F. Rietveld, dr. N. Sidorova, dr. L.J.A.M. Somers, dr. M. Voorhoeve, and dr. J.C.S.P. van der Woude.
Technical staff: dr.ir. H.M.W. Verbeek.
AIS Group secretary:
M.A. van Buul, telephone number (040)(247) 2733, M. Kemper, telephone number (040)(247) 2602.

Section Specification and Verification (SV)

Formal Methods (FM) Group:
Full professor: prof.dr. J.C.M. Baeten
Part-time professor: prof.dr. H. Brinksma.
Assistant and associate professors: dr. S. Andova, dr.ir. P.J.L. Cuijpers, dr. R. Kuiper, dr. S.P. Luttik, dr. R.P. Nederpelt, dr. S.M. Orzan, and dr. E.P. de Vink.
Technical staff: dr. E.J. Luit.
FM Group secretary:
A.D. Volkers, telephone number (040)(247) 5155.

Design and Analysis of Systems (OAS) Group:
Full professor: prof.dr.ir. J.F. Groote.
Part-time professor: prof.dr. J.H. Geuvers.
Assistant and associate professors: dr.ir. R.R. Hoogerwoord, dr. M.R. Mousavi, dr.ir. M.A. Reniers, dr.ir. J.W. Wesselink, dr.ir. T.A.C. Willemse, and dr. H. Zantema.
Technical staff: dr.ir. J.W. Wesselink.
OAS Group secretary:
M.M.W.G. van den Bosch-Zaat, Telephone number (040)(247) 5010.

Section Software and Systeem Engineering (SSE)

Software Engineering and Technology (SET) Group:
Full professor: prof.dr. M.G.J. van den Brand.
Assistant and associate professors: dr.ir. L.G.W.A. Cleophas, dr.ir. M.G.J. Franssen, drs. H.P.J. van Geldrop-van Eijk, dr.ir. C. Hemerik, dr.ir. T. Verhoeff, and dr.ir. G. Zwaan.
Technical staff: ir. E.T.J. Scheffers.

SET Group secretary:
J.E. Driever, telephone number (040)(247) 5145.

System Architecture and Networking (SAN) Group:
Professor: prof.dr. J.J. Lukkien.
Part-time professor: prof.dr.ir. C.H. van Berkel.
Assistant and associate professors: dr.ir. R.J. Bril, dr. M.R.V. Chaudron, drs. R.H. Mak, dr. T. Ozcelebi, dr. P.D.V. van der Stok, and dr. J.P. Veltkamp.
Technical staff: dr.ir. P.H.F.M. Verhoeven.
SAN Group secretary:
C.M.M. Brouwer-van der Most, telephone number (040)(247) 8309.

Security (SEC) Group:
Professor: prof.dr. S. Etalle
Part-time professor: prof.dr. B.F.P. Jacobs
Assistant and associate professors: dr. J.L. den Hartog
SEC Group secretary:
J.G.W. Klooster-Derks, telephone number (040)(247) 5141.

2.1.7 Department Office

The Department Board delegates day-to-day operations to the Department Office. The managing director heads the Department Office, which is sub-divided into six offices:

- Human Resource Management (HRM) Office,
- Financial Services Office,
- Computer Services Office (BCF),
- Management Support Office,
- Education Office,
- Public Relations.

The managing director of the Department Office is mr.drs. P.M.L. Tijssen.

The following are members of the staff of the Department Office:

Department Secretarial Services:
Head: M.P.M. de Faber.
Secretarial assistant: P.C.J. Gudden-van den Boomen, telephone number (040)(247) 2750.
Administration: J.G.A. Brandts-Steenbergen.
General and janitorial services: J.W. Schellekens.

HRM Office:
Head: P.J. Evers b.c.
Staff: A. Boekema, C.M. van Dam, and L.G. van Kollenburg-Walraet.

Financial Services Office:
Head: M.C.H. Hoff b.a.
Staff: Y.H. Borg-Soedira, Y.H. Borg-Soedira, J. den Braven bc, F. Haassen, and H. de Morrée.

Computer Services Office:
Head: ir. M. van der Woude.
Staff: R.L.M. Beckers, S. Hoop, V.B. Huijgen, and J.P.H. Hunnekens.

Management Support Office:
Policy advisor Mathematics: ir. H.J.M. Wijers.
Policy advisor Computer Science: dr. D.M. de Haan.

Education Office:
Head: dr. E.F. Kaasschieter.
Student Administration:
Staff: J. Berger-van der Aalst, E. van den Hurk, W.T.A. Linders, J.M.L.G. Sanders, and M.J.C.P. de Wit-van Geenen.
Bachelor study advisor: dr. C.J. Bloo.
Secretarial services: G. van der Linden-Cocu (CS) and C. Welten-Verhulst (Math).
Educationalist: dr.drs. J. C. Perrenet.

Public Relations:
Head: drs. J.M.F. Horvath-Notten.
Members: Y.H.M. Houben en M.L.M. Theunissen.

2.1.8 Student Council

The Student Council's (SR) main goal is to help solve problems in the educational process. These problems may have to do with exams, timetables or teachers, but the SR also mediates in cases where individual students encounter problems. Students with questions or complaints can contact the SR via:

- meetings that are scheduled on Mondays from 12:45 to 13:15 in room HG 5.95 (only during course weeks);
- or via an e-mail to: sr@win.tue.nl or klachten@gewis.nl.

In addition, the SR forms a link between the students and the faculty, the university as a whole, and other organizations.
Furthermore, the SR considers ways to improve the education program and department administration.
Finally, the SR attempts to stimulate communication between members of the Education Council (OCI), the Department Council (FR), the University Council (UR) and the Student Advisory Body (SAO).

2.2 Facilities

2.2.1 Buildings

Regulations on access to university buildings are described in the departmental chapter of the student statutes, see w3.tue.nl/nl/diensten/stu/regelingen_en_gedragscodes/studentenstatuut. Regulations on the use of computer rooms are outlined on the website at www.win.tue.nl/reglementen. For oral English explanation of these regulations, contact the Computer Services Office in room HG 8.73, telephone number (040)(247) 2802 or e-mail wshelp@win.tue.nl.

2.2.2 Lecture rooms, halls and other instruction facilities

Lecture rooms and halls are managed at institutional level by W.M. Timmermans, Auditorium 2.08, telephone number (040)(247) 2645. Reservations of the meeting and instruction rooms HG 5.95, 6.01, 6.05, 6.05a, 6.29, 8.39 and 8.61 can be arranged through the department secretary, telephone number (040)(247) 2750.

2.2.3 Library services

Library services are provided for all department employees and students. The library collection reflects the departmental scientific specialization in research and education. Opening times are Monday through Friday from 9:00 to 17:00. The department library is located in room HG 6.47. Students also have free access to the central library and all other departmental libraries. For further information, please consult the student statute.

Literature search:
In addition to its own search catalog VUBIS, the library also offers online bibliographical searching facilities.

Inquiries:
For further information, please contact the department librarian ir. E.J.M. Jacobs, or the other library staff members, M.G.J.M. Vringer, Y.J.W. Verplak, and P. Hafedi-Ghezelji, reachable at telephone number (040)(247) 2766 or e-mail wiskeninf.bib@tue.nl.
Additional information on the library of the TU/e, circulating regulations etc. can be found at the web pages of the library: www.tue.nl/bib.

2.2.4 Sale of study materials

Study material can be bought at the (lecture) notes warehouse subdivision Notes Sale (“*Dictatenverkoop”*). Daily opening hours are from 9:00 to 16:00. The warehouse is closed during introduction week. Inquiries can be made at: HG -1.42, telephone number (040)(247) 2446.
For book sales at discount prices, please refer to section 2.3.

2.2.5 Computer Services Office

The tasks of the Computer Service Office (BCF) are:

- to provide computer facilities;
- to provide user support;
- to administer student accounts on the student server “svstud”, a Linux-server for the students of the department;
- and to manage the use of computer rooms HG 8.63 and 5.48.

Students can print at printers close to HG 5.48 and at the tenth floor. Working locations for notebook use are available in HG 5.48, and also in the lounge at the eighth floor for quick notebook use. The OGO-rooms at the tenth floor can be used for notebooks in case they are not scheduled for teaching. Details on the regulations on the use of the computer facilities can be accessed at www.win.tue.nl/reglementen. For problems with student e-mail accounts, please contact the ICT Information and Service Desk at LG 1.94, telephone number (040)(247) 4649. The Notebooks Help Desk is located at HG 8.86, telephone number (040)(247) 2979. The BCF Help Desk is located in room HG 8.73. The opening hours of the BCF Help Desk are Monday through Friday from 9:00 to 17:00. Telephone number (040)(247) 2802, e-mail: wshelp@win.tue.nl, www.win.tue.nl/bcf.

2.3 Study association GEWIS

The study association GEWIS (union of math- and computer-science students) was founded over 25 years ago. GEWIS champions student rights, promotes student interests and offers students extracurricular activities. It organizes excursions to national companies and tries to organize an international study trip on a regular basis. It organizes the freshmen introduction week and the weekly drink on Thursdays from 16:30 until 19:00 in HG 10.52.
GEWIS publishes a magazine "Supremum", a yearbook, and organizes sporting events, (sailing-) weekends, parties and numerous other activities. On request, it is possible to organize an informal gathering at GEWIS. On Mondays, Wednesdays and Fridays from 12:30 to 13:30, GEWIS provides a book sale in HG 10.52, offering study books at reduced prices. In addition, the GEWIS-website offers old exams.
GEWIS can be reached at: HG 10.52, telephone number (040)(247) 2815, e-mail: bestuur@gewis.nl and www.gewis.nl.

2.4 Information resources

Current information on program changes, changes in the course schedules, practical courses, exams and other important matters is available as listed below:

Leading information on the program:

- The master program guide is available in print at the desk at the Student Administration office and digitally on the website. It contains the Education and Examination Regulations and Examination Rules and Procedures in chapter 6.

Personal contact at the department:

- The master study advisor: dr. J.C.S.P. van der Woude in room HG 7.79, consulting-hours at Monday from 17:00 to 18:00, and at Wednesday from 11:45 to 13:15 or e-mail J.C.S.P.v.d.Woude@tue.nl.

Study advisor dr. J.C.S.P. van der Woude

- Student Administration in room HG 6.45 (inquiries desk) or at telephone number (040)(247) 2379, for general information and inquiries about study arrangements, regulations, schedules and calendars and study results. The opening times of the inquiries desk are for students from 11:00 to 12:00, and from 13:00 to 15:00.
  International students coordinator: W.T.A. Linders in room HG 6.31, telephone number (040)(247) 5160 or e-mail W.T.A.Linders@tue.nl.
- The Student Association GEWIS is in room HG 10.52 or at telephone number (040)(247) 2815.

Personal contact at the university:

- The Student Service Center is in room HG 0.72 or at telephone number (040)(247) 8015 for general information and inquiries about financial aid, student assistantships, admissions, university passes, exam regulations etc.
- International student affairs: International Office in room HG 0.72, telephone number (040)(247) 8015 or e-mail io@tue.nl.

Several internet sources of information are available:

- The website at w3.tue.nl provides general TU/e information.
- Information about the department, academic counseling, social events and activities, etc. can be found at w3.win.tue.nl.
- The electronic course catalog can be accessed at owinfo.tue.nl and contains current course information. Also examinations and course schedules are available at this webpage.
- Information about education in computer science is available at w3.tue.nl/en/services/cec/study_information/masters_programs/computer_science_and_engineering.

At the start of each semester kick-off meetings are organized to inform CSE-students on relevant issues.

3. general course and program information

3. General Course and Program Information

This chapter provides information about the structure and organizational aspects of the master programs. The CS Division offers several master programs, all with some aspects in common. The focus of this chapter is on these commonalities.

3.1 Master programs

Four master programs are offered, one of which is offered as a specialization within the master program CSE. This is in anticipation of an independent status as a full master program in the future:

- Computer Science and Engineering (CSE). This master program has a specialization:
  - Information Security Technology (IST), an interdisciplinary variant in cooperation with the Mathematics Division, the Radboud University in Nijmegen, and the University Twente.
- Business Information Systems (BIS), an interdisciplinary master program in cooperation with the Department of Technology Management (TM),
- Embedded Systems (ES), an interdisciplinary master program in cooperation with the Department of Electrical Engineering (ES).

The CS Division also contributes in the Computer Science specialization of the master program Science Education and Communication (SEC), offered by the Eindhoven School of Education (ESoE), see www.esoe.nl/onderwijs. Graduates in the CS specialization from the program are entitled to teach computer science at Dutch high schools. Graduates from one of the above mentioned master programs will also be admitted to the SEC-program and are offered a one-year program.

The special flavors of the CSE and IST master programs and their translation into details of substance will be discussed in the next chapter.

3.2 Goals

After the master program, the graduates will have the following competences:

1. a. In-depth knowledge of the foundations of computer science.
   b. Insight into formalisms, methods, tools and their mutual relations.
   c. Insight into the relationships within the field of computer science and the power to follow important topical developments within the field.
2. a. Be capable of designing or redesigning complex computerized systems in a structured way, to allow these systems to carry out their tasks in a correct and efficient way.
   b. Have sufficient insight into the principles of design methods to make an argued choice for a specific methodology for a concrete situation.
3. a. Be capable of carrying out research assignments in a responsible scientific fashion and be able to report about the assignments.

3.3 Structure of the master programs

All programs comprise two years of study or 120 credit points (ects); a credit point is equivalent to 28 hours of study and homework. The courses are standardized to 5 credit points per course. The two years of course work and practical training are divided into three parts, consisting of:

1. Mandatory core courses to create a sufficient layer of theory and general or program related knowledge.
2. Elective courses will serve as preparation for the specialization. For CSE-students it is possible to allot up to 20 credit points towards an internship with approval in advance from the examinations committee. Students with a slightly different background may need to allot some electives to compensate for deficiencies.
3. Master project and thesis to be spent on a specialist topic of theoretical or practical nature. This part presents the opportunity to show your independent engineering and academic skills in research and design.

3.4 Lecture and interim examination periods

Each study year is divided into two semesters (September – January and February – July). Each semester consists of a lecture period of three blocks of five weeks separated by interim examination periods of one week and followed by an examination period of three weeks. For details see the agendas and calendars at owinfo.tue.nl.

3.5 Examination and titles

There is only one examination at the end of the program. It consists of final course results and the final master project grade. Completion of the program will lead to the title: Master of Science (MSc) with addition of the name of the program. Graduates are also entitled to use the Dutch title of *ingenieur* (*ir*). For more information see the examination requirements in section 6.2.

3.6 Admissions

General and specific master program requirements are applicable to admissions. The specific requirements may be higher in terms of knowledge prerequisites, but may also provide more possibilities for entry for students from other related areas of specialization.

3.6.1 General admissions requirements

To be eligible for admission to any of the master programs, a Bachelor of Science degree comparable to a Bachelor of Science Degree in Computer Science is required. This degree must be of an equivalent academic level and approximate scientific content as the corresponding Dutch BSc degrees. In addition, sufficient proficiency in the English language is necessary.

3.6.2 Admissions with deficiencies

For students from other universities, a limited portion of the electives may be used to eliminate deficiencies. Arrangements must be made in advance in conjunction with the study advisor, the admissions committee and the Examinations Committee.

3.6.3 Dutch students

In general, students with a Dutch university BSc degree in Computer Science are admissible to the program without prior clearing from the admissions committee.

3.6.4 Foreign students

The applications of students with a foreign university BSc degree in Computer Science will be evaluated by the admissions Committee, taking into account both the academic level of the degree and the subjects studied by the applicant. In some special cases, relevant work experience may also be considered. The level of the degree is determined by the NUFFIC (www.nuffic.nl).

3.6.5 Admissions procedure

The procedure to be followed depends on your particular situation. Detailed information on the application procedure can be found on the site of the Student Service Center of the TU/e, w3.tue.nl/en/diensten/cec/study_information/studying_at_tue/admission. Foreign students must be aware that the admissions procedure, including visa application and other formalities, may take a while.

3.6.6 Pre-master program for polytechnic graduates (HBO)

Students who have completed a polytechnic program of computer science are eligible to participate in the pre-master program. Completion of the pre-master program gives access to the master program in Computer Science and Engineering.
Students who have completed another polytechnic program, but do wish to do the pre-master program that gives admission to the CSE master program, are individually assessed by the admissions committee of the master program. This assessment results in an individual decision of the admissions committee concerning admission to the (possibly adapted) pre-master program.

The pre-master program that a student with a completed polytechnic program of computer science has to follow consists of the following units of in total 30 credit points:

Block	Code	Program unit	Credits
A	2DL03	Basic mathematics	3
B	2DL04	Calculus A	3
A-C	2ID05	Datamodeling and databases	6
A-C	2IT05	Logic and set theory	6
C	2DL06	Linear algebra	3
C	2DL07	Statistics A	3
D-F	2IT15	Automata and process theory	6

Those taking the pre-master program for polytechnic graduates are required to include some units of the bachelor program *Technische Informatica* as homologation units in the elective part of the master program:

Block	Code	Program unit	Credits
A-B	2IJ26	Algebra *	3
A-C	2IT25	Discrete structures *	6
A-C	2IW05	Software specification	6
D-F	2IL05	Data structures	6

*) The students in the specialization IST include Discrete structures (2IT25). The regular students in the standard CSE program include Algebra (2IJ26).

Those taking the pre-master program for polytechnic graduates may be given permission to take part in some of the units of the master program. A necessary condition for permission is that the student has at least scored 15 credit points from the pre-master program.
Those taking an adapted or individually composed pre-master program in the bachelor program may be given permission to take part in some of the units of the master program, or may be allowed to follow altered or entirely different units from the master program.
The students that wish to take study components from the master program must submit a request to this effect as a contracting party to the TU/e. The form needs to be signed the pre-master coordinator or the study advisor.
If the request is granted, then the period of enrolment is set; this may be a maximum of one year on the condition that it is not longer than the enrolment of the student in the bachelor program.

The pre-master coordinator is dr.ir. M.L.P. van Lierop, HG 6.44, Telephone number (040)(247)3022.
The study advisor is dr. J.C.S.P. van der Woude, HG 7.79, telephone number (040)(247)5146.

4. master program specifics

4. Master Program Specifics

This master program exists, informally, in two variants. One goes under the generic name CSE and is considered to be the main program. The other is IST (Information Security Technology), a so-called master-specialization. IST cooperates with the Mathematics Division, the Radboud University in Nijmegen and the University Twente, and is meant to become an independent master program in the future. These two variants will be addressed separately below.

Chapter 5 presents some information about the area of expertise dependent specializations that can be chosen.

4.1 Computer Science and Engineering

The master program in Computer Science and Engineering (CSE) at TU/e is a challenging two-year program. It rests on a sound theoretical foundation with an emphasis on design in general, and on the design of quality software in particular. As a graduate, you will have developed a scientific attitude and an engineering approach to the general field of Computer Science. You will be able to play a leading role in the development of the field, either in scientific research, in industry, commerce or governmental organizations. The focus is on the design of efficient and reliable software systems. The complexity of these systems is the main (and intriguing) problem, especially in the common case of several communicating systems that are working in parallel. In order to construct dependable protocols for the behavior of such systems, you need knowledge of algorithms, performance, hardware, methods of design and documentation, and an insight into the variability and maintainability of these protocols.

4.1.1 Curriculum

As mentioned in section 3.3, the curriculum is divided in three parts. The mandatory part of the curriculum is 30 credit points and consists of a choice of five courses out of a collection of eight courses that give an indication of each of the eight areas of expertise:

Block	Code	Program unit	Credits
A-C	2IF25	Formal methods	5
A-C	2IL45	Advanced algorithms	5
A-C	2IN25	Real-time architectures	5
A-C	2IS15	Generic language technology	5
A-C	2IV35	Visualization	5
A-C	2IW25	Requirement analysis, design and verification	5
D-F	2ID45	Advanced databases	5
D-F	2II55	Business process management systems	5

Additionally CSE students should follow a seminar to prepare for their master project. There will be a seminar for each area of expertise in which typical research issues for that field will be treated.

Block	Code	Program unit	Credits
A-C	2IF95	Seminar formal methods	5
A-C	2II95	Seminar information systems	5
A-C	2IL95	Seminar algorithms	5
A-C	2IN95	Seminar systems architecture and networking	5
A-C	2IS95	Seminar software engineering and technology	5
A-C	2IV95	Seminar visualization	5
A-C	2IW95	Seminar design and analysis of systems	5
D-F	2IC95	Seminar security	5
D-F	2II95	Seminar information systems	5

The elective part of the curriculum amounts to 60 credit points and it consists mainly of courses. The elective courses offered by the division of computer science are listed in section 4.3. In general, curricular courses from other computer science master programs are acceptable too. Other electives may be selected whenever this leads to a better preparation for the final master project. Approval in advance by the examinations committee is required.
In some cases, an internship may replace some electives. In section 4.3.1 the details of this possibility are discussed.

4.1.2 Master project

The Master project is a project of 30 credit points (half a year) and it can be completed in any of the fields of expertise in the department, as long as a staff member is supervising it. The CS division has nine areas of expertise, each offering specialization courses. For details on the interests in the areas of expertise please refer to chapter 5.

The preparation that is needed for a successful master project in one of these specializations can be achieved through careful elective selections and following the appropriate seminar. In order to compose a well-balanced program that provides adequate prerequisites for the final project, it is advisable to first choose and consult a project supervisor in the area of expertise of your interest before scheduling elective courses. You may also want to consult the study advisor.
For the requirements to be met by students for master project work, please refer to section 4.4 on planning and to the graduation regulations in section 6.2.

4.1.3 Further details

- The program director is prof.dr.ir. J.F. Groote, e-mail: J.F.Groote@tue.nl.
- The study-program assistant director is M.L.P. van Lierop, e-mail: M.L.P.v.Lierop@tue.nl.
- The study advisor is dr. J.C.S.P. van der Woude, e-mail: J.C.S.P.v.d.Woude@tue.nl.
- For more information consult the CSE webpage w3.tue.nl/en/services/cec/study_information/masters_programs/computer_science_and_engineering.

4.2 Information Security Technology

A Master of Science in Information Security Technology (IST) is an academic expert in the area of digital communication in general, and in information security technology in particular. Information security technology protects data that are stored, transmitted, accessed or modified against all kinds of threats. This can vary from unauthorized access to malicious manipulations. Information security technology is essential for secure communication and data protection in many situations.

The IST program is a joint master program between three Dutch universities: Eindhoven University of Technology (TU/e), Radboud University in Nijmegen (RU), and University of Twente (UT). These three universities have joint their forces with respect to security education in the Kerckhoffs Institute (see www.kerckhoffs-institute.org). Each of the mandatory and special elective courses is taught at only one of these three universities. This implies that students have to travel to other sites for part of their education. The program is set up in such a way that, averaged over the two years of their master's studies, students will have to travel one day per week to another university.

A Master of Science in Information Security Technology can become involved in cryptographic primitives, security protocols, data storage, communication, or information security management. Additionally, he or she can act as internal or external consultant, regarding the security of information systems and networks, or regarding the security policy of an organization. A Master in Information Security Technology can enter a job in the following institutions: research laboratories and academic institutes (both for theoretical and applied work); applied R&D in industry; the financial world; governmental agencies; consultancy agencies (all with respect to security in the area of information systems and relevant policymaking).

4.2.1 Curriculum

The curriculum consists of both computer science courses and mathematics courses. Below is an overview of the program.

Block	Code	Program unit	Credits	Location
First year				
A-C	2IF05	Introduction to computer security	6	Twente
A-C	2WC12	Cryptography 1	6	Eindhoven
D-F	2IF02	Verification of security protocols	6	Eindhoven
D-F	2IF06	Software security	6	Nijmegen
		Elective courses*	36	
Second year				
A-C	2IF07	Security in organizations	6	Nijmegen
A-C	2IF08	Network security	6	Twente
A-C		Elective courses*	18	
D-F	2IM91	Master project	30	

*) At least three elective courses must be chosen from the list of electives for IST.

4.2.2 Electives for IST

In this section a collection of courses at MSc-level is outlined. Items on this list can be selected as electives towards degree completion for the master specialization IST. Also the general CSE-electives (see section 4.4) can be selected, but at least three elective courses must be chosen from the list of electives for IST:

Block	Code	Program unit	Credits	Location
First year				
A-C	2IF09	Biometric recognition	6	Twente
A-C	2IF11	Distributed trust management	6	Eindhoven
A-C	2WC14	Linux kernel and hacker's hut	6	Eindhoven
D-F	2IF03	Seminar information security technology	6	Eindhoven
D-F	2IF13	Privacy seminar	6	Nijmegen
D-F	2WC13	Cryptography 2	6	Eindhoven
Second year				
A-C	2IF14	Hardware and operating system security	6	Nijmegen
A-C	2IF15	Secure data management	6	Twente

4.2.3 Master project

The master project can be completed under supervision of the staff of any of the groups in the department, provided the program and the subject are chosen in agreement with the study-program manager.
For requirements with respect to the start of the master project, please refer to section 4.4 on planning and to the graduation regulations in section 6.2.

4.2.4 Further details

- The study-program manager is dr.ir. L.A.M. Schoenmakers, e-mail: L.A.M.Schoenmakers@tue.nl.
- Students with a Bachelor's degree in Computer Science or Mathematics from another university or with a different background will have to submit their curriculum to the admissions committee for evaluation and approval. Very likely, these students will have to go through a special homologation phase that takes place during the first term of the program.

4.3 Electives

In this section a collection of courses at MSc-level is outlined. Items on this list can be selected as electives towards degree completion for all master specializations, as far as they were not yet mandatory for the specialization in question. For these electives it is not necessary to request approval to the Examinations Committee in advance.

Block	Code	Study component	Credits
A-C	2ID25	Information retrieval	5
A-C	2ID55	Adaptive systems	5
A-C	2IF25	Formal methods	5
A-C	2IF35	Formal modelling in cell biology	5
A-C	2II35	Web information systems	5
A-C	2II45	Software architecting	5
A-C	2II65	Metamodeling and interoperability	5
A-C	2IL35	I/O-efficient algorithms	5
A-C	2IL45	Advanced algorithms	5

Block	Code	Study component	Credits
A-C	2IN25	Real-time architectures	5
A-C	2IS15	Generic language technology	5
A-C	2IS25	Distributed trust management	5
A-C	2IV05	Additional component computer graphics	5
A-C	2IV35	Visualization	5
A-C	2IW25	Requirement analysis, design and verification	5
A-C	2IW45	Programming by calculation	5
A-C	2IW55	Algorithms for model checking	5
D-E	2IN35	VLSI programming	5
D-F	2ID45	Advanced databases	5
D-F	2IF45	Process algebra	5
D-F	2IF65	Proving with computer assistance	5
D-F	2II55	Business process management systems	5
D-F	2II75	Business process simulation	5
D-F	2II85	IT-governance	5
D-F	2IL55	Geometric algorithms	5
D-F	2IP45	Software project management	5
D-F	2IS35	Verification of security protocols	5
D-F	2IV55	Interactive virtual environments	5
D-F	2IW15	Automated reasoning	5
D-F	2WX04	Communication skills *	3
Capita selecta			
	2IS99	Capita selecta software engineering and technology	5
	2IC99	Capita selecta security	5
	2ID99	Capita selecta databases and hypermedia	5
	2IF99	Capita selecta formal methods	5
	2II99	Capita selecta architecture of information systems	5
	2IL99	Capita selecta algorithms	5
	2IN99	Capita selecta systems architecture and networking	5
	2IV99	Capita selecta visualization	5
	2IW99	Capita selecta design and analysis of systems	5

*) For foreign students only, that have not participated in the TU/e summer course.

Other electives may be chosen provided that they are approved by the Examinations Committee in advance. Please consult the study advisor dr. J.C.S.P. van der Woude, HG 7.79, telephone (040)(247) 5146.

4.3.1 Internship

In some cases an internship may be a valuable addition to the program. It should enhance practical experience and provide deepening of knowledge. An internship takes 20 credit points as part of the electives and should contribute to the specialization. In general, internships will only be allowed for students that followed a bachelor program at the TU/e, but exceptions are possible. Requests for internships accompanied by convincing arguments explaining the reasons why the intended internship fits into the program are to be sent to the educational director or the study advisor.

4.4 Planning

The master program is a short program. In only two years, you must meet several conditions and obligations and advance planning may help to meet them in time, so that the study is not unnecessarily prolonged.

A reverse inventory gives the best view on the schedule to be kept. During the master project, you should be able to spend full time and concentration on your project. In practice, however, it turns out to be rather difficult to plan curricular activities and, especially, their success. Therefore, we leave room for at most two courses of in total at most ten credit points to be finished during the master project period. However, be aware that you are not allowed to finish your project before you completed all your courses.

The start of your master project is marked by submitting a completed graduation plan containing the necessary information on the project (name, place, period, supervisor, company and so on) and stating the fact that you have completed your curricular part of the program (except for courses of at most ten credits). The form must be accompanied by a project description and signed by you, your supervisor, the head of the relevant area of expertise and the study advisor. Prior to this step, you need:

- an approved program. The Examinations Committee must approve your program consisting of the mandatory courses and your choice of the electives. In order to obtain this approval you construct a program, possibly with the help of the study advisor, fill out the program form, have it signed by yourself and the supervisor of your choice and hand it in at the student administration office (HG 6.45).
- a supervisor. After a while you will probably have a clear picture of the academic direction you want to pursue in your studies. If not, you may want to talk to several staff members, along with the study advisor. In the area of expertise for your subject, there are people that you may want to be involved with as you complete the master project. You should discuss and try to reach agreement with these people on the prerequisites and the curricular program that is needed to fruitfully complete the project.

As a rule of thumb, you should start your search for a supervisor and the construction of your individual program not later than at the end of the first year. This is because some room for the special needs for the specific project should be left in the second year. The study advisor may be helpful to you in this regard.
Please refer to the graduation regulations in section 6.2. The necessary forms can be obtained from the Student Administration or at w3.win.tue.nl/en/education/education_computer_science/graduation_regulations.

5. specializations

5. Specializations

In this chapter, you can read about the different specialization options within the CS Division. Details on non-divisional specialization options are available through the study advisor.

5.1 Algorithms

Contact person: Prof.dr. M.T. de Berg

The creation, storage, analysis and manipulation of spatial data plays a central role in robotics, computer graphics, geographical information systems, and other areas of computer science. In all these areas, there are many challenging algorithmic questions. For example, a typical problem in robotics is to compute efficient routes for a robot moving through a factory building while avoiding all obstacles in its way. A typical problem in geographic information systems could be to find a good location of a new airfield, say the location such that the region in a 20-mile radius around it is the least populated. Such problems form the focus of this area of expertise: we study techniques and concepts for the design and analysis of efficient algorithms and data structures, with emphasis on algorithms for spatial data. Typical master projects are either experimental or theoretical in nature, depending on the interests of the student.

Core courses for the ALG area of expertise are:

- Advanced algorithms (2IL45),
- I/O efficient algorithms (2IL35),
- Geometric algorithms (2IL55),
- Seminar algorithms (2IL95),
- Capita selecta algorithms (2IL99).

Other relevant courses:

- Additional component computer graphics (2IV05),
- Visualization (2IV35),
- Interactive virtual environments (2IV55).

5.2 Formal methods

Contact person: prof.dr. J.C.M. Baeten

Research in Formal Methods is a systematic and scientific study of issues in Computer Science, based on solid mathematical principles. The area of Formal Methods concerns fundamental research and considers systems and constructions used in Computer Science. These constructions are described exactly in a formal syntax and are supplied with formal semantics, whenever appropriate. Formal Methods increase understanding of systems, increase clarity of description and help solve problems and remove errors. The use of Formal Methods increases dependability and usability of constructions and systems in Computer Science. Formal Methods are not studied in isolation, but for practical application. Thus, choice of research topics is inspired by the practice of Computer Science. To support application, existing tools are used and new tools are developed.

Based on our expertise and the benefits expected in application, we focus on the following specific areas:

- Process algebra (functional correctness and performance analysis),
- Assertional methods,
- Formal methods in life sciences,
- Stochastic systems,
- Hybrid systems.

Relevant courses for the FM area of expertise are:

- Formal methods (2IF25),
- Formal methods in cell biology (2IF35),
- Process algebra (2IF45),
- Proving with computer assistance (2IF65),
- Automated reasoning (2IW15),
- Requirement analysis, design and verification (2IW25),
- Seminar formal methods (2IF95),
- Capita selecta formal methods (2IF99).

5.3 Information Systems

The areas of expertise of the specialization profile Information Systems are as follows:

- Databases en Hypermedia (DH),
- Architecture of Information Systems (AIS).

Contact person: prof.dr. P.M.E. De Bra

5.3.1 Databases and Hypermedia

The focus of DH is on the study of concepts and technologies that are used to store, access and manage information. Information often comes from several sources that each contain a wealth of information of which only a small subset is of interest to any particular user or user group. This information needs to be accessible over the Web. The challenge is to integrate these often disparate sources and extract the information content that interests the user in a Web-based environment. Adaptation, or automatic personalization, must ensure that each user is guided (automatically) to the information that is relevant to him. In order to realize adaptive, Web-based systems concepts and techniques from the area of databases, data mining, knowledge bases and the semantic web need to be combined and engineered into web based systems. This effort results in Adaptive Hypermedia systems.
Adaptive Hypermedia is studied at the conceptual and the practical level: the former is done through the study of Adaptive Hypermedia Reference Models, the latter through the development of the Adaptive Hypermedia Architecture (currently named AHA!), a general-purpose web-based adaptive hypermedia system.

5.3.2 Architecture of Information Systems

The focus of AIS is to investigate methods, techniques and tools for the design of architectures for complex information systems. The focus is typically on systems where (business) processes play an important role, e.g., systems to support organizations in doing their work. The research concentrates on formalisms for modeling and methods to analyze models. Modeling processes is one main focus, using theoretical models such as Petri nets but also different industrial languages. Another focal area is process mining, i.e., extracting models from event logs.

Models obtained through design or through process mining can be used for the configuration of systems but also all kinds of analysis ranging from verification and conformance checking to simulation and gaming.

Relevant courses for the IS areas of expertise are:
- Advanced databases (2ID45),
- Information retrieval (2ID25),
- Adaptive systems (2ID55),
- Capita selecta databases and hypermedia (2ID99),
- Web information systems (2II35),
- Software architecting (2II45),
- Business process management systems (2II55),
- Metamodeling and interoperability (2II65),
- Business process simulation (2II75),
- IT-governance (2II85),
- Seminar information systems (2II95),
- Capita selecta architecture of information systems (2II99).

5.4 Design and Analysis of Systems

Contact person: prof.dr.ir. J.F. Groote

The focus of the area of expertise OAS (*Ontwerp en Analyse van Systemen*) is on modeling and verifying behavior of systems and programs. Behavior must be understood as all possible actions that a system can consecutively perform during its lifetime.
Computer-based systems are so complex, that it is impossible to program them without understanding how the different software components communicate, and what the responsibilities of these parts are. By modeling the behavior, these responsibilities are made explicit. Due to the complexity of the matter at hand, it is also non-trivial to get these behavioral models correct. For this purpose we use analysis techniques. Primarily, these are used to find flaws in the model, and ultimately these are employed to show that the modeled behavior satisfies all the requirements. For instance, a data communication protocol must not lose messages, and a firewall should under no circumstance let an intruder pass.

With current modeling techniques it is no problem to model the communication patterns of even the most complex systems. Using modal formulas most requirements can be formulated in a formal, precise way. Using one of the many existing process equivalences, it is very well possible to state the behavioral equivalence between implementations and specifications. So, in general, it is not really problematic (but sometimes hard) to formulate the properties that a system ought to have.

The current technological bottleneck is our capability to prove that a requirement holds for a given model (the model checking problem) or that two processes are actually equivalent (the equivalence checking problem).
The major research activity of this group is to increase the strength of the analysis tools.

The core problem of the analysis of behavior is the state space explosion problem. There are so many states in which a system can end up, that it is generally impossible to explore these all individually. For this purpose, we must use so-called symbolic techniques to enable the

verification. These techniques come from the realm of automatic reasoning, term rewriting and computer assisted theorem checking.
Also, state space reduction techniques (abstract interpretation, confluence checking) are relevant to reduce the problem size.
Visualization turns out to be a relevant tool, to detect unforeseen problems and to increase insight in the behavior. Knowledge of algorithms, including I/O-efficient algorithms is relevant, to construct analysis tools capable of dealing with huge state spaces.

In order to investigate how effective our analysis techniques are, we are constantly assessing their practical use. For instance, the OAS group is involved in the standardization of several protocol standards (e.g. firewire).
Our role is to assist the standardization process by showing where the protocol does not conform to its intention. With several of the embedded system industries around Eindhoven, we have a similar relationship: we design, model and analyze (parts of) the behavior of the equipment they are building.

Relevant courses for the OAS area of expertise are:
- Formal methods (2IF25),
- Formal modelling in cell biology (2IF35),
- Process algebra (2IF45),
- Proving with computer assistance (2IF65),
- Software Architecting (2II45),
- I/O-efficient algorithms (2IL35),
- Advanced algorithms (2IL45),
- Generic language technology (2IS15),
- Visualization (2IV35),
- Automated reasoning (2IW15),
- Requirement analysis, design and verification (2IW25),
- Programming by calculation (2IW45),
- Algorithms for model checking (2IW55),
- Seminar design and analysis of systems (2IW95),
- Capita selecta design and analysis of systems (2IW99).

5.5 System Architecture and Networks

Contact person: drs. R.H. Mak

Imagine an electronic system that is not somehow networked with other systems. Found one? Must be a pretty boring system then, since one of the fascinating developments of the last years is that devices of all forms, factors and functionality have become connected. This area of expertise focuses on the study of parallel and distributed systems. The emphasis is on the architecture of networked embedded systems, including hardware and software aspects. The study aims to advance design methodologies and the application of quantitative analyses of real systems.
- A few current points of attention are:
- home networking - embedded intelligence and intelligent cooperation,
- embedded processor architectures,
- component-based systems - predictability of non-functional requirements,
- large-scale parallel computing - scientific simulation.

Much of the work is done in cooperation with industry through national and international projects. Several other divisions within TU/e cooperate for these projects; most notably, Electrical Engineering, Industrial Design, Bio-Medical Engineering and Chemical Technology.

Core courses for the SAN area of expertise are:
- I/O-efficient algorithms (2IL35),
- Real-time architectures (2IN25),
- Software architecting (2II45),
- VLSI programming (2IN35),
- Parallel computations and applications (2IN55),
- Capita selecta system architecture and systems (2IN90),
- Seminar system architecture and networking (2IN95).

Other relevant courses are:
- Adaptive systems (2ID55),
- Seminar information security technology (2IF03),
- Web information systems (2II35),
- Advanced algorithms (2IL45),
- Eric language theory (2IS15),
- Requirement analysis, design and verification (2IW25).

5.6 Software Engineering and Technology

Contact person: dr.ir. C. Hemerik

The focus of this area of expertise is on using abstraction and mathematics in the construction of computer programs, the emphasis being on program construction (as opposed to verification). The fundamental problem is the conflict between precision and conciseness in the use of formal methods. Informal reasoning can be more concise than formal reasoning, but at the expense of precision (and thus reliability); on the other hand, formal methods can increase precision, but often at the expense of conciseness (thus impeding creativity). Only theories of programming in which the two are reconciled can make a significant contribution to programmer productivity. The contribution that university research can offer to the practical problem of software design is the identification of good abstractions, and their incorporation into programming methods. Well-established examples of such contributions are invariants, fixed points, higher order functions and type polymorphism.

Very recent examples that have attracted much attention because of their great potential are the work on design patterns in object-oriented programming and that on so-called “generic programming”. The former has attracted much interest worldwide but lacks theoretical underpinnings. The latter emanated from the Dutch STOP (Specification and Transformation of Programs) project. In addition, typed lambda calculi provide a unifying framework for many notions from mathematics, logic and computer science. One viewpoint is to consider them as logical systems with explicit proof objects, a feature which facilitates automated construction and verification of proofs. Another way of looking at them is as functional programming languages with a rich type structure, which is useful in the analysis and design of programming languages. Combining the two viewpoints leads to formal systems in which programs, data types, specifications, theorems and proofs are fully integrated.

Relevant courses for the SET area of expertise are:
- Generic language technology (2IS15),
- I/O efficient algorithms (2IL35),
- Advanced algorithms (2IL45),
- Geometric algorithms (2IL55),
- Programming by calculation (2IW45),
- Seminar software engineering and technology (2IS95),
- Capita selecta software construction (2IS99).

5.7 Visualization

Contact person: dr.ir. H. van de Wetering

The focus of this area of expertise is on the development of new methods and techniques for interactive visualization in order to analyze and manipulate large datasets. One focu s of the group is information visualization, which aims at giving insight in abstract data, such as tree structures, networks and multivariate data, for applications such as software engineering and DNA analysis.
Other interests are visualization of flow fields and tensor fields, as well as visualization of mathematical objects.
In all these fields, aims are to develop new visual representations and interaction methods, as well as to develop new evaluation methods and obtain a better understanding of the visualization process itself.

Furthermore, in cooperation with the National Research Institute for Mathematics and Computer Science (CWI) desktop virtual reality systems are studied. Typical topics here are to develop methods for calibration, input - including 2D/3D combination input - and pattern matching and to build and evaluate applications.

Core courses for the VIS area of expertise are:
- Visualization (2IV35),
- Geometric algorithms (2IL55),
- Additional component computer graphics (2IV05),
- Interactive virtual environments (2IV55),
- Seminar visualization (2IV95),
- Capita selecta visualization (2IV99).

Other relevant courses:
- I/O efficient algorithms (2IL35),
- Information Retrieval (2ID25).

5.8 Security

Contact person: prof.dr. S. Etalle

The interconnectivity and pervasiveness of computers and of embedded systems like PDAs and smart phones is not only determining new functionalities, but is also opening the way to increasingly sophisticated attacks. Indeed, in the last years the field of security has become one of the main focuses of computer science research around the globe. The newly established security group aims at contributing to a comprehensive framework for the engineering, the deployment and the maintenance of secure distributed systems, in which existing and new techniques are harmonized and integrated. The group focuses on distributed system security: a broad area that deals with the security of embedded systems as well as of the ICT infrastructures. Prominent subfields are: the specification and the enforcement of usage policies of critical systems, verification of security protocols, trust management.

The group cooperates actively with the Radboud University and the University of Twente in the Kerckhoffs security master.

Relevant courses for the SEC area of expertise are:

- Information security seminar (2IF03),
- Verification of security protocols (2IF02),
- Distributed trust management (2IF11),
- Introduction to computer security (2IF05),
- Linux kernel and hackers hut (2WC14),
- Cryptography 1 (2WC12),
- Cryptography 2 (2WC13),
- Coding and crypto 1 (2WC09).

6. master program regulations

6. Master program regulations

6.1 Education and Examination Regulations

The Board of the Mathematics and Computer Science Department of Eindhoven University of Technology, TU/e

in view of section 9.15, subsection 1 under a, section 7.13, subsections 1 and 2, section 9.38 under b, and section 9.18, subsection 1 under a, of the Higher Education and Research Act

having heard the advice of the Departmental Council of Mathematics and Computer Science at April 7, 2008

having heard the advice of the degree program committee of March 10, 2008

hereby adopts

the Education and Examination Regulations of the Computer Science and Engineering Master's degree program

which read as follows:

Chapter 1 General

Article 1.1 Definitions

In these Regulations, the following terms should be understood to mean:

a. WHW: the Higher Education and Research Act (*Wet op het Hoger onderwijs en Wetenschappelijk onderzoek*);

b. student: a person enrolled in a degree program as a student or external student;

c. practical exercise: an educational activity in one of the following forms:
- writing a thesis,
- undertaking a project or an experimental design,
- carrying out a design or research assignment,
- doing a literature study,
- doing an internship,
- making a public presentation,
- taking part in fieldwork or an excursion,
- conducting tests and experiments,
- writing a position paper,
- or taking part in a different educational activity designed to acquire specific knowledge, insights or skills;

d. STU: the Education and Student Service Center (*Onderwijs en Studenten Service Centrum*) of the TU/e.

Article 1.2 The program

1. In regard to the program, Annex 1 includes:
   a. the content of the program and the corresponding examination
   b. the content of the specializations,
   c. the organization of the practical exercises,
   d. the study workload of the program and of each of the accompanying study components.
   e. the number and the sequence of the interim examinations and practical exercises, and the times at which they can be taken.
   f. whether the program is offered as a full time, part time or dual program,
   g. whether interim examinations are taken orally, written or otherwise,
   h. where necessary, that successful participation in interim examinations is a condition for admission to other interim examinations,
   i. where necessary, the obligation to take part in practical exercises with a view to taking the interim examination in question,
   j. where necessary, the study components from which the student chooses to complete the optional part of the degree program,
   k. the requirements for issuing a proof of admission,
   l. the Bachelor's diplomas providing direct admission to the program,
   m. the transitional arrangements as referred to in article 8.2.
   n. the conditions under which the Examinations Committee may grant an exemption for one or more examinations on the basis of past successful interim examination results in higher education or knowledge and skills acquired outside higher education.
2. Annex 2 contains details of the wide variety of choices within the program, the criteria relevant to those choices, and the assistance available to students in making their choices and drawing up a study plan.
3. Annex 3 contains the special study programs for HBO students and dual students, in which the transition program for HBO students is incorporated, as defined in Annex 4 of the Education and Examination Regulations for the Bachelor's program.
4. Annexes 1, 2 and 3 constitute an integral part of these regulations.

Article 1.3 Qualities

Master of Science graduates:

- are qualified to degree level within the domain of 'science engineering & technology',
- are competent in the relevant domain-specific discipline(s),
- are able to conduct research and design independently,
- have the ability and attitude to include other disciplines in their research, where necessary,
- have a scientific approach to complex problems and ideas,
- possess intellectual skills that enable them to reflect critically, reason and form opinions,
- are good at communicating the results of their learning, thinking and decision-making processes on an international level,
- are aware of the temporal and social context of science and technology (comprehension and analysis) and can integrate this into their scientific work,
- in addition to a recognizable domain-specific profile, possess a sufficiently broad basis to be able to work in an interdisciplinary and multidisciplinary context, the latter in the sense of being focused on other relevant disciplines needed to solve the design or research problem in question.
- actively seek new potential applications, taking into consideration the social context

Article 1.4 Enrollment and admission

1. Without prejudice to what is otherwise stipulated by or pursuant to the WHW regarding enrollment for Master's degree programs, enrollment for the TU/e Master's degree program is only open to those who have direct access to this program based on a Bachelor's degree certificate, as specified in Annex 1 under k, or who possess proof of admission.
2. Proof of admission is issued by the Departmental Board on the basis of the TU/e admission regulations for Master's degree programs (*Regeling Toelating Masteropleidingen*), as approved by the Executive Board on 8 June 2006.
3. The Examinations Committee may decide that a student who is enrolled in a Bachelor's program at TU/e can be admitted to a corresponding Master's program before he/she has passed the final examination of the aforementioned Bachelor's program.
4. Admission as referred to in paragraph 3 will be granted in any case if the student has sufficient results for and/or exemption from study components in the Bachelors program with a study load of at least 160 credits and, if applicable, has sufficient results for the components of a specialization in the Bachelors program that prepares the student for the corresponding Master's program, and has fulfilled the further conditions relating to study components that must be part of the aforementioned study load of at least 160 credits, as specified in Annex 1, under k.
5. Regarding the sequence of interim examinations in the Master's degree program, students may not take the interim examinations of the study components in the second year of the program until they have passed the final examination of the corresponding Bachelor's program.
6. To make it easier for students to move on directly from a Bachelor's degree program to the corresponding Master's degree program, they will as far as possible be given the opportunity to start the Master's program at the beginning of each semester.

Article 1.5 Language

Considering section 7.2 of the WHW it has been determined that, contrary to the basic principle, programs will be given and interim and final examinations will be taken in English (see the TU/e code of conduct for foreign languages approved by the Executive Board on 3 April 2003).

Chapter 2 Interim examinations

Article 2.1 Frequency and form and sequence of examinations

1. Annually, the Executive Board draws up a timetable for written interim examinations, which is announced at the start of the academic year.
2. In special cases, the Departmental Board can deviate from the timetable referred to in the previous article, no later than two months before the interim examinations take place. The Departmental Board will inform the students of the change, giving reasons, without delay.
3. Oral or other types of interim examinations will be administered at a time determined by the examiner, wherever possible in consultation with the student in question.
4. Students will be given the opportunity to take the interim examinations of the degree program at least twice each academic year (see Annex 1e and article 2.1 of the Examination Rules and Procedures for the program concerned for the rules governing the three kinds of examination).
5. If a subject is removed from the curriculum, two more opportunities will be given to take the interim examination in that subject in the first year after the subject is no longer taught.

6. Contrary to the provisions in paragraph 4, at least one opportunity will be given per academic year to take an interim examination for any subject not taught in that specific academic year.
7. In special cases, the Examinations Committee may decide to deviate from the set number of times an interim examination may be taken, and from the form in which the interim examination is taken, as described in Annex 1, under g and e.

Article 2.2 Term of validity of interim examinations

1. Interim examination results are in principle valid for an unlimited period.
2. If an interim examination result is older than six years, the Examinations Committee may however demand that the student take a supplementary or alternative interim examination.
3. Paragraphs 1 and 2 also apply to interim examinations taken before 1 September 2007.

Article 2.3 Oral interim examinations

1. No more than one person will be given an oral interim examination at a time, unless the Examinations Committee has decided otherwise.
2. As a rule a second examiner will be present at an oral interim examination.
3. Oral interim examinations will be taken publicly.
4. In special cases, the Examinations Committee may deviate from the provisions in the previous paragraphs.

Article 2.4 Results

1. The examiners will determine the results immediately after an oral interim examination, and in any case no later than one day after.
2. The examiners will determine the result of a written interim examination as soon as possible, but no later than 15 working days after the examination has been taken.
3. Contrary to the provisions of paragraph 2, the examiners will determine the result of a test as soon as possible, but no longer than five working days after the test has been taken.
4. Interim examinations taken in other than oral or written form are usually taken by delivering a report or an elaboration of exercises, here referred to as a piece of work. In case several pieces of work need to be delivered, the last piece of work is meant. The examiner will determine the result of such an interim examination as soon as possible, but within 15 working days after the final delivery date that has been determined by the examiner and has been communicated to the student, provided that the piece of work has been delivered by the student to the examiner on this date at the latest.
5. If the examiners in question are unable to meet the requirements in the previous paragraphs due to special circumstances, they will notify the Examinations Committee, stating the reasons. The students involved will be informed of the delay immediately by the Examinations Committee, and of the term within which the results will be made known.
6. Students will be informed of the result of the interim examination by or on behalf of the Examinations Committee, in written or electronic form.
7. When they receive their results, students will be informed of their rights of perusal, as referred to in article 2.5, the opportunity to evaluate the interim examination, as referred to in article 2.6, and the opportunity to submit an objection to the examination appeals board.

Article 2.5 Right of perusal for written interim examinations

1. Students will be given the opportunity, on request, to peruse their assessed work up to at least 20 working days after the announcement of the result of a written interim examination. Students intending to submit an administrative appeal against the assessment of their written work will be supplied with a copy of the assessed work at cost price.
2. During the terms mentioned in paragraph 1, any interested person may, on request, peruse the questions and assignments of a given interim examination, as well as the standards on which the assessment was based.
3. Within five days after the request for perusal is received, the Examinations Committee will announce the venue and time that the perusal referred to in paragraphs 1 and 2 will take place.
4. If students or interested persons can prove that they were prevented from appearing at the fixed place and time through no fault of their own, they will be offered another opportunity, if possible, within the term mentioned in paragraph 1 of this article.

Article 2.6 Evaluation

1. As soon as possible after the announcement of the result of an oral interim examination, at the request of the students concerned or on the initiative of the examiners, an evaluation will take place between the examiners and the students. In such cases, the assessments given will be substantiated.
2. If a collective evaluation is organized after a written interim examination is finished, instigated by or on behalf of the Examinations Committee, the time and venue for this evaluation will be announced by the Examinations Committee.
3. If a student, through no fault of his/her own, is or has been prevented from attending the collective evaluation, or if no collective evaluation has been or is to be organized, the student can ask the examiner for an individual evaluation within 20 days after the results of the written interim examination have been announced, giving reasons.
4. The Examinations Committee may grant permission to deviate from the provisions of paragraph 2.

Chapter 3 Approval of the Examinations Committee

Article 3.1 Exemption

1. A written request for an exemption to take one or several interim examinations will be submitted to the Examinations Committee no later than two months before the examination takes place.
2. The request must include all documents reasonably needed for an assessment of whether the student in question can be granted an exemption.
3. The grounds for which the Examinations Committee can grant an exemption to taking a particular interim examination are exclusively related to the level, the content and the quality of the interim or final examinations the student in question has already passed, or on the latter's knowledge, insight and skills acquired outside of higher education.
4. A decision not to grant an exemption will only be taken by the Examinations Committee after the student has been given an opportunity to be heard.
5. The Examinations Committee will decide four weeks after receipt of the request.
6. The decision to grant an exemption for taking an interim examination will correspond to the grade "satisfactory" and marked EX.

7. For the application of this article, taking an interim examination is also understood to mean taking part in a practical exercise.
8. The conditions for granting an exemption are given in Annex 1, under n; the provisions of article 3.1, paragraph 3, are subject to these conditions.

Article 3.2 Electives

1. A written request for approval of the electives to be taken by a student, as referred to in the Annex under j., will be submitted to the Examinations Committee no later than two months before the teaching of the subjects in question begins.
2. A decision not to grant the approval will only be taken by the Examinations Committee after the student in question has been given an opportunity to be heard.
3. The Examinations Committee will decide on the request within four weeks of receiving it.
4. The Examinations Committee may deviate from the provisions of paragraph 1.

Article 3.3 Flexible degree program

1. A substantiated request for permission to take an optional degree program as intended in section 7.3c of the law must be submitted to the Examinations Committee at least three months before the start of the program or programs in question.
2. A decision not to grant permission will only be taken by the Examinations Committee after the student has been given an opportunity to be heard.
3. The Examinations Committee will decide on the request within four weeks of receiving it.
4. The decision will state the degree program to which the optional program is deemed to belong.
5. The Examinations Committee may deviate from the provisions of paragraph 1.

Chapter 4 Functional impairment

Article 4.1 Studying with a functional impairment

1. Students should submit a written request for an adjustment of their program, interim examinations or practical exercises, or for special facilities to be provided because of a permanent functional impairment, three months before they are scheduled to take part in the programs or practical exercises. The request should be addressed to the Departmental Board and submitted to STU.
2. The request should be accompanied by any documents reasonably required to assess the request. These should include at least a recent statement from a physician or psychologist or from a BIG, NIB or NVO-registered assessment agency. If possible, the statement should provide an estimation of the extent and likely duration of the functional impairment.
3. The decision regarding adaptations or granting facilities will be taken by the Departmental Board within four weeks of receipt of the request. The Board will ensure that the quality and level of the programs, the interim examinations or the practical exercises are still safeguarded.
4. The STU will send requests relating to adaptations to the Departmental Board, together with its recommendations. It will send requests relating to facilities to enable the student to take an interim examination, together with its recommendations, to the Examinations Committee, with a copy to the Departmental Board.
5. Wherever possible, adaptations will be attuned to the individual's functional impairment. Facilities may consist of adjustments to the individual situation of the form or duration of the program, interim examinations or practical exercises, or of practical aids.

Chapter 5 Final examinations

Article 5.1 Periods and frequency of final examinations

There will be at least three opportunities to take final examinations annually. The dates of the meetings of the Examinations Committee will be announced at the start of the academic year.

Chapter 6 Student counseling and study progress

Article 6.1 Student counseling

1. The Departmental Board will provide counseling to students on the opportunities for courses of study inside or outside the degree program including appointing one or more student counselors.
2. The student counselor will advise the student (either on request or on the counselor's own initiative) on all the aspects of the student's degree program, and will ensure, partly based on the student's study progress and whenever necessary, adequate referral to the competent bodies of the TU/e, to STU student counselors or TU/e confidential counselors.

Article 6.2 Monitoring study progress

1. The Departmental Board will ensure that the interim examination results of the individual students are registered and made known in good time in the TU/e education information system.
2. Where appropriate, the Departmental Board will organize discussion of the results between student and his/her counselor
3. The student counselor will inform students who fall behind in their studies of the opportunities to receive extra support or measures that may need to be taken to limit the delay as much as possible.

Chapter 7 Objections and appeal

Article 7 Objections and appeal

1. Based on these Regulations, an objection against a decision of the Departmental Board may be lodged with the Departmental Board within six weeks of that decision being made known to the person or persons involved.
2. Based on these Regulations, an administrative appeal against a decision taken by or on behalf of the Examinations Committee may be lodged with the Examinations Appeals Board within four weeks of that decision being made known to the persons involved.

Chapter 8 Final provisions

Article 8.1 Amendments

1. An amendment of these Regulations will not apply in the current academic year unless it does not reasonably harm the interests of the students.
2. An amendment of these Regulations may not backdate any decision already taken in regard to a student.

Article 8.2 Transitional arrangement

1. If these Regulations, including the Annex, are amended, the Faculty Board will, if necessary, make a transitional arrangement. The transitional arrangement will be incorporated in the Annex to these Regulations.

2. The transitional arrangement will always include:
   a. regulations regarding exemptions that may be obtained based on interim examinations already passed, and
   b. the term of validity of the transitional arrangement.

Article 8.3 Effective date

These Regulations replace all previous versions and will become effective on September 1, 2008.

Drawn up by the Faculty Board by a decision dated April 28, 2008.

Annex 1 to article 1.2, first paragraph of the Education and Examination Regulations for the Computer Science and Engineering Master's Degree Program

a. Content of the degree program and related examination

The degree program comprises the following study components with the educational credits mentioned behind each component.

Computer Science and Engineering (CSE) Courses:

Block	Code	Study component	Credits
First year			
Core courses *			**25**
A-C	2IF25	Formal methods	5
A-C	2IL45	Advanced algorithms	5
A-C	2IN25	Real-time architectures	5
A-C	2IS15	Generic language technology	5
A-C	2IV35	Visualization	5
A-C	2IW25	Requirement analysis, design and verification	5
D-F	2ID45	Advanced databases	5
D-F	2II55	Business process management systems	5
A-F		**Elective courses**	**35**
Second year			
Seminar **			**5**
A-C	2IF95	Seminar formal methods	5
A-C	2II95	Seminar information systems	5
A-C	2IL95	Seminar algorithms	5
A-C	2IN95	Seminar systems architecture and networking	5
A-C	2IS95	Seminar software engineering and technology	5
A-C	2IV95	Seminar visualization	5
A-C	2IW95	Seminar design and analysis of systems	5
D-F	2IC95	Seminar security	5
D-F	2II95	Seminar information systems	5
A-C		**Elective courses**	**25**
D-F	2IM91	**Master project *****	**30**

*) It is not necessary to request approval of these electives to the Examinations Committee in advance. At least five out of eight core courses must be chosen.

**) It is not necessary to request approval of this elective to the Examinations Committee in advance. At least one seminar must be chosen.

***) This subject can only be followed if the individual master's degree program has been approved by the Examinations Committee (see the Graduation regulations for Computer Science and Engineering).

Elective Courses:

In this section a collection of courses at MSc-level is outlined. Items on this list can be selected as electives towards degree completion. It is not necessary to request approval to the Examinations Committee in advance.

Block	Code	Study component	Credits
A-C	2ID25	Information retrieval	5
A-C	2ID55	Adaptive systems	5
A-C	2IF25	Formal methods	5
A-C	2IF35	Formal modelling in cell biology	5
A-C	2II35	Web information systems	5
A-C	2II45	Software architecting	5
A-C	2II65	Metamodeling and interoperability	5
A-C	2IL35	I/O-efficient algorithms	5
A-C	2IL45	Advanced algorithms	5
A-C	2IN25	Real-time architectures	5
A-C	2IS15	Generic language technology	5
A-C	2IS25	Distributed trust management	5
A-C	2IV05	Additional component computer graphics	5
A-C	2IV35	Visualization	5
A-C	2IW25	Requirement analysis, design and verification	5
A-C	2IW45	Programming by calculation	5
A-C	2IW55	Algorithms for model checking	5
D-E	2IN35	VLSI programming	5
D-F	2ID45	Advanced databases	5
D-F	2IF45	Process algebra	5
D-F	2IF65	Proving with computer assistance	5
D-F	2II55	Business process management systems	5
D-F	2II75	Business process simulation	5
D-F	2II85	IT-governance	5
D-F	2IL55	Geometric algorithms	5
D-F	2IP45	Software project management	5
D-F	2IS35	Verification of security protocols	5
D-F	2IV55	Interactive virtual environments	5
D-F	2IW15	Automated reasoning	5
D-F	2WX04	Communication skills *	3
Capita selecta			
A-C	2IS99	Capita selecta software engineering and technology	5
	2IC99	Capita selecta security	5
	2ID99	Capita selecta databases and hypermedia	5
	2IF99	Capita selecta formal methods	5
	2II99	Capita selecta architecture of information systems	5
	2IL99	Capita selecta algorithms	5
	2IN99	Capita selecta systems architecture and networking	5
	2IV99	Capita selecta visualization	5
	2IW99	Capita selecta design and analysis of systems	5

*) For foreign students only, that have not participated in the TU/e summer course.

b. Content of the specializations

The degree program contains the following specializations with corresponding credits:

Information Security Technology (IST) Courses:

Block	Code	Study component	Credits
First year			
A-C	2IF05	Introduction to computer security	6
A-C	2WC12	Cryptography 1	6
D-F	2IF02	Verification of security protocols	6
D-F	2IF06	Software security	6
		Elective courses*	**36**
Second year			
A-C	2IF07	Security in organizations	6
A-C	2IF08	Network security	6
A-C		**Elective courses***	**18**
D-F	2IM91	**Master project ****	**30**

*) At least three elective courses must be chosen from the list of electives for IST. The remainder elective courses can be chosen both from the list of electives for IST as from the general list of elective courses.

**) This subject can only be followed if the individual master's degree program has been approved by the Examinations Committee (see the Graduation regulations for Computer Science and Engineering).

Electives for IST:

In this section a collection of courses at MSc-level is outlined. Items on this list can be selected as electives towards degree completion for the master specialization IST. It is not necessary to request approval to the Examinations Committee in advance.

Block	Code	Study component	Credits
First year			
A-C	2IF09	Biometric recognition	6
A-C	2IF11	Distributed trust management	6
A-C	2WC14	Linux kernel and hacker's hut	6
D-F	2IF03	Seminar information security technology	6
D-F	2IF13	Privacy seminar	6
D-F	2WC13	Cryptography 2	6
Second year			
A-C	2IF14	Hardware and operating system security	6
A-C	2IF15	Secure data management	6

c. Organization of practical exercises

Not applicable for the Computer Science and Engineering Master's degree program.

d. Student workload of the degree program and of each of the study components it comprises:

The student workload of the program is 120 credit points. The student workload of the study component is indicated under a or b, respectively.

e. Number and frequency of the interim examinations and practical exercises

The program has no interim examinations and practical exercises that are administered in some specified order.

f. Form of the degree program

The program may be followed full time or part time.

g. Format of interim examinations:

The interim examinations of the study components listed under a or b will be taken in the form as indicated below:

Computer Science and Engineering (CSE) Courses:

Block	Code	Study component	Credits	Examinations						
				Form	A	B	C	D	E	F	I
A-C	2IF25	Formal methods	5	w			1st	2nd			
A-C	2IL45	Advanced algorithms	5	a							
A-C	2IN25	Real-time architectures	5	w+a			1st	2nd			
A-C	2IS15	Generic language technology	5	w+a			1st	2nd			
A-C	2IV35	Visualization	5	w			1st	2nd			
A-C	2IW25	Requirement analysis, design and verification	5	w+a		1st	2nd				
D-F	2ID45	Advanced databases	5	w+a						1st	2nd
D-F	2II55	Business process management systems	5	w+a						1st	2nd
A-C	2IF95	Seminar formal methods	5	a							
A-C	2II95	Seminar information systems	5	a							
A-C	2IL95	Seminar algorithms	5	a							
A-C	2IN95	Seminar systems architecture and networking	5	a							
A-C	2IS95	Seminar software engineering and technology	5	a							
A-C	2IV95	Seminar visualization	5	a							
A-C	2IW95	Seminar design and analysis of systems	5	a							
D-F	2IC95	Seminar security	5	a							
D-F	2II95	Seminar information systems	5	a							
D-F	2IM91	Master project	30	a							

w = written; a = assignment

Information Security Technology (IST) Courses:

Block	Code	Study component	Credits	Examinations						
				Form	A	B	C	D	E	F	I
A-C	2IF05	Introduction to computer security	6	w+a							
A-C	2WC12	Cryptography 1	6	w+a			1st	2nd			
D-F	2IF02	Verification of security protocols	6	w+a							
D-F	2IF06	Software security	6	w							
A-C	2IF07	Security in organizations	6	w							
A-C	2IF08	Network security	6	w+a							
D-F	2IM91	Master project	30	a							

w = written; a = assignment

Elective Courses:

Block	Code	Study component	Credits		Examinations						
				Form	A	B	C	D	E	F	I
A-C	2ID25	Information retrieval	5	w+a	*	*					
A-C	2ID55	Adaptive systems	5	w+a	*	*					
A-C	2IF25	Formal methods	5	w+a			1st	2nd			
A-C	2IF35	Formal modeling in cell biology	5	a							
A-C	2II35	Web information systems	5	a							
A-C	2II45	Software architecting	5	w+a			1st	2nd			
A-C	2II65	Metamodeling and interoperability	5	w+a			1st	2nd			
A-C	2IL35	I/O-efficient algorithms	5	a							
A-C	2IL45	Advanced algorithms	5	a							
A-C	2IN25	Real-time architectures	5	w+a			1st	2nd			
A-C	2IS15	Generic language technology	5	w+a			1st	2nd			
A-C	2IS25	Distributed trust management	5	w+a			1st	2nd			
A-C	2IV05	Additional component computer graphics	5	a							
A-C	2IV35	Visualization	5	a							
A-C	2IW25	Requirement analysis, design and verification	5	w+a		1st	2nd				
A-C	2IW45	Programming by calculation	5	a							
A-C	2IW55	Algorithms for model checking	5	w			1st	2nd			
D-E	2IN35	VLSI programming	5	a							
D-F	2ID45	Advanced databases	5	w+a						1st	2nd
D-F	2IF45	Process algebra	5	w						1st	2nd
D-F	2IF65	Proving with computer assistance	5	w+a						1st	2nd
D-F	2II55	Business process management systems	5	w+a						1st	2nd
D-F	2II75	Business process simulation	5	w						1st	2nd
D-F	2II85	IT-governance	5	a							
D-F	2IL55	Geometric algorithms	5	a							
D-F	2IP45	Software project management	5	a							
D-F	2IS35	Verification of security protocols	5	w+a						1st	2nd
D-F	2IV55	Interactive virtual environments	5	a							
D-F	2IW15	Automated reasoning	5	w+a						1st	2nd
D-F	2WX04	Communication skills	3	a							
A-C	2IS99	Capita selecta software engineering and technology	5	w			1st	2nd			
	2IC99	Capita selecta security	5								
	2ID99	Capita selecta databases and hypermedia	5								
	2IF99	Capita selecta formal methods	5								
	2II99	Capita selecta architecture of information systems	5								
	2IL99	Capita selecta algorithms	5								
	2IN99	Capita selecta systems architecture and networking	5								
	2IV99	Capita selecta visualization	5								
	2IW99	Capita selecta design and analysis of systems	5								

w = written; a = assignment; * = test

Electives for IST:

Block	Code	Study component	Credits	Examinations						
First year				**Form**	**A**	**B**	**C**	**D**	**E**	**F**	**I**
A-C	2IF09	Biometric recognition	6	a							
A-C	2IF11	Distributed trust management	6	w+a							
A-C	2WC14	Linux kernel and hacker's hut	6	a							
D-F	2IF03	Seminar information security technology	6	a+o							
D-F	2IF13	Privacy seminar	6	a+o							
D-F	2WC13	Cryptography 2	6	w+a					*	*	
Second year											
A-C	2IF14	Hardware and operating system security	6	w							
A-C	2IF15	Secure data management	6	w+a							

w = written; a = assignment; o = oral; * = test

h. Conditions for admission to the interim examinations

Not applicable for the Computer Science and Engineering Master's degree program.

i. Participation in practical exercises:

Not applicable for the Computer Science and Engineering Master's degree program.

j. The study components from which students must choose for the optional parts of their degree programs:

For the optional parts of their degree programs, students must make a choice from the following study components:

Elective Courses:

In this section a collection of courses at MSc-level is outlined. Items on this list can be selected as electives towards degree completion. It is not necessary to request approval to the Examinations Committee in advance.

Code	Study component
2ID25	Information retrieval
2ID55	Adaptive systems
2IF25	Formal methods
2IF35	Formal modeling in cell biology
2II35	Web information systems
2II45	Software architecting
2II65	Metamodeling and interoperability
2IL35	I/O-efficient algorithms
2IL45	Advanced algorithms
2IN25	Real-time architectures
2IS15	Generic language technology
2IS25	Distributed trust management
2IV05	Additional component computer graphics

Code	Study component
2IV35	Visualization
2IW25	Requirement analysis, design and verification
2IW45	Programming by calculation
2IW55	Algorithms for model checking
2IN35	VLSI programming
2ID45	Advanced databases
2IF45	Process algebra
2IF65	Proving with computer assistance
2II55	Business process management systems
2II75	Business process simulation
2II85	IT-governance
2IL55	Geometric algorithms
2IP45	Software project management
2IS35	Verification of security protocols
2IV55	Interactive virtual environments
2IW15	Automated reasoning
2WX04	Communication skills *
Capita selecta	
2IS99	Capita selecta software engineering and technology
2IC99	Capita selecta security
2ID99	Capita selecta databases and hypermedia
2IF99	Capita selecta formal methods
2II99	Capita selecta architecture of information systems
2IL99	Capita selecta algorithms
2IN99	Capita selecta systems architecture and networking
2IV99	Capita selecta visualization
2IW99	Capita selecta design and analysis of systems

*) For foreign students only, that have not participated in the TU/e summer course.

Electives for IST:

Code	Study component
2IF09	Biometric recognition
2IF11	Distributed trust management
2WC14	Linux kernel and hacker's hut
2IF03	Seminar information security technology
2IF13	Privacy seminar
2WC13	Cryptography 2
2IF14	Hardware and operating system security
2IF15	Secure data management

k. Admission requirements for issuing proof of admission
The admission requirements for the Master's degree program correspond to the qualities regarding the knowledge, insight and skills that students obtained at the time of finishing their *Technische Informatica* Bachelor's degree program.

Admission of foreign students:
1. Command of English: now that programs are given in English, students must have an IELTS or comparable score of at least 6.
   Comparable scores are:
   - TOEFL paper-based: 550
   - TOEFL computer-based: 213
   - TOEFL internet-based: 80
   - Cambridge certificate: A, B or C
2. The level of education in the country in which the student has completed his/her pre-university education: this must be more or less comparable with that in the Netherlands.
3. Level of knowledge: the student must have accumulated sufficient knowledge on the basis of the subjects he/she has studied abroad to be at a level comparable to that of Dutch students who are admitted to the Master's degree program.

l. Bachelor's degree certificates that provide direct access to the Master's program:
The following Bachelor's degree certificates from the institutions for higher education indicated below provide direct access to the Master's degree program:
Technische Informatica (TU/e, TUD, UT)
Telematica (UT)
Informatica (RUG, UU, UvA, VU, UL, RU, OU)

m. Transitional arrangements:
Not applicable for the Computer Science and Engineering Master's degree program.

n. Supplementary conditions for exemptions:
Not applicable for the Computer Science and Engineering Master's degree program.

Annex 2, as referred to in article 1.2, second paragraph of the Education and Examination Regulations for the Computer Science and Engineering Master's Degree Program

Not available for the Computer Science and Engineering Master's degree program.

Annex 3, as referred to in article 1.2, first paragraph of the Education and Examination Regulations for the Computer Science and Engineering Master's Degree Program

Students who have completed a polytechnic (*HBO*) program of computer science are eligible to participate in the pre-master program. Completion of the pre-master program gives access to the master program in Computer Science and Engineering.
Students who have completed another polytechnic program, but do wish to do the pre-master program that gives admission to the CSE master program, are individually assessed by the Admissions committee of the master program. This assessment results in an individual decision of the Admissions committee concerning admission to the (possibly adapted) pre-master program.

The pre-master program that a student with a completed polytechnic program of computer science has to follow consists of the following units of in total 30 credit points:

Block	Code	Program unit	Credits
A	2DL03	Basic mathematics	3
B	2DL04	Calculus A	3
A-C	2ID05	Datamodeling and databases	6
A-C	2IT05	Logic and set theory	6
C	2DL06	Linear algebra	3
C	2DL07	Statistics A	3
D-F	2IT15	Automata and process theory	6

Those taking the pre-master program for polytechnic graduates are required to include some units of the bachelor program *Technische Informatica* as homologation units in the elective part of the master program:

Block	Code	Program unit	Credits
A-B	2IJ26	Algebra *	3
A-C	2IT25	Discrete structures *	6
A-C	2IW05	Software specification	6
D-F	2IL05	Data structures	6

*) The students in the specialization IST include Discrete structures (2IT25). The regular students in the standard CSE program include Algebra (2IJ26).

Those taking the pre-master program for polytechnic graduates may be given permission to take part in some of the units of the master program. A necessary condition for permission is that the student has at least scored 15 credit points from the pre-master program.
Those taking an adapted or individually composed pre-master program in the bachelor program may be given permission to take part in some of the units of the master program, or may be allowed to follow altered or entirely different units from the master program.
The students that wish to take study components from the master program must submit a request to this effect as a contracting party to the TU/e. The form needs to be signed by the pre-master coordinator or the study advisor.
If the request is granted, then the period of enrolment is set; this may be a maximum of one year on the condition that it is not longer than the enrolment of the student in the bachelor program.

Explanatory notes to the Education and Examination Regulations

General

Pursuant to section 9.15, subsection 1 of the Higher Education and Scientific research Act (WHW), the Dean must adopt the Education and Examination Regulations, the content of which is specified in section 7.13, subsection 2 of the WHW. These Regulations implement both of these sections.

In addition, section 9.38 of the WHW provides that the Departmental Board requires prior agreement of the Departmental Council to adopt or amend the Education and Examination Regulations, with the exception of the matters mentioned under a to g, including subsection 2 of section 7.13 of the Higher Education and Scientific Research Act. This means that the Departmental Council has agreed with these Regulations, excepting paragraphs a to d of the Annex. In drawing up the Regulations, the Departmental Board has followed the recommendations of the Departmental Council.

The Study Program Committee also made recommendations in accordance with the provisions of section 9.18, subsection 1 of the WHW. These have been taken into account by the Departmental Board in drawing up the Regulations.

For the sake of transparency and clarity, particularly for the students, it was decided to include in the Regulations, wherever possible, the details and regulation of the competences and tasks of the Examinations Committee, as spread over a large number of sections in the WHW pertaining to the Committee. As a result, the Examination Rules and Procedures for this degree program only contain arrangements pertaining to the competences and tasks granted to the Committee based on section 7.12 of the WHW, and to those matters which, because of their content, do not belong in these Education and Examination Regulations.

These Regulations and the Examination Rules and Procedures, including all Annexes, form part of an integral whole and should be read in conjunction with each other.

Article 1.1

The definitions in these Regulations have been limited to those concepts that were necessary for drawing up the Regulations. This does not affect the fact that clarity should be provided about the exact meaning of the various – sometimes legally-defined – concepts used in these Regulations. A glossary has been added for this purpose, to prevent confusion about the meaning of the concepts.

Article 1.2

This article refers to Annex 1, which constitutes an integral part of these Regulations, in which course-specific aspects of the degree program in question are described and regulated. These relate to the matters regarding the content of the Education and Examination Regulations as specified in section 7.13, subsection 2 of the WHW, which only relate to the content, form and scope of the education and interim examinations to which these Regulations pertain.

The other stipulations of these Education and Examination Regulations are general in nature and do not only apply to the program concerned here, but are widely applicable throughout the

TU/e. This safeguards the unity of regulations and certainty. Students can be sure that the Education and Examination Regulations of all TU/e degree programs, in so far as those Regulations relate to non course-specific aspects, contain uniform rules. Apart from the course-specific matters mentioned in sections a through j, the Annex includes two other important items in relation to the current Master's degree program, under k and l: the admission requirements for which proof of admission may be issued and which must be included in the Regulations on the basis of section 7.30a, subsection 3 and section 7.30b, subsection 1 of the WHW. The Bachelor's degree certificates that provide direct admission to the Master's degree program are included in the Annex under 1. Also see the explanatory note for article 1.4. Additionally, under m, the Annex gives further details of the transitional arrangement specified in article 8.2 and under n, the rules allowing the Examinations Committee to grant students an exemption, for example, that a student may not be granted exemptions amounting to more than 60 ECTS.

Article 1.3

Section 7.13, subsection 2 under c of the WHW indicates that the Education and Examination Regulations must include the qualities regarding knowledge, insight and skills that students should have acquired at the conclusion of their degree programs. The qualities included in this section were adopted by the Executive Board and published in the institutional plans for 2004-2007 and in the educational vision adopted in June 2005. These qualities are also closely connected to the academic criteria outlined in a joint publication of the TU/e, the Technological University of Delft and the University of Twente entitled "Criteria for Academic Bachelor's and Master's Curricula" (2005 edition).

Article 1.4

Although enrollment for a Master's degree program does not formally constitute part of the Education and Examination Regulations, for the sake of legibility and completeness of these current Regulations, this article describes which students are eligible for enrollment in the Master's degree program. Part 1 of the Annex specifies the Bachelor's degree certificates that provide direct access to the Master's degree program; i.e. the specific Bachelor's degree program for which this Master's degree program serves as a corresponding program. In addition, a number of Bachelor's degree certificates from other universities and institutes of higher education also provide direct admission, based on agreements between the Executive Board and these other institutes for higher education.

Students who do not possess the aforementioned Bachelor's degree certificates are only eligible for enrollment if they have proof of admission issued by the Departmental Board. The procedure for obtaining proof of admission is described in the admission regulations of the Master's degree program, which were adopted by the Executive Board on 6 June 2006.

Paragraphs 3 to 6 include the Executive Board's guidelines (which were approved on 21 November 2002 and came into effect on 21 November 2002) on the admission of students who have not yet passed their Bachelor's degree.

Article 1.5

This article implements the decision of the Executive Board of February 6, 2003, the TU/e foreign languages Code of Conduct, requiring departments to state in their Education and

Examination Regulations the language in which programs will be given and interim examinations and examinations will be taken. In the context of the TU/e's internationalization policy, it has been agreed throughout the institution that courses and interim and final examinations for the Master's degree programs, with the exception of the Architecture, Building and Planning program (excepting a few specializations) will be given in the English language. In legal terms this is possible if the quality of the programs and the specific expertise in the field of study in question necessitate the engagement of non-Dutch speaking lecturers, and if the courses are aimed at non-Dutch speaking students. This applies to all the Master's degree programs of the TU/e.

The provisions of article 1.5 do not alter the fact that, in special cases, the Departmental Board may decide that programs will be given in Dutch. This may occur, for example, if all the students and the lecturer from the part of the degree program in question are Dutch speakers, and there is no other reason to choose a different language than Dutch.

Article 2.1
Annually, at the start of the academic year, the Executive Board announces in which period the written interim examinations of the TU/e will take place, so that students are informed of the dates in good time.

The second paragraph of this article enables the Departmental Board to make changes to the timetable in special cases, at the latest two months before the interim examinations are to take place. Special cases may occur as a result of the long-term illness of a lecturer, or a change in staff of the degree program. In such cases, the Departmental Board is obliged to inform the students of the change without delay, giving the reasons why the timetable has changed.

Clearly, oral interim examinations cannot be set centrally. Paragraph three states that the dates for these examinations will be determined wherever possible in consultation between the student in question and the examiner.

The fourth paragraph outlines what applies for all TU/e degree programs: students will be given the opportunity, at least twice annually, to take written, oral or other types of examinations.

If a subject is removed from the curriculum during the first academic year and no more lessons are given in that subject, two more opportunities will be provided to take the interim examination. These provisions apply to all forms in which the interim examination for a subject is taken as prescribed in the Annex to the Regulations under g, i.e to written, oral or other types of examinations.

These rules regarding the frequency and form of the interim examinations do not affect the competence of the Examinations Committee, in special cases, to deviate from the rules (paragraph seven). The committee may, on request or at its own initiative, decide to give an extra opportunity to take a particular interim examination during a certain academic year, for all or for individual students. In special cases, the Examinations Committee may also take a (well-founded) decision to convert a written interim examination into an oral examination or other form. In special cases and if there are good enough reasons, the Examinations Committee may also decide to convert a written interim examination into an oral interim examination or other

form. Lastly, in special cases, the Examinations Committee may make exceptions regarding the sequence of the interim examinations, as is specified in the Annex to these regulations. In such cases, it must be clear that the decision to change the frequency or form of an interim examination will not adversely affect the student or students in question.

If the sequence of interim examinations is not specified in this article, the program concerned does not have a fixed examination sequence.

Article 2.2
This article states that the term of validity of a successful interim examination result is unlimited. Because of the rapid development of the various fields of science in recent years, adjustments and reformulations of the curriculum occur so frequently that, generally speaking, after a period of six years the program content and, therefore, the exit qualifications of a degree program change to such an extent that interim examinations passed six years ago cannot simply be assumed to be up to date and valid. For that reason the Examinations Committee may demand that a student takes a supplementary or alternative interim examination if the result of a previous examination is more than six years old. As a different rule applied last year, paragraph three states that the new rule also applies to interim examinations passed before 1 September 2007.

Article 2.3
This article states that no more than one student at a time will be given an oral interim examination.

In addition, this article prescribes that, as a rule, oral interim examinations will be administered by two examiners, to ensure that assessment of the oral interim examination is in accordance with the applicable rules and standards, and to ensure that the proper procedure is followed in the course of the interim examination.

Lastly, in accordance with the relevant provisions in the WHW, it is determined that oral interim examinations will be administered in public. In special cases, the Examinations Committee can make exceptions to that rule. For example, an exception could be based on considerations of the Examinations Committee regarding the issue of order during the interim examinations, or at the request of a student taking an interim examination.

Article 2.4
The terms within which and the manner in which results of interim examinations are announced or published are determined in this article. In all cases, students will receive a written or electronic statement from or issued on behalf of the Examinations Committee.

The terms are different for tests (formerly partial examinations) (paragraph 3) since it is to students benefit to obtain their results as quickly as possible. Tests are important for the interim examination because they are taken halfway through the module or subject concerned, giving the student the opportunity to improve during the time remaining.

When the results are given, the students will be informed of their right to inspect their work and request an evaluation. These matters are arranged in articles 2.5 and 2.6 of these Regulations.

Article 2.5
The right of students to peruse their work enables them to form an opinion on the assessment of their work by the examiner. Such an inspection must be expressly requested by the student in question to the examiner.

Section 7.13, subsection 2 under q, of the WHW prescribes that the Education and Examination Regulations should provide an arrangement for the manner and term within which – generally – cognizance may be taken of the questions or assignments asked or set in the framework of a written interim examination, as well as of the standards on which the assessment has been based. These provisions, which apply to every interested person and not just to students, are made in the context of the openness and verifiability of assessments prescribed by the government. The Departmental Board has chosen to implement this openness in the framework of the regulations pertaining to students' right of perusal; it is therefore provided for in the second paragraph of this article.

The term within which a request for perusal should be addressed to the examiner has been left open; however, as the examiner must announce the venue and time for the inspection within five working days of the request for inspection being received, and as the inspection must take place within 20 working days of the day the result is announced, it would be logical for the student (or other interested person) in question to submit a request to the examiner as soon as possible after the result is announced. The manner in which a request should be submitted is not specified here, to enable students and examiners to make a verbal agreement or make arrangements by e-mail.

Article 2.6
The first paragraph of this article specifies provisions for the evaluation of oral interim examinations. The evaluation will address not only the questions and answers, but also the manner in which the assessment has been conducted.

The second paragraph specifies the way in which evaluations of written interim examinations should be organized. The Examinations Committee may decide whether to arrange a collective evaluation or, at the student's request, and individual evaluation.

If the Examinations Committee arranges a collective evaluation, it will announce the time and venue for the evaluation on the basis of the provisions in paragraph three. This article does not give a term within which the evaluation must be held or announced, to give the Examinations Committees maximum opportunity to provide tailor-made solutions and to take the possibilities and circumstances into account. It is reasonable, however, that such an evaluation should take place within 20 working days at the most.

Students may only request individual evaluations on the condition that no collective evaluation has been organized, or if they can prove that, through no fault of their own, they have not been able to take part in the collective evaluation. Such requests must be submitted within 20 days; it is not specified whether requests should be submitted in writing, verbally or electronically. It would make sense, however, for students who are unable to take part in the collective evaluation to submit requests for individual evaluations in writing or by e-mail, since they have to explain why they are or were unable to participate.

If no collective evaluation has been or is being arranged, a student's request for an individual evaluation clearly does not have to include reasons and his/her request will reasonably be granted.

Article 3.1
Students who have already passed interim examinations or examinations in a different degree program at the TU/e or at a different institution of higher education, or have acquired knowledge or skills outside of higher education, may ask the Examinations Committee to grant them an exemption for one or several interim examinations of this degree program.

Grounds for which the Examinations Committee may grant exemptions relate exclusively to the level, content and quality of the interim or final examinations passed earlier or of the knowledge and skills acquired outside of higher education. This is specified in paragraph three of this article, which requires that the decision of the Examinations Committee should ensure that full justice is done to the exit qualifications of the program. The Examinations Committee can ask the advice of the examiner of the study component concerned before making a decision.

The fourth paragraph of this article prescribes that the Examinations Committee, if it does not intend to grant an exemption, will give the student in question an opportunity to explain his/her requests in person. The student may of course decide not to take advantage of use this opportunity.

The fifth paragraph states that the Examinations Committee should decide on requests for exemption within four weeks. This does not affect the entitlement of the Examinations Committee to inform the student submitting the request in good time that the term of four weeks will be extended, for example, because of academic vacations. Of course, such an extension should be substantiated and should meet the requirements of reason and fairness.

On the basis of the sixth paragraph, the Examinations Committee's decision to grant the exemption will correspond to a satisfactory grade, marked with the abbreviation EX (for "exemption"). This is important in determining the final examination result and the corresponding supplement to be awarded to the student.

The seventh paragraph of the article explains that an exemption may be granted not only for a specific interim examination but also for all forms of practical exercise that are part of a degree program.

The final paragraph offers the Examinations Committee the option of imposing conditions when granting an exemption.

Article 3.2
Under j, the Annex to these Regulations includes a list of the various study components from which students must choose to complete the optional parts of their degree programs. These choices require the Examinations Committee's approval.

The second paragraph of this article prescribes that the Examinations Committee, if it does not intend to grant an exemption, will give the student in question an opportunity to explain his/her requests in person. The student may of course decide not to take advantage of use this opportunity.

As to the term of four weeks, also in this case, the Examinations Committee will let the student in question know in good time if – for example, due to academic vacations – the decision cannot be taken within that term. Of course, such an extension should be substantiated and should meet the requirements of reason and fairness.

Article 3.3

This article outlines the procedure to be followed by students who wish to obtain the Examinations Committee's permission to take an optional degree program. In section 7.3c of the WHW, students are given an opportunity to compose their own degree programs from the various study components offered by the TU/e, instead of taking the courses of one of the degree programs included in the Croho (Central Register of Higher Education Degree Programs) under the name of the TU/e. The article in question also states that a student should refer to the Examinations Committee "best qualified for this". In cases in which it is not clear which Examinations Committee is best qualified to grant permission for a student to take an optional degree program, the Executive Board will appoint an Examinations Committee.

Under paragraph one of this article, a student wishing to take an optional degree program must submit a request to the Examinations Committee at least three months before the start of the program, stating the reasons for the request and explaining why the degree program registered in the Croho does not meet his/her requirements.

The second paragraph requires that the Examinations Committee give the student the opportunity to be heard if the Board intends to reject the request. The student may of course decide not to take advantage of use this opportunity.

The Examinations Committee may decide whether it will grant permission to take an optional degree program. Clearly, the Committee must be convinced that the optional program proposed by the student in question meets the requirements of section 7.3, subsection 2 of the WHW, which states that a degree program should be a coherent whole of study components aimed at realizing clearly-defined objectives concerning the knowledge, insights and skills that students should possess by the time they finish their degree program. Also, in all other respects, the requirements of degree programs prescribed by the WHW should be met.

On the basis of the third paragraph of this article, the Examinations Committee will take a decision no later than four weeks after receiving the request, specifying – paragraph 4 – the degree program to which the flexible degree program will be deemed to belong. This is important to determine which Education and Examination Regulations and Examination Rules and Procedures apply to the student concerned. In addition, the student's study progress will have to be recorded under the name of a degree program registered in the Croho (Central Register of Higher Education Degree Programs), and students' certificates will have to state the name of a degree program registered in the Croho. As to the term of four weeks, also in this case, the Examinations Committee will let the student in question know in good time if – for example, due to academic vacations – the decision cannot be taken within that term. Of course, such an extension should be substantiated and should meet the requirements of reason and fairness.

This article does not deal with the possibility that students may wish to exchange only specific parts of their current degree programs with parts from other TU/e programs, since this is self-evident. On the basis of this article, this also requires the approval of the Examinations Committee.

Article 4.1
The Departmental Board can be asked to make adjustments or provide special facilities or students with functional impairments, including all conditions that are chronic or permanent in nature and which structurally impair a student in attending classes and taking part in interim examinations or practical exercises in the usual manner. This expressly refers to functional impairments of a permanent nature.

A request for adaptations or facilities should be submitted three months before the programs, interim examinations or practical exercises in question are scheduled to take place. They should be addressed to the Departmental Board and submitted to STU. The words 'if possible' in the first paragraph of this article take account of the fact that students who are enrolling at the TU/e for the first time will generally only submit their request at the time when they submit their application for enrollment. These requests will of course also be dealt with. The term of three months means that the student cannot expect that the department can arrange special facilities within a shorter period of time.

An STU staff member will discuss the request with the student concerned. The request will then be sent to the Departmental Board or the Examinations Committee, together with STU's recommendations. The request should be accompanied by all documents reasonably necessary to assess the request. This should include at least a recent statement by a physician or a psychologist, or by a BIG, NIB or NVO-registered assessment agency. The intent is that a formally recognized expert in the field in question submits a statement about the nature and duration of the functional impairment, which may affect a student's ability to attend classes and practical exercises and to take interim examinations.

The Departmental Board will decide on the request for adaptations or special facilities within four weeks of receipt of the request and the STU's recommendations. The Board is responsible for assessing whether the student's request can be reasonably granted. The costs to the department for possible adjustments and facilities should be in reasonable proportion to their objective. The Examinations Committee will also decide on the request within four weeks of receipt of the request and the STU's recommendations. The Examinations Committee should expressly safeguard the continued quality and level of the educational activities of the degree program in question.

Article 5.1
Concerning the Master's examination, the dates of the Examinations Committee's meetings will be announced at the start of the academic year. In any case, three opportunities will be given to take the examination during the academic year.

Article 6.1
Section Section 7.13, subsection 2 under u of the WHW specifies that the Education and Examination Regulations should include provisions about the counseling of individual students. In this context, this article states that the Departmental Board should appoint student counselors. Clearly the Departmental Board must also ensure that these student counselors are

easily accessible to students and are qualified to provide individual student counseling. The first paragraph of this article states that this counseling should at least be focused on informing students of their study opportunities within or outside the TU/e. More specific objectives are not formulated, since it is a matter of counseling individuals, who are likely to go to their student counselor with a wide range of questions and requests. It should be clear, however, that student counselors cannot take decisions, and that their activities are restricted to giving advice to the individual student. Students should bear this in mind.

The second paragraph explains that a student's progress may be a reason for contact with the student counselor, but that counseling is not limited to that. In addition, the paragraph states a student counselor/coach/mentor must ensure adequate referral of the student in question to the competent bodies. This naturally, depends on there being good reason for referral and the nature of the issue presented by the student to the counselor/coach/mentor in question.

Article 6.2
It is necessary to safeguard students' progress for them personally, for example in connection with their study grants and loans, but also for the degree program as such. It is important for the department to be able to identify possible pitfalls at an early stage and to take measures, if necessary. Students' individual progress is a significant clue for identifying such pitfalls.

The first paragraph of this article states that all the interim examination results of individual students must be recorded and entered in the TU/e education information system, which is accessible to all students. During their degree programs, students can then always stay up to date on their interim examination results. On request, interim examination information can be issued by a third party, as long as this is in accordance with the provisions of the Personal Data Protection Act (WBP).

The second paragraph of this article states that, if necessary – for example, in the case of significant delay in their studies – students should be invited for personal interviews with their student counselor to discuss the causes of the delays, etc. Under paragraph three of this article, the students in question will in any case be informed of opportunities within the department for receiving extra support and measures that need to be taken to prevent further delays. Naturally, it is up to the students themselves to decide whether they wish to take part in such interviews and/or take advantage of these opportunities.

Article 7
This article requires no further explanation.

Article 8.1
This article states that changes to these Regulations, including changes to the content of the curriculum as outlined in the Annex, may only be implemented during an academic year if the changes do not, within reason, harm the interests of the students. In addition, the article clearly explains that any amendment to these Regulations may not affect earlier decisions made with respect to students.

Article 8.2
This provision guarantees that the Departmental Board will decide whether a transitional arrangement is needed in case of a change to the Regulations, in order to safeguard students' interests. In most cases, if the curriculum is changed, a transitional arrangement will have to be devised to enable current students to conclude their studies. This also means that students who decide to transfer to the new curriculum must be informed about which previously passed interim examinations warrant exemptions in the new program. Since such a transitional arrangement cannot be of unlimited duration, it is essential that the duration of the arrangement should be expressly stated.

Glossary

Certificate	1. A document issued by the Examinations Committee to a student as proof that an examination has been passed (section 7.11 of the WHW) 2. A document issued by the examiner in question to a student as proof that an interim examination has been passed (section 7.11 of the WHW)
Credit	A credit equals 28 hours of study. 60 Credits equal 1680 hours of study (section 7.4 of the WHW)
Degree program	A coherent whole of study components, focused on the realization of accurately defined objectives in the area of knowledge, insight and skills which the person who concludes the degree program should possess (section 7.3, subsection 2 of the WHW). This applies to both the Bachelor's and Master's degree programs of the TU/e, as registered in the Central Register of Higher Education Degree Programs (Croho)
ECTS	Credit in accordance with the European Credit Transfer System. See student workload and credit
Electives	A list of study components, included in the Annex to article 1.2, from which students must choose to fill the optional parts of their degree programs. The choices made require the Examinations Committee's approval (section 3.2 of these Regulations)
Final examination	An investigation by the Examinations Committee into the question whether a student has passed the interim examinations of the degree program
Examiner	A member of staff appointed by the Examinations Committee and charged with teaching the study component in question, or an expert from outside the university, for the benefit of administering interim examinations (section 7.12, subsection 3 of the WHW)

Examinations Committee	Committee appointed by the Departmental Board for each degree program (or group of degree programs) to administer examinations and organize and coordinate the interim examinations (section 7.12, subsection 1 of the WHW)
Interim Examination	An investigation into the knowledge, insight and skills of a student, as well as assessment of the results of that investigation (section 7.10, subsection 1 of the WHW)
Student	A person formally registered as such by the Executive Board for a degree program of the TU/e, in conformity with the Enrollment and Termination of Enrollment Regulations of the TU/e
Study component	A part of a degree program followed by an interim examination, as defined in the Annex to the Education and Examination Regulations of the degree program. Also designated as a Subject.
Study workload	The study workload of each degree program and each study component is expressed in (whole) credits (section 7.4 of the WHW)
Subject	See Study component
Teaching period	The period in which teaching in the degree programs takes place, as determined by the Executive Board at the start of each academic year.
Test	Formerly partial examination. A test is part of an interim examination and is taken into account in the final grade for the interim examination. Tests are taken and assessed individually.
Working days	Mondays through Fridays, except official holidays recognized by the Dutch government.

6.2 Examination Rules and Procedures of the TU/e

The Examinations Committee for the Bachelor's degree program in Computer Science and the Master's degree program in Computer Science and Engineering of the Eindhoven University of Technology, TU/e

in view of section 7.12 of the Higher Education and Research Act (WHW)

hereby adopts

the Computer Science Bachelor's degree program and the Computer Science and Engineering Master's degree program Examination Rules and Procedures, which read as follows:

Chapter 1 General provisions

Article 1.1 Definitions

In these Rules and Procedures, the following terms should be understood to mean:

a. WHW: the Higher Education and Research Act;
b. OER: the Education and Examination Regulations of the degree program;
c. student: a person enrolled in the Computer Science Bachelor's degree program or the Computer Science and Engineering Master's degree program as a student or external student;
d. STU: the Education and Student Service Center of the TU/e;
e. practical exercise: an educational activity in one of the following forms:
   - writing a thesis,
   - undertaking a project or an experimental design,
   - carrying out a design or research assignment,
   - doing a literature study,
   - doing an internship,
   - making a public presentation,
   - taking part in fieldwork or an excursion,
   - conducting tests and experiments,
   - writing a position paper,
   - or taking part in a different educational activity aimed at the acquisition of specific knowledge, insights or skills.

Article 1.2 Working method of the Examinations Committee

In annex 1 the procedures of the Examinations Committee can be included.

Chapter 2 Interim Examinations

Article 2.1 Participation and registration

1. A student must be registered for a degree program in order to take the interim examinations offered by that program, taking into account the sequence specified in Annex 1 to the Education and Examination Regulations under h. and i.
2. A student wishing to take part in a centrally organized written interim examination must register at the STU in the manner specified by the STU, no later than five working days before the scheduled date of the interim examination period in question.
3. A student who has already taken an interim examination three times without passing should consult with study counselor before registering for the interim examination in question again to discuss how the problem is to be addressed on the basis of a study plan drawn up by the student.
4. With reference to paragraph three, students who register for an interim examination but fail to appear will be considered to have failed the examination.
5. The work of students who take part in an interim examination without having registered for it will not be assessed.
6. The Examinations Committee will determine whether a student meets the conditions for admission to an interim examination see the OER for the Bachelor's and Master's program concerned in Annex 1, under e, h and i).
7. In exceptional circumstances, the Examinations Committee can permit a student to take an alternative interim examination to the centrally organized examination.
8. Where it is considered necessary for organizational or educational reasons, registering for study components, such as practical exercises and lectures, must occur according to the rules published in the subject pages on owinfo.nl. Students who do not comply with these rules when registering for a study component, or who register after the date specified, may not participate in the component in the period concerned. The Examinations Committee may make exceptions in such cases.

Article 2.2 Withdrawal

1. After registering for an interim examination, a student may withdraw no later than five working days before the examination is to take place, by notifying STU in the manner specified by STU.
2. With reference to paragraph three of article 2.1, students who withdraw within five working days before the interim examination will be considered to have failed the examination.
3. In exceptional cases, the Examinations Committee may deviate from the provisions in paragraph two of this article.
4. The Examinations Committee can ask the advice of the student counselor of the degree program in question or of the STU student advisors.

Article 2.3 Questions and assignments

1. The questions and assignments of the interim examination will be restricted to the content of the course material. As a rule, the course material for the interim examination will be announced at the start of the course. The exact content of the material for the interim examination and what aids the student may use during the examination will be made known no later than one month before the examination is to take place.

2. The questions and assignments of the interim examination will be restricted to the learning objectives announced in advance.
3. The questions and assignments will be clear and unequivocal, and formulated so that the student is able to ascertain how extensive or detailed the answer should be.
4. The student may keep the questions and assignments at the end of the interim examination, unless the examiner objects to this or the nature of the questions and assignments precludes this.

Chapter 3 Procedure during interim examinations

Article 3.1 Preserving order during interim examinations (see Annex 2)

1. For each interim examination the Examinations Committee will appoint at least one examiner and, if necessary, invigilators.
2. Students are obliged, before or during the interim examination, and at the request of the examiners or the invigilators, to identify themselves by showing their student card and valid proof of enrollment for the current academic year.
3. Before, during and immediately after an interim examination, students are obliged to follow the instructions of the examiners or invigilators. These instructions include the directions referred to in Annex 2 of these Examination Rules and Procedures.
4. Any student who fails to comply with the provisions in paragraphs two and three of this article may be immediately excluded by the examiner from further participation in the interim examination.
5. Exclusion as described in paragraph 4 means that the interim examination results of the student in question will not be assessed and that they will be considered to have failed the examination, with regard to implementation of paragraph three of article 2.1.
6. For the implementation of this current article, interim examinations also include any practical exercises that are part of the degree program.

Article 3.2 Regulations regarding fraud

1. Fraud comprises in any case any action by a student, or failure to act by a student, which makes it partially or completely impossible for the examiner to form an accurate opinion of his/her knowledge, understanding and skills.
2. Fraud includes: - submitting work under his/her own name that has been done by others or copied from others wholly or partially: this includes copying word-for-word or paraphrasing the work of others without indicating that the words or underlying ideas belong to someone else; - actively offering his/her own work to others, who might then submit it as their own work.
3. If an examiner or invigilator should discover or suspect fraud in relation to the interim examination, either before, during or immediately after the interim examination, the examiner will record this in writing as soon as possible. If requested, the student in question should present any evidence required. Refusal to do so will be mentioned in the report.
4. The student in question will be given the opportunity to add written comments to the examiner's report.
5. The report will be sent to the Examinations Committee as soon as possible, if applicable, together with the student's written comments.
6. The Examinations Committee will take the measures it deems appropriate, taking into account the provisions of subsection 4 of section 7.12 of the WHW.

7. Before taking a decision based on the previous paragraph, the Examinations Committee will give the student in question an opportunity to explain his/her actions.
8. For the implementation of this current article, interim examinations also include practical exercises that are part of the degree program.

Chapter 4 Assessment of interim examinations and practical exercises

Article 4.1 Assessment

1. Assessment of interim examinations and practical exercises is carried out by an examiner or examiners.
2. The results of interim examinations and practical exercises will be determined for each individual student, and may be divided into a number of components.
3. The assessment of an interim examination, as well as the investigation mentioned in article 5.1, paragraph 2, of these Examination Rules and Procedures, will be expressed in whole numbers on a scale of 0 to 10. The assessment of tests can be expressed in decimals. The assessment of practical exercises is expressed in whole numbers on a scale of 0 to 10, or in half numbers, or in the designations Failed (FL), Sufficient (PA) or Done (DN)
4. An interim examination is passed if the grade is 6 or higher, or with an assessment of PA or DN. A practical exercise is passed if the grade is 5.5 or higher, or with an assessment of PA or DN.
5. If a student registers for an interim examination but fails to appear, he/she will be considered to have failed the examination, under the provisions of paragraph three of article 2.1, and the examination result will be marked NP (No show).
6. If a student has committed fraud, as specified in article 3.2 of these Rules and Procedures, the examination result, in accordance with article 2.1, paragraph 3, will be considered as Failed (FL).
7. The assessment standards will be announced at the latest immediately before the start of the interim examination.
8. The method of assessment should enable the student to ascertain how the results of the interim examination were determined.

Chapter 5 Final examinations

Article 5.1 Registration

1. Students should register for a final examination at the STU in the manner specified by the STU no later than 20 days before the date of the examination.
2. The Examinations Committee will inform the students in good time when it plans to conduct an investigation, as provided in section 7.10, subsection 2 of the WHW.

Article 5.2 Assessment and result

1. If a student has taken an interim examination more than once, the Examinations Committee will take into account the highest grade obtained in determining the result of the final examination.
2. The result of the final examination will be ‘passed’ or ‘failed’.
3. A student is considered to have passed the final examination if he/she has passed the corresponding interim examinations and practical exercises, taking into account the compensation arrangements specified in article 5.3 and any exemptions that may have been granted to the student on the basis of article 2.7, paragraph 6 of the OER for the degree program, or if the investigation carried out by the Examinations Committee, as specified in article 5.1, paragraph 2, resulted in a grade of 6 or higher.

Article 5.3 Compensation and bonus arrangements

This program has no compensation or bonus arrangements except the stipulations in article 5.5.

Article 5.4 Certificate and supplement

1. The certificate will be awarded in public unless, in exceptional cases, the Examinations Committee decides otherwise.
2. The certificate will contain the information specified in section 7.11, subsection 2, of the WHW.
3. When the certificate is awarded, the student will also receive a supplement.
4. The supplement will contain the information specified in section 7.11, subsection 3, of the WHW, as well as the grades received for parts of the examination and, if required, for other study components that are not part of the examination, if the students in question have passed the interim examinations for those study components before the Examinations Committee determines the final examination result.

Article 5.5 Special qualifications for the propaedeutic year

A student is considered to have passed the examination for the propaedeutic year if he/she has passed the corresponding interim examinations and practical exercises, except an interim examination or practical exercise for which he/she is judged with the grade of 5. This regulation is only in force in case he/she passes the examination for the propaedeutic year in the first year of enrolment in the Bachelor's degree program. For the rest the propositions in article 5.2, paragraph 3, hold with respect to the examination for the propaedeutic year.

Article 5.6 Special qualification for Bachelor's programs

1. The Examinations Committee may award the classification "cum laude" if the student achieves an average grade of 8 or higher for all the study components (including minors) that are part of the program. In addition, none of the study components may have a grade lower than a 6.
2. Only individual assessments are included in the calculation of the average grade. Group assessments are not taken into account.
3. If the Bachelor's program is concluded with a graduation project, the Examinations Committee may impose supplementary requirements regarding the result of the project.

Article 5.7 Special qualification for Master's programs

The Examinations Committee may award the classification "cum laude" if the student achieves an average grade of 8 or higher for all the study components, with the exception of the graduation project, which must have a grade of 9 or higher. In addition, none of the study components may have a grade lower than a 6.

Chapter 6 Final provisions

Article 6.1 Security
During the processing of written or other types of interim examinations, the Examinations Committee will ensure proper protection against loss, theft or wrongful acts.

Article 6.2 Appeals
No later than four weeks after the decision has been made known to them, interested parties may lodge an appeal against a decision of the Examinations Committee or the examiners, based on these Examination Rules and Procedures, with the Examination Appeals Board (CBE) as referred to in section 7.60 of the WHW.

Article 6.3 Amendments
Amendments to these Examination Rules and Procedures may only come into force in the current academic year if this does not, within reason, have a negative effect on the interests of the students.

Article 6.4 Transitional arrangement/provision
The degree classifications specified in articles 5.6 and 5.7 apply to students who start the first year of the Bachelor's program or the first year of the Master's program on September 1, 2007. For students already enrolled in previous years, the Rules and Procedures of the year in which they started the program are applicable.

Article 6.5 Effective date
These Examination Rules and Procedures replace the Rules and Procedures of all previous versions and come into effect September 1, 2007.

Adopted by the Examinations Committee for the Bachelor's degree program in Computer Science and the Master's degree program in Computer Science and Engineering on June 18, 2007.

Annex 1 Working method of the Examinations Committee

The Examinations Committee can install from its members a committee in behalf of daily matters consisting of the chairperson, a member and the secretary.

Annex 2 to article 3.1, paragraph 3, of the Examination Rules and Procedures for the Bachelor's degree program in Computer Science and the Master's degree program in Computer Science and Engineering of June 18, 2007

Instructions for written interim examinations

1. Students may be admitted to the examination up to 15 minutes after the start. They will not be allowed any extra time.

2. Students may not leave the examination room earlier than 15 minutes after the start of the examination.

3. At the start of a written interim examination, students must fill in their ID number, program and full name and address on the attendance card provided and lay the card on the table so that the examiner or invigilator can see it clearly. In exceptional cases, the examiner may accept an alternative official means of identification.

4. Students must fill in the above information at the top of every sheet of paper to be handed in, clearly and completely, in capital letters, and with all initials. The sheets should be numbered in sequence.

5. The TU/e will provide all the necessary paper. Students must bring their own writing and drawing materials. Rulers, compasses and set squares with angles of 30 and 45 degrees are allowed for drawings.

6. Students are not permitted to use papers, books, calculators, etc. other than those issued by the examiner, unless explicitly stated otherwise on the interim examination form.

7. Students are not permitted to use a mobile telephone or other electronic equipment during the examination, unless explicitly stated otherwise by or on behalf of the Examinations Committee.

8. At the end of the examination, students may not leave their seats or talk to each other until all the written work has been collected by the invigilators.

9. Students must hand in all their written work to the invigilators personally.

Annex 3 to article 5.2, paragraph 4, of the Examination Rules and Procedures for the Bachelor's degree program in Computer Science and the Master's degree program in Computer Science and Engineering of June 18, 2007

Graduation regulations for Computer Science and Engineering

Rules for the 'master project' component of the examination

These rules are part of the 'Rules and Regulations' of the 'Computer Science and Engineering' master's degree program, laid down by the Examinations Committee of the Computer Science and Engineering master's degree program.

Definitions

Graduation tutor: the person who guides the student during the master project.

Graduation supervisor: a member of the Computer Science sub-department within the Mathematics and Computer Science department, responsible for the graduation phase of the student.

Area of expertise: one of the groups within the Computer Science sub-department.

Subject

Article 1
These regulations are concerned with the preparation and examining of the “master project” that forms a mandatory program unit within the program, as described in article 8 of the Education and Examination Regulations of the two-year Computer Science and Engineering master’s degree program.

Article 2
The “Examination Rules and Procedures” and the “Education and Examination Regulations” for the Computer Science and Engineering master’s degree program are equally applicable.

Master project

Article 3
The master project consists of the research assignment and/or the design assignment to be independently carried out by the student in combination with the oral and written reporting about this assignment. The master project is the final part of the Computer Science and Engineering master’s degree program.

Execution of the master project in a team

Article 4
1. It is permitted to carry out the master project in a team, as long as each of the team members has a personal assignment or sub-assignment that can be individually assessed. Graduation can be said to take place in a team if more than one student works simultaneously on a complicated and/or sizeable assignment.
2. Where the word ‘student’ is used in these regulations, unless specifically stated otherwise, this also refers to a group of students carrying out the master project in a team.

Supervisory team

Article 5
1. The graduation supervisor is an assistant professor, an associate professor or a professor from the Computer Science sub-department within the Mathematics and Computer Science department. In case that the master project is part of the master-specialization Information Security Technology the graduation supervisor can also be an assistant professor, an associate professor or a professor from the Coding Theory and Cryptology section within the Mathematics and Computer Science department. The head of the area of expertise in question within the Mathematics and Computer Science department should approve the choice of the graduation supervisor on behalf of the Examinations Committee.
2. The student should look for a suitable graduation supervisor and graduation tutor. If the student cannot find a suitable graduation supervisor then the director of the Computer Science and Engineering master’s degree program will assign a graduation supervisor.
3. The choice of the graduation tutor should be submitted to the graduation supervisor for approval.

4. The function of graduation supervisor and graduation tutor can be combined in one person.
5. The graduation supervisor makes a problem description of the master project that needs to be approved by the professor of the chair within which the student is graduating. The approval will be based on the scientific level of the project, the feasibility of the goals of the project and the manageability of the project. The problem description is included to the graduation plan as an appendix.
6. The graduation supervisor and the student make a graduation plan detailing information related to the student's study progress, the graduation topic, how the student can be contacted during the graduation phase and the choice of the tutor.
7. The Examinations Committee will only approve the graduation plan referred to in section 6 if all program units have been completed and the master's degree program has been approved. In special circumstances the Examinations Committee can also decide to approve the plan if:
   a. the graduation supervisor considers that a few uncompleted program units can better be completed during the graduation period, or if
   b. the student can show that waiting for the next possible examination period to complete a few uncompleted program units will have a disproportionately negative effect on the course of his or her studies.

   The total number of credits in a) and b) may not be more than 10 credits. The program units mentioned in a) and b) may not be part of the student's bachelor program.
8. The definitive starting date of the graduation phase is considered to be the moment at which the Examinations Committee accepts the graduation plan. On behalf of the Examinations Committee, the master-coordinator checks whether all of the requirements have been met to start the master project.
9. Within one month after the starting date of the master project the student makes a detailed project plan that includes the targets and a time schedule. The student discusses the project plan with the graduation supervisor.
10. The graduation tutor is required to deliver instructions to the student considering the execution of the master project, to give feedback to texts delivered by the student in a reasonable time, to guard the progress of the project, and to stimulate, motivate and correct the student. The student is supposed to take initiatives, to guard the progress of the project, and to report to the graduation tutor at least each fortnight.

Assessment Committee

Article 6

1. The composition of the Assessment Committee should be decided upon no later than two months before the completion of the master project. The graduation supervisor should give the proposal for approval to the head of the area of expertise within which the student is graduating, and also to the secretary of the Examinations Committee.
2. An Assessment Committee consists of three voting members who together determine the final mark for the master project.
3. The Assessment Committee referred to in section 1 and 2 consists of three voting members including the graduation supervisor and the graduation tutor. Advisory members may be included in the committee. The voting members of the Assessment Committee are appointed as examiners by the Examinations Committee according to article 7.12, section 3 of the

Higher Education and Research Act (WHW: *Wet op het Hoger Onderwijs en Wetenschappelijk Onderzoek*). A PhD student may only act as a voting member of the Assessment Committee if he is the graduation tutor.

4. The Assessment Committee has voting members from at least two chairs within the Computer Science sub-department at the TU/e.
5. The graduation supervisor is the chairperson of the Assessment Committee. In the absence of the graduation supervisor, one of the other voting members acts as the chairperson of the Assessment Committee.
6. If one of the voting members at the last moment cannot take part as a member of the Assessment Committee, and if this would have a disproportionately negative effect on the assessment then, at the student's request or the request of one of the other voting members of the Assessment Committee, the head of the area of expertise from which the student is graduating can appoint a replacement on behalf of the Examinations Committee.

Assessment

Article 7

1. The voting members of the Assessment Committee together determine a final mark. If an agreement cannot be reached, each member individually gives a final mark, without knowledge of the marks given by the other members; the arithmetical mean is then calculated and rounded to the nearest integer from 1 up to and including 10. Marks ending in .5 are rounded up. The considerations leading to the assessment are shared with the student.
2. If a student achieves a mark of at least 9 for his or her master project and if the student has an average mark of at least 8 for the other program units from the master's degree program, then he or she can be considered for a diploma with honors.
3. In cases where the master project has been carried out in a team, it must be clearly stated which student was responsible for each part of the report; the students making up the team will be questioned and assessed separately.

Article 8

The master project is assessed on the following four aspects:

- the quality of the report, with respect to scientific quality, structure and style,
- the quality of the graduation presentation, once again related both to content and style,
- the quality of the defense, i.e. the way in which the candidate answers the questions from the assessors about the report and the presentation,
- the execution of the assignment during the graduation phase.

The Assessment Committee will give a master project assessment report to the student. In this report it should be clearly described how the student is judged with respect to the four aspects, and how the final mark is determined.

Graduation report, presentation and defense

Article 9

1. The student will supply a good quality copy of the final graduation report to the members of the Assessment Committee referred to in article 6, at least 15 working days before the date of the final presentation referred to in article 10.

2. The graduation report is reproduced a maximum of 15 times at the expense of the department. Covers and a form for the university's Reproduction Department can both be collected from the Student Administration office. The copies should be ready at least two weeks before the Examinations Committee meeting for which the student has put his or her name forward.
3. The report will be made public after the assessment by the Assessment Committee, unless the organization in which the graduation phase has taken place considers that its publication would harm its interests. The organization or the graduation supervisor can submit a request concerning confidentiality to the Examinations Committee. The student should then make a summary suitable for general publication to be included in the assessment.

Article 10

1. After completion of the graduation report, the student will give a final presentation and will defend his or her thesis in the presence of the Assessment Committee referred to in article 6. The place and date of the final presentation and the defense will be made known beforehand. An interim presentation is strongly recommended but is not mandatory.
2. The graduation plan can include a date for an interim evaluation between the graduation supervisor and the student. A report will be made of this discussion. This report should be handed in to the master-coordinator.
3. The final presentation cannot take place before all program units from the master's degree program have been completed.
4. The final presentation and the following assessment should take place at least two weeks before the examination meeting in which the student can be declared to be passed.
5. The final presentation is public and is held in buildings of the Technische Universiteit Eindhoven.
6. The defense is not public; only the student and the Assessment Committee are present unless both parties have no objection to the presence of others.

Disputes

Article 11

1. In the case of disputes between the graduation tutor and the graduation supervisor, the advice of the graduation supervisor will be followed. Disputes can be brought before the Examinations Committee.
2. Disputes between the student and the graduation supervisor can be brought before the Examinations Committee.
3. The student can appeal against decisions of, and the treatment by, the Assessment Committee at the TU/e's Examinations Appeals Board, on the basis of article 7.60 of the WHW.

Concluding article

Article 12

The Examinations Committee will decide any cases not covered by these regulations. If the need arises, the Examinations Committee can deviate from these regulations.

Explanatory notes to the Examination Rules and Procedures of the Bachelor's degree program in Computer Science and the Master's degree program in Computer Science and Engineering

General

Under section 7.12, subsection 4, of the Higher Education and Research Act (WHW), the Examinations Committee must draw up rules for the proper procedure to be followed during interim examinations and relating to any measures to be taken to safeguard that. In addition, under the same section, the Examinations Committee may provide guidelines and instructions to examiners regarding the assessment of persons taking interim examinations and determining the results of interim examinations. These Examination Rules and Procedures serve to implement this legal assignment and authority.

In drawing up these Examination Rules and Procedures, a direct link was made with the Education and Examination Regulations adopted for the degree program by the Departmental Board (OER), which regulate a large number of issues on the basis of the Departmental Board's legal authority. These Examination Rules and Procedures should therefore be read in conjunction with the OER for this degree program and – where admission to the program is concerned – the admission regulations for Master's degree programs.

Article 1.1

The definitions in these Examination Rules and Procedures have been limited to those concepts that were necessary for drawing up the Rules and Procedures. This does not affect the fact that clarity should be provided about the exact meaning of the various – sometimes legally-defined – concepts used in these Regulations. A glossary has been added for this purpose, to prevent confusion about the meaning of the concepts.

Article 1.2

The work of the Examinations Committee may include, for example, appointing committees from among its own members to look after daily activities, etc.

Article 2.1

The first paragraph of this article specifies that a student may only legally take part in an interim examination if he/she is enrolled in the degree program. In addition, the rules included under e, h. and i. of the Annex to the Education and Examination Regulations apply. These refer to the sequence of interim examinations and the obligation to participate in certain practical exercises before an interim examination can be taken.

The second paragraph determines that a student wishing to take part in a centrally organized, written interim examination must register at the STU no later than five days before the interim examination period in question. Registration should take place in the manner determined by the STU, i.e. through www.owinfo.tue.nl.

The Executive Board of the TU/e considers it important that students prepare thoroughly for interim examinations. A student who has already taken an interim examination three times without passing should consult with the study counselor before registering for the interim examination again to discuss how the problem is to be addressed on the basis of a study plan

drawn up by the student. The purpose of this compulsory student counseling is to discuss the student's approach to his/her study and how this might lead to serious study delays. The study counselor must ensure that agreement is reached on the student's approach on the basis of the student's study plan and will provide any assistance necessary. This is specified in the third paragraph. A student may not register for an interim examination if they have already failed it three times. This means that a student who has already had two fails and one satisfactory grade may register to do the interim examination again to try and improve the grade. In this case, too, a student who has three fails and one or more satisfactory grades should contact the study counselor.

To encourage students to prepare thoroughly for interim examinations, the fourth paragraph of this article specifies that a student who registers for an interim examination, and then fails to appear or leaves early without handing in the work, will be considered as having failed the examination. In this way, the Examinations Committee discourages students from registering for interim examinations too easily. In such cases, the student is considered as having taken part in the interim examination, as specified in paragraph 3.

The fifth paragraph of this article explains to students that, failure to register for a centrally organized written interim examination according to the specified procedure will result in the examination not being assessed and therefore not being taken into account in determining the result of their final examination.

In the sixth paragraph the Examinations Committee is designated as the body that ascertains whether a student meets all the requirements to be allowed to take part in an interim examination.

The exceptional circumstances referred to in the seventh paragraph could include, for example, a situation beyond the student's control, such as illness or a death in the family. The student can make this known no later than five days after the examination, providing written evidence of the cause (e.g. a doctor's statement that the student had consulted him/her with x symptoms on date y, or a death certificate (not a newspaper announcement)).

The last paragraph contains the provisions for registering for practical exercises and lectures for organizational or educational reasons. Organizational reasons can include the availability of rooms, laboratory capacity, the availability of invigilators, limited measuring equipment, etc. Educational reasons might include the fact that a certain practical exercise or project requires certain prior knowledge. Registration is then necessary to determine whether candidates meet these requirements.

Article 2.2

A student may withdraw from an interim examination after registering, but must do so no later than five working days before the examination is to take place. The student should notify the STU in the manner determined by STU, i.e. through www.owinfo.tue.nl. If a student withdraws later than five working days before the interim examinations start without clearly stating the reasons, he/she will be considered to have failed the interim examination and this will count in determining whether the student has taken the examination three times before without passing it.

In the third paragraph of this article it is left to the Examinations Committee to decide whether the reasons given by the student for withdrawing from the examination too late are such that the second paragraph should not be implemented. The fourth paragraph indicates that the Examinations Committee may consult the student counselor or the STU student advisors about the circumstances of the student in question.

Article 2.3
This article should be considered an instruction by the Examinations Committee to its appointed examiners regarding the questions and assignments of the interim examinations of the degree program. Paragraphs 1 through 3 outline the factors that the examiners should take into account when setting the questions and assignments for an interim examination.

In the first place, the questions and assignments should relate to the interim examination material. The course material of the study component to which the interim examination relates is announced in broad lines at the start of the course. The exact content of the material for the interim examination should be made known to the students no later than one month before the examination is to take place. It will be assumed that students are familiar with material from earlier study components of the program. No later than one month before the examination, the students should also be informed of which aids they are permitted to use and to what extent they need to supply these themselves. These include, for example, a pocket calculator, a notebook, lecture notes or books.

In the second place, the Examinations Committee specified that the learning objectives of the subject in question should be clear beforehand and that the questions and assignments of the interim examination do not exceed those objectives. In addition, as a rule, the interim examination should not focus only on specific parts of the interim examination course material.

The third paragraph states that the questions and assignments must be clear and unequivocal; they should be drawn up in such a way or be accompanied by instructions that will reasonably enable students to ascertain how elaborate or detailed their answers should be. It should be clear to the students what kinds of answers are expected.

Finally, the fourth paragraph of this article gives students the right to take the questions and assignments with them at the end of the interim examination, unless the examiner objects or the nature of the questions and assignments precludes this, for example, if the examination takes place in a laboratory.

Article 3.1
The first paragraph of this article specifies that the Examinations Committee will appoint examiners and, if necessary, invigilators for each interim examination. This applies to written, oral and other types of examinations. Before, during and after the interim examination, the examiners should ensure that the proper procedures are followed, on behalf of the Examinations Committee.

The examiners appointed by the Examinations Committee are generally lecturers on the course relating to the interim examination. That means that the Examinations Committee will also appoint examiners for interim examinations in minors or electives chosen by the student who

are lecturers in those subjects. The examiners determine whether the student has completed the interim examination or practical exercise successfully and submit proof of this to the Examinations Committee. The Committee retains the final responsibility. The subsequent paragraphs of this article describe the correct procedures in more detail.
In the first place, before or during the interim examination and at the request of the examiners or invigilators, students should provide proof of identity by showing valid proof of enrollment for the academic year in question and their student cards (paragraph 2). This is intended to prevent students from letting someone else take the interim examination in their place. The result of an interim examination should be irrefutably entered against the correct student's name.

Secondly, before, during and immediately after an interim examination students should follow the instructions of the examiners or invigilators. These instructions might constitute a prohibition on the use of certain aids or instructions to maintain silence during the examination. Annex 2 of these Rules and Procedures includes a number of instructions that fall into these categories.

Under the fourth paragraph of this article, if a student fails to comply with a request to show identification or refuses to follow the instructions of the examiner or invigilator, the examiner may order the student to leave the room and take no further part in the examination.

The fifth paragraph of this article states that, if a student is excluded from further participation in an interim examination, no result will be determined for examination and the student will be considered to taken the examination, as understood in the third paragraph of article 2.1.

The last paragraph specifies that the above provisions not only apply to written and oral interim examinations, but also to practical exercises.

Article 3.2
The first two paragraphs of this article define what constitutes fraud. The rest of the article describes the powers and courses of action open to the examiner and students if the examiner or the invigilator discovers or suspects them of fraud during or after an interim examination.

The third paragraph requires that the examiner record such incidents in writing as soon as possible. At the examiner's request, the student in question should present any evidence to show that he or she did not commit fraud. If the student refuses to do this, the refusal will be mentioned in the examiner's report. On the basis of the third paragraph, the student has the right to add written comments to the examiner's report.

The fourth paragraph requires that the examiner send the report to the Examinations Committee immediately, together with the student's comments. It is then up to the Examinations Committee to take any measures it considers appropriate. It is explicitly not the intention that an examiner who discovers or suspects fraud takes action independently. Under section 7.12, subsection 4 of the WHW, the Examinations Committee may deny the student in question the right, for a maximum period of one year, to take part in interim examinations or final examinations of the degree program mentioned in the Examinations Committee's decision.

The seventh paragraph states that the Examinations Committee should give the student an opportunity to be heard before it decides on any measures to be taken.

The final paragraph of this article states that interim examinations should also be understood to include the practical exercises that are part of the degree program.

Article 4.1

This article contains directions from the Examinations Committee for the examiners regarding the assessment of interim examinations and practical exercises. The first paragraph states that this assessment should be carried out by the appointed examiners. To ensure that the quality of the assessment is up to standard and that the standards for assessment are uniform, it is advisable that the assessment is conducted by several examiners.

The second paragraph specifies that assessments always relate to individual students. This applies in all cases to oral interim examinations – see article 2.3 and the Explanatory Notes to the Education and Examination Regulations corresponding to these Rules and Procedures – and to the assessment of practical exercises. For the assessment of group projects, for example, this means that the examiner ascertains and assesses individual students' contributions to group projects – if applicable, taking account of the various components, and, based on that, determines whether the individual student has passed the interim examination. Tests (previously partial interim examinations) can be assessed in tenths of a whole number. A test is part of an interim examination.

The third paragraph states that the assessment of interim examinations is expressed in whole numbers. It is not possible, therefore, to give a student a 7.4 or 5.8, for example. The same applies to investigations carried out by the Examinations Committee based on section 7.10, subsection 2, of the WHW, before awarding the examination review certificate referred to in article 5.1, paragraph two, of these Requirements. Such an investigation should be considered an interim examination in the sense of the WHW.

Regarding the assessment of practical exercises, the fourth paragraph of this article starts from three options in addition to the figures referred to in the previous paragraph: 'satisfactory', 'unsatisfactory' or 'done'. Only practical exercises can be assessed using half number. Other assessments by the examiners are not permitted.

For the sake of clarity, the fourth paragraph also states when a student has passed an interim examination or a practical exercise. This is important because it enables the Examinations Committee to ascertain whether a student can be allowed to take part in an interim examination, in cases where the sequence of interim examinations and practical exercises is specified.

The fifth paragraph specifies how an interim examination is assessed if a student does not attend, and the sixth paragraph what happens if a student is guilty of fraud.

The seventh paragraph of this article specifies that the assessment standards should be made known in good time before an interim examination is taken. Students should know what is expected of them beforehand. Finally, the eighth paragraph specifies that assessment should be conducted in such a way that students understand how the results of their interim examinations were determined.

Article 5.1
Article 4.1 of the OER corresponding to these requirements states that the dates of the three meetings of the Examinations Committee on which the final examination may be taken, will be announced at the start of each academic year. This article requires that students who wish to take the final examination register with the STU no later than 20 days before the date of the examination.

Students may only register for the final examination if they have passed all the interim examinations that are part of the final examination, which will generally consist of awarding of the certificate. Section 7.10, subsection 2, of the WHW states that students who have passed the interim examinations of the study components of the degree program are considered to have passed the final examination. However, under the same provision in the WHW, the Examinations Committee is entitled, before awarding certificate, to subject the examinee to an investigation to be conducted by the Examinations Committee itself. The second paragraph of article 5.1 of these Requirements states that the Examinations Committee will notify the student in good time that such an investigation is going to be conducted.

These Regulations do not include more detailed provisions regarding withdraw from a final examination or appearing without having registered, as referred to in article 2.3, because the Examinations Committee takes the view that such cases will occur only rarely. However, if such a case were to occur, the Examinations Committee is free to decide what action it will take.

Article 5.2
This article specifies how the Examinations Committee should judge cases in which students have taken an interim examination more than once. This may happen if a student wants to improve his/her study results, with a view to the compensation arrangements in article 5.3 of these Regulations. In such cases, on the basis of the first paragraph, the Examinations Committee will determine the result of the final examination by taking into account the highest grade.

The second paragraph determines that the result of the final examination will either be ‘passed’ or ‘failed’.

For the sake of completeness and clarity, the third paragraph of this article states that determination of whether a student has passed the examination is based not only on whether the student has passed all the interim examinations of the degree program in question. The Examinations Committee will also take into account the compensation arrangements described in article 5.3, together with any exemptions that may have been granted to the student under article 2.7 of the OER corresponding to these Rules and Procedures, and whether the investigation instituted by the Examinations Committee, as referred to in article 5.1, paragraph two, has resulted in a grade of 6 or higher.

Article 5.3
This program has no compensation or bonus arrangements except the stipulations in article 5.5.

Article 5.4

The first paragraph of this article indicates that certificates are awarded publicly unless, in exceptional cases, the Examinations Committee decides otherwise. The second paragraph specifies – in accordance with section 7.11, subsection 2, of the WHW – the certificate should mention the following details:

- the degree program in question, as entered in the Central Register of Higher Education Study Programmes (Croho). This means that the name of the degree program on the certificate should correspond to the name entered in the Croho;
- the components of the examination, in accordance with the OER of the degree program in question;
- the degree being awarded by the institution board, based on the certificate;
  the date on which the degree program was last accredited, or passed the new degree program test.

In addition, the third paragraph states that graduates will also be given a supplement. In accordance with section 7.11, subsection 3, of the WHW, with a view to the international recognition of the degree program, the said supplement will include:

- the name of the degree program and the name of the TU/e,
- whether it is an academic higher education (WO) or higher professional education (HBO) degree program,
- a description of the contents of the degree program, and
- the study workload of the degree program.

Section 7.11, subsection 3, of the WHW also specifies that – due to the international aspect of the program – the supplement should be drawn up in both Dutch and English.

In addition, the Examinations Committee will include the student's list of grades in the supplement, as well as any study components which are not part of the final examination of the degree program and which the student may have passed. The student may have followed parts of other TU/e degree programs and passed the corresponding interim examinations, and may appreciate these interim examinations also being mentioned on the supplement. The student will, however, have to request the Examinations Committee to do this and submit to the Board evidence of having passed these earlier interim examinations at the TU/e. The Examinations Committee has decided not to include a procedure for such a request in these Regulations, leaving it to the student to make a timely request to the Examinations Committee.

A condition for including these results on the supplement is that the study components in question were passed by the student before the Examinations Committee determined the result of the examination.

This provision means that no additional information will be added to a certificate or supplement once it has been awarded. If a student passes other interim examinations or examinations after the certificate has been awarded, this will have no consequences for the certificates or supplements awarded earlier.

Article 5.5
The qualification that is included in article 5.5 acts for the benefit of the improvement of the study pace. It is expected from a student who is able to pass the examination for the propaedeutic year within one year, that he/she is able to compensate the deficient knowledge that corresponds to the interim examination or practical exercise for which he/she is judged with the grade of 5 in the remainder of his/her study period.

Articles 5.6 and 5.7
In its decision of 27 February 2007, the Executive Board determined the degree classifications for Bachelor's and Master's degree programs at the TU/e. A proposal to introduce other classifications will be finalized in the spring of 2007, in consultation with the program directors. These new classifications will only become effective as of 1 September 2008. This means that there may be different classifications within the programs in the 2007-2008 academic year. Regarding article 5.6, paragraph 2, stating that group assessments are not taken into account in calculating a student's average grade, it should noted that the results of tests can be included in the calculation if they are taken and assessed individually.

Article 6.1
This article specifies that the Examinations Committee must take adequate measures to protect work produced by students in the context of interim examinations from loss, theft or illegal acts. The measures taken by the Examinations Committee in this respect take the form of a guideline for examiners regarding the assessment and determination of the results of interim examinations.

Article 6.2
Students may appeal against all decisions of the Examinations Committee or of examiners, based on these Rules and Procedures, to the Examination Appeals Board of the TU/e. The term for submitting such requests is four weeks after the decision of the Examinations Committee is made known to the person who lodges an appeal. Students are advised to discuss their intention to submit an appeal with the Examinations Committee within seven working days of receiving the Committee's decision. Depending on the outcome of this discussion, the student is still free to submit the appeal. NB: this does not mean that that the four-week period for submitting appeals is suspended for seven working days. It still starts on the date that the student is informed of the Examinations Committee's decision.

Article 6.3
This provision guarantees that, when making an amendment to these Regulations, the Examinations Committee will ensure that the interests of students are not harmed unreasonably by the amendment coming into effect in the course of the academic year. If that is the case, the amendment will not take effect until the next academic year.

Article 6.4
A transitional arrangement has been introduced, in connection with the changes to the degree classifications as of 1 September 2007. Any other transitional arrangements relating to the program can be added to this.

Glossary

Certificate	1. A document issued by the Examinations Committee to a student as proof that an examination has been passed (section 7.11 of the WHW) 2. A document issued by the examiner in question to a student as proof that an interim examination has been passed (section 7.11 of the WHW)
Credit	A credit equals 28 hours of study. 60 Credits equal 1,680 hours of study (section 7.4 of the WHW)
Degree program	A coherent whole of study components, focused on the realization of accurately defined objectives in the area of knowledge, insight and skills that the person who concludes the degree program should possess (section 7.3, subsection 2, of the WHW). This applies to both the Bachelor's and Master's degree programs at the TU/e, as entered in the Central Register of Higher Education Study Programs (Croho)
ECTS	European Credit Transfer System. See study workload and credit
Examiner	A member of staff appointed by the Examinations Committee and charged with teaching the study component in question, or an expert from outside the university, for the benefit of administering interim examinations (section 7.12, subsection 3, of the WHW)
Examinations Committee	Committee appointed by the Departmental Board for each degree program (or group of degree programs) to administer examinations and organize and coordinate interim examinations (section 7.12, subsection 1, of the WHW)
Final examination	An investigation by the Examinations Committee into the question whether a student has passed the interim examinations of the degree program
Interim Examination	An investigation into the knowledge, insight and skills of a student, as well as the assessment of the results of that investigation (section 7.10, subsection 1 of the WHW)
Student	A person formally registered as such by the Executive Board for a degree program at the TU/e, in conformity with the Enrollment and Termination of Enrollment Regulations of the TU/e
Study component	A part of a degree program followed by an interim examination, as defined in the Annex to the Education and Examination Regulations of the degree program. Also designated as a Subject.

Study workload	The study workload of each degree program and each unit of study is expressed in (whole) credits (section 7.4 of the WHW)
Subject	See Study component
Teaching period	The period in which teaching the degree programs takes place, as determined by the Executive Board at the start of each academic year.
Working days	Mondays through Fridays, except official holidays recognized by the Dutch government.

7. course descriptions

7. Course descriptions

0L870 Ethics and Law

General information

Academic year:	2008/2009
Class planning/	• Semester 1 Block A t/m Semester 1 Block B
Target group:	• Computer Science and Engineering Bachelor, Bachelor's and four/five year program (jaar 1), Compulsory, Dutch • HBO-minor Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch • HBO-minor Computer Science and Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch • HBO-minor Embedded Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
ECTS credits BaMa:	3
Provided by:	• Department: Technology Management (responsible) • Subdepartment: History, Philosophy and Technology Studies • Subdepartment: Technology and Policy • Section: Philosophy and ethics of technology
Lecturers:	• dr. A. Spahn (responsible lecturer) • prof.mr.dr. J.M. Smits (co-lecturer)
Information:	• Secr. F&ET - IPO 2.21 - M.J.Schaaf@tue.nl - tel. 4753 • dr. A. Spahn - IPO 2.35 - tel: 2746 - a.spahn@tue.nl
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:	• 9 weeks video lecture, 2 hours
Type of examination/ planning:	• Written, Semester 1 Block B (3 hours), Semester 1 Block C (3 hours)
Course material:	• Boek: L.M.M. Royakkers e.a. (red.) Ethiek & Techniek. Morele overwegingen in de ingenieurspraktijk. Baarn: HBuitgevers 2005/2006 (recommended) • F.A.M. van der Klaauw-Koops en S.F.M. Corvers (red.) Praktisch informaticarecht. Groningen: Martinus Nijhoff 2002 (recommended)

Contents

Learning objectives: Is able to critically reflect on the field of study: computer science; Is able to ask adequate questions, and has a critical yet constructive attitude towards analyzing and solving moral and legal problems in computer science; Is able to analyze and to discuss the ethical and legal aspects of the consequences and assumptions of scientific thinking and acting with colleagues and non-colleagues.

Contents: On the basis of case-based exercises several basic concepts of ethics and law will be introduced, such as computer ethics, philosophical foundations of computer ethics, privacy, property rights, and different senses of responsibility.

2DL03 Basic mathematics

General information

Academic year: 2008/2009

Class planning/ Target group:

- HBO-minor Architecture, Building and Planning, Bachelor's degree program (jaar 1), Compulsory, Dutch
- Semester 1 Block A
  - HBO-minor Biomedical Instrumentation Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Building Services, Bachelor's degree program (jaar 1) Compulsory, Dutch
  - HBO-minor Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Chemical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Computer Science and Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Electrical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Embedded Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Human-Technology Interaction, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Innovation Management, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Mechanical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Operations Management and Logistics, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Sustainable Energy Technology, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Technology and Policy, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - Pre-master program Biomedical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch

- Pre-master program Building Services, Bachelor's degree program (jaar 1), Compulsory, Dutch
- Pre-master program Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
- Pre-master program Computer Science & Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
- Pre-master program Electrical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
- Pre-master program Embedded Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
- Pre-master program Mechanical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
- Pre-master program Sustainable Energy Technology, Bachelor's degree program (jaar 1), Compulsory, Dutch
- Pre-master program Systems and Control, Bachelor's degree program (jaar 1), Compulsory, Dutch

- Semester 2 Block D
  - HBO-minor Biomedical Instrumentation Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Building Services, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Chemical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Computer Science and Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Electrical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Embedded Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Human-Technology Interaction, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Innovation Management, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Mechanical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Operations Management and Logistics, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Sustainable Energy Technology, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Technology and Policy, Bachelor's degree program (jaar 1), Compulsory, Dutch

ECTS credits BaMa: 3

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Mathematics

Components of this subject:	• 2YL03 - Basic mathematics, general part
Lecturers:	• drs. A. Duits (responsible lecturer) • dr.ir. F.J.L. Martens (co-lecturer) • dr.ir. F.J.L. Martens (instructor) • M. Ugryumova MSc (instructor) • J.A. Villegas Bautista MSc (instructor) • Not yet known (instructor)
Information:	• drs. A. Duits - HG 9.04 - tel: 4034 - a.duits@tue.nl
Course web page:	http://www.win.tue.nl/~fransm/onderwijs/2DL03
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:	• lecture, 5 hours • instruction, 5 hours
Type of examination/ planning:	• Written, Semester 1 Block A (3 hours), Semester 1 Block B (3 hours), Semester 2 Block D (3 hours), Semester 2 Block E (3 hours)
Course material:	• Calculus, a complete approach, R.A. Adams, 9th edition, ISBN 0-321-27000-2 (recommended) • Diktaat Rekenvaardigheden, dictaatnummer 2589 (recommended)

Contents

Learning objectives:	-
Contents:	-

2DL04 Calculus A

General information

Academic year:	2008/2009

Class planning/ Target group:	• HBO-minor Architecture, Building and Planning, Bachelor's degree program (jaar 1), Compulsory, Dutch
	• Semester 1 Block B
	  • HBO-minor Biomedical Instrumentation Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
	  • HBO-minor Building Services, Bachelor's degree program (jaar 1), Compulsory, Dutch
	  • HBO-minor Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
	  • HBO-minor Chemical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
	  • HBO-minor Computer Science and Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
	  • HBO-minor Electrical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
	  • HBO-minor Embedded Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch

    - HBO-minor Human-Technology Interaction, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - HBO-minor Innovation Management, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - HBO-minor Mechanical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - HBO-minor Operations Management and Logistics, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - HBO-minor Sustainable Energy Technology, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - HBO-minor Technology and Policy, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - Pre-master program Biomedical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - Pre-master program Building Services, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - Pre-master program Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - Pre-master program Computer Science & Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - Pre-master program Electrical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - Pre-master program Embedded Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - Pre-master program Mechanical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - Pre-master program Sustainable Energy Technology, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - Pre-master program Systems and Control, Bachelor's degree program (jaar 1), Compulsory, Dutch
- Semester 2 Block E
    - HBO-minor Biomedical Instrumentation Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - HBO-minor Building Services, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - HBO-minor Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - HBO-minor Chemical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - HBO-minor Computer Science and Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - HBO-minor Electrical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - HBO-minor Embedded Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
    - HBO-minor Human-Technology Interaction, Bachelor's degree program (jaar 1), Compulsory, Dutch

- HBO-minor Innovation Management, Bachelor's degree program (jaar 1), Compulsory, Dutch
- HBO-minor Mechanical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
- HBO-minor Operations Management and Logistics, Bachelor's degree program (jaar 1), Compulsory, Dutch
- HBO-minor Sustainable Energy Technology, Bachelor's degree program (jaar 1), Compulsory, Dutch
- HBO-minor Technology and Policy, Bachelor's degree program (jaar 1), Compulsory, Dutch

ECTS credits BaMa: 3

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Mathematics

Components of this subject:
- 2YL04 - Calculus A, general part

Lecturers:
- dr. R.R. van Hassel (responsible lecturer)
- dr. W.C.M. van Beers (instructor)
- dr.ir. H.A. Wilbrink (instructor)
- ir. P.P. van Liesdonk (instructor)
- Not yet known (instructor)

Information:
- dr. R.R. van Hassel - HG 8.89 - tel: 4278 - r.r.v.hassel@tue.nl

Course web page: http://www.win.tue.nl/wsk/onderwijs/2DL04

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture, 5 hours
- instruction, 5 hours

Type of examination/ planning:
- Written, Semester 1 Block B (3 hours), Semester 1 Block C (3 hours), Semester 2 Block E (3 hours), Semester 2 Block F (3 hours)

Course material:
- Calculus, a complete Course (Sixt Edition), R.A. Adams, ISBN 0-321-27000-2 (recommended)

Contents

Learning objectives: If a student, who has followed the lectures and also tried to make the exercises, can use the concepts and methods, which are described in the contents of this course.

Contents:
- Complex Numbers.
- Differential equations.
- Functions of several variables.
- Maxima and minima.
- Integrate over 2-dimensional domains.

The docent keeps the right to fit the contents of the course.

2DL06 Linear algebra

General information

Academic year: 2008/2009

Class planning/ Target group:

- Semester 1 Block C
  - HBO-minor Biomedical Instrumentation Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Building Services, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Chemical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Computer Science and Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Electrical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Embedded Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Mechanical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Sustainable Energy Technology, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - Pre-master program Building Services, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - Pre-master program Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - Pre-master program Computer Science & Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - Pre-master program Electrical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - Pre-master program Embedded Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - Pre-master program Mechanical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - Pre-master program Sustainable Energy Technology, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - Pre-master program Systems and Control, Bachelor's degree program (jaar 1), Compulsory, Dutch
- Semester 2 Block F
  - HBO-minor Biomedical Instrumentation Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Building Services, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch

- HBO-minor Chemical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
- HBO-minor Computer Science and Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
- HBO-minor Electrical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
- HBO-minor Embedded Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
- HBO-minor Mechanical Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
- HBO-minor Sustainable Energy Technology, Bachelor's degree program (jaar 1), Compulsory, Dutch

ECTS credits BaMa: 3

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Mathematics

Components of this subject:
- 2YL06 - Lineaire algebra, general part

Lecturers:
- dr.ir. F.J.L. Martens (responsible lecturer)
- dr. W.C.M. van Beers (co-lecturer)
- M.S. Modelski MSc (instructor)
- J.H. Sinkovic MSc (instructor)
- Not yet known (instructor)
- Not yet known (instructor)

Information:
- dr.ir. F.J.L. Martens - HG 8.90 - tel: 4280 - f.j.l.martens@tue.nl

Course web page: http://www.win.tue.nl/~wbeers/2DL06

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture, 4 hours
- instruction, 4 hours

Type of examination/ planning:
- Written, Semester 1 Block C (3 hours), Semester 2 Block F (3 hours)

Course material:
- Elementary Linear Algebra with Applications, Bernard Kolman, David R. Hill, 9th edition, Pearson (recommended)

Contents

Learning objectives: -

Contents: -

2DL07 Statistics A

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block C
- HBO-minor Architecture, Building and Planning, Bachelor's degree program (jaar 1), Compulsory, Dutch

- HBO-minor Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
- HBO-minor Computer Science and Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
- HBO-minor Embedded Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
- HBO-minor Human-Technology Interaction, Bachelor's degree program (jaar 1), Compulsory, Dutch
- HBO-minor Innovation Management, Bachelor's degree program (jaar 1), Compulsory, Dutch
- HBO-minor Operations Management and Logistics, Bachelor's degree program (jaar 1), Compulsory, Dutch
- HBO-minor Technology and Policy, Bachelor's degree program (jaar 1), Compulsory, Dutch
- Pre-master program Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
- Pre-master program Computer Science & Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
- Pre-master program Embedded Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch

- Semester 2 Block F
  - HBO-minor Architecture, Building and Planning, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Computer Science and Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Embedded Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Human-Technology Interaction, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Innovation Management, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Operations Management and Logistics, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Technology and Policy, Bachelor's degree program (jaar 1), Compulsory, Dutch

ECTS credits BaMa: 3

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Mathematics

Components of this subject:
- 2YL07 - Statistics A, general part

Prior knowledge:
- 2DL04 - Calculus A (recommended)

Follow-up subjects:
- 2DL08 - Statistics B

Lecturers:
- dr.ir. E.E.M. van Berkum (responsible lecturer)
- dr. C. Giardina (instructor)

Information:
- dr.ir. E.E.M. van Berkum - HG 10.18 - tel: 2903 - e.e.m.v.berkum@tue.nl

Course web page: http://www.win.tue.nl/~eberkum/2DL07/
Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture, 4 hours
- instruction, 4 hours

Type of examination/ planning:
- Written, Semester 1 Block C (3 hours), Semester 2 Block F (3 hours)

Course material:
- Applied Statistics and Probability for Engineers, D.C. Montgomery, G.C. Runger, 4th edition, ISBN 0-471-74589-8 (compulsory)
- Statistical Compendium dikt. Nr. 2218 (compulsory)

Contents

Learning objectives: The students should have knowledge of the principles of probability and should be able to apply the standard probability distributions. In a given problem they should know which probability distribution should be used. The student should know the basic statistical methods for estimation and testing. The student should be able to apply them, know what the assumptions are and be able to draw conclusions. The student should be able to read and understand articles in which basic statistical methods are used.

Contents: Introduction to probability, random variables. Binomial, Poisson-distribution. Normal, exponential distribution. Mean and variance of a random variable. Central Limit Theorem, linear combination of random variables. Descriptive statistics. Estimation theory (unbiasedness and Mean Square Error), confidence intervals, principles of hypothesis testing.

2IC95 Seminar security

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 2 Block D t/m Semester 2 Block F
  - Business Information Systems, Master's degree program (jaar 1), Optional, English
  - Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
  - Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- dr. A. Serebrenik (responsible lecturer)
- prof.dr. S. Etalle (co-lecturer)

Information:
- dr. A. Serebrenik - HG 5.71 - tel: 3595 - a.serebrenik@tue.nl

Education and examination

Type of education:
- lecture, 2 hours
- Introductory lectures, followed by an independent literature study. The study should result in oral and written presentations.

Type of examination/ planning:
- Assignment(s)

Contents

Learning objectives: After finishing the course successfully, a student is able to explore a new security topic on his/her own and present the exploration results in an oral and/or written form.

Contents: Variable.

2IC99 Capita selecta security

General information

Academic year: 2008/2009

Target group:
- Business Information Systems, Master's degree program (jaar 1), Optional, English
- Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
- Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- prof.dr. S. Etalle (responsible lecturer)

Information:
- prof.dr. S. Etalle - HG 9.83 - tel: 5016 - s.etalle@tue.nl

Education and examination

Type of education: -

Contents

Learning objectives: -

Contents: -

2ID05 Datamodeling and databases

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - Computer Science & Engineering Master (for homologation only), Master's degree program (jaar 1), Optional, English
  - Computer Science Education (for homologation only), Master's degree program (jaar 1), Optional, English
  - Computer Science and Engineering Bachelor, Bachelor's and four/five year program (jaar 2), Compulsory, English

- Embedded Systems (for homologation only), Master's degree program (jaar 1), Optional, English
- Innovation Sciences (ICT), Bachelor's and four/five year program (jaar 3), Compulsory, English
- Minor Business Information Systems, Bachelor's degree program (jaar 3), Compulsory, English
- Minor Computer Science and Engineering, Bachelor's degree program (jaar 3), Compulsory, English
- Pre-master program Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, English
- Pre-master program Computer Science & Engineering, Bachelor's degree program (jaar 1), Compulsory, English

ECTS credits BaMa: 6

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Components of this subject:
- 2XD05 - Datamodeling and databases, partial examination A
- 2YD05 - Datamodeling and databases, partial examination B

Prior knowledge:
- 2IT05 - Logic and set theory (recommended)

Lecturers:
- prof.dr. P.M.E. de Bra (responsible lecturer)
- dr. A. Serebrenik (instructor)
- dr. M. Pechenizkiy (instructor)

Information:
- prof.dr. P.M.E. de Bra - HG 7.72 - tel: 4476 - debra@win.tue.nl

Course web page: http://wwwis.win.tue.nl/2ID05

Education and examination

Type of education:
- lecture, 2 hours
- instruction, 4 hours

Type of examination/ planning:
- Written, Semester 1 Block C (3 hours), Semester 2 Block F (3 hours)

Contents

Learning objectives: This course teaches students to design (the data structures of) information systems. With "design" we mean that the students learn to translate a natural language description of a business' information needs into a data model, expressed in the entity relationship model. Studens must be capable of translating that model into a relational database structure. They must be able to optimize this structure by means of constraints and decomposition algorithms. Students also must become fluent in query languages, in order to express natural language questions in query languages, and in order to express queries in natural language.

Contents: Entity-Relationship Model (and equivalent UML constructs) Designing E-R diagrams for business situations The Relational Database model Constraints and Decompositions Query languages: translation from natural language to query languages and back; equivalence of query languages.

2ID25 Information retrieval

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - Business Information Systems, Master's degree program (jaar 1), Compulsory, English
  - Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
  - Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Components of this subject:
- 2XD25 - Information retrieval, partial examination A
- 2YD25 - Information retrieval, partial examination B

Prior knowledge:
- 2DI05 - Linear algebra (recommended)
- 2ID45 - Advanced databases (recommended)
- 2II15 - Datamining and knowledge systems (recommended)
- 2IL05 - Data structures (recommended)

Lecturers:
- dr. M. Pechenizkiy (responsible lecturer)

Information:
- Computer science, Databases and hypermedia - HG 7.73 - wsinfsys@win.tue.nl - tel. 2733
- dr. M. Pechenizkiy - HG 7.82 - tel: 4977 - m.pechenizkiy@tue.nl

Course web page: http://wwwis.win.tue.nl/2ID25

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Written and Assignment(s)
- 20% Individual assignments
  20% Partial exams (multiple choice tests)
  60% Group project assignment
  There will be no final exam. There will be the final presentation sessions either during the week 50 (2008) or week 5 (2009) where students will present the results of their project work.

Course material:
- Introduction to Information Retrieval, by Christopher Manning, Prabhakar Raghavan, Hinrich Schütze, Cambridge University Press, 2008. http://www-csli.stanford.edu/~schuetze/information-retrieval-book.html. There is no need for students to order this book since it is still available online with a free access. (compulsory)

Contents

Learning objectives: The objective of this course is to introduce students to the theoretical background and practical aspects of modern Information Retrieval (IR) as well as machine learning/data mining techniques that are used for IR. After having followed the course, the student should:

- know the basic principles and techniques of IR, the foundations of machine learning/data mining for data indexing, clustering, and classification in IR context;
- become aware of various application areas of IR, existing IR systems, and challenging research topics in IR;
- obtain skills for IR design, development and evaluation.

During the course students will practice different skills studying research literature, and working on the individual exercises and group course project.

Contents: The course 'Information Retrieval' presents lectures covering the main topics in the field of Information Retrieval and related application areas. These topics include: Search Engines and Query Languages (keyword-based and query-based engines, meta-search and information filtering), IR models (probabilistic IR, statistical language models, latent-concept models), and Relevance Feedback in IR. The course will contain a Machine Learning module that provides foundations for further topics, including Text Mining (text categorization, text classification, association discovery), Multimedia Mining (image, audio and video retrieval, indexing and searching), Web Mining (web usage mining and web structure mining, pagerank, hubs and authorities), Web Crawling (agents, architectures, algorithms), User Modeling for personalized, and adaptive IR. Although being self-contained, this module is an integral part of Adaptive Systems and Information Retrieval courses and therefore is mandatory for the students taking either of the courses.

2ID35 Database technology

General information

Academic year: 2008/2009 - **subject will NOT be taught during academic year 2008**

Target group:
- Business Information Systems, Master's degree program (jaar 1), Optional, English
- Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
- Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- Not yet known (responsible lecturer)

Information:
- Computer science, Databases and hypermedia - HG 7.73 - wsinfsys@win.tue.nl - tel. 2733

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- 6 weeks lecture, 2 hours
- 9 weeks assignment(s)
- 3 weeks question and answer sessions.

Type of examination/ planning:	• Written, Semester 1 Block C (3 hours), Semester 2 Block D (3 hours) and Assignment(s)
Course material:	• A. Silberschatz, H. Korth, and S. Sudarshan, "Database System Concepts", 5th Edition (2005) McGraw-Hill. (compulsory) • D. Shasha, and P. Bonnet, "Database Tuning", (2002) Morgan Kaufmann Publishers. (recommended)

Contents

Learning objectives:	Insight into and knowledge of concepts, methods and techniques for the improvement of the performance of data-intensive systems and for the realization of characteristic database properties such as persistence, reliability and integrity. The insight and knowledge are acquired partly by following lectures, partly by study, and partly by setting up and carrying out database experiments.
Contents:	Selected topics from the area of database system properties and their realization. The implementation design of a database system has to take performance and dependability requirements into account. In this course the different ways are studied in which database systems try to meet these requirements. In particular, attention will be paid to access and storage structures, query and transaction processing, concurrency control and recovery. These aspects will mainly be studied for both central and distributed relational database systems. Some topics will be covered in the lectures, others in an assignment. The actual topics will be announced via the on-line study guide.

2ID45 Advanced databases

General information

Academic year:	2008/2009

Class planning/ Target group:	• Semester 2 Block D t/m Semester 2 Block F
	  • Business Information Systems, Master's degree program (jaar 1), Compulsory, English
	  • Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
	  • Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa:	5
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Prior knowledge:	• 2IDo5 - Datamodeling and databases (compulsory) • 2ITo5 - Logic and set theory (recommended)
Lecturers:	• dr. T.G.K. Calders (responsible lecturer) • prof.dr. J. Paredaens (co-lecturer)
Information:	• dr. T.G.K. Calders - HG 7.82a - tel: 4568 - t.calders@tue.nl
Course web page:	http://wwwis.win.tue.nl/2ID45
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture, 2 hours
- instruction, 2 hours

Type of examination/ planning:
- Written, Semester 2 Block F (3 hours), Semester Interim (3 hours) and Assignment(s)
- 30% assignments 70% written exam

Course material:
- Silberschatz, H.F. Korth, S. Sudarshan, "Database System Concepts" (Fifth Edition), McGraw-Hill. (compulsory)
- Additional material can be found at the course homepage

Contents

Learning objectives:
- knowing the main characteristics and relevant research results for the 5 database models mentioned in the content description;
- understanding the practical relevance of the different database models;
- understanding the advantages and disadvantages of one model over another;
- be able to decide, based on a problem description, which database model is best suited to solve this problem;
- be able to quickly master vendor-specific products implementing one of the database models.

Contents:

This course studies different database models and their properties.
The models that will be discussed are:
- The XML data model (query languages XQuery and XPath),
- Object database models (complex data types, transient and persistent data, sub-typing, polymorphism, OQL, versioning, Java data objects, etc.),
- Data warehousing and online analytical processing (data warehousing, ROLAP, MOLAP, and HOLAP, star and snow-flake schemas, etc.),
- Models for handling spatial and temporal data will be handled (Geographic information systems, spatial indices, temporal databases.), and
- deductive databases (datalog). For all these conceptual models, during the course it will be discussed why these models were introduced, what are their relative advantages and disadvantages, how to use them, and, at a high level, how they are implemented.

2ID55 Adaptive systems

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - Business Information Systems, Master's degree program (jaar 1), Optional, English
  - Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
  - Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa:	5
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Components of this subject:	• 2XD55 - Adaptive systems, partial examination A • 2YD55 - Adaptive systems, partial examination B
Lecturers:	• prof.dr. P.M.E. de Bra (responsible lecturer)
Information:	• prof.dr. P.M.E. de Bra - HG 7.72 - tel: 4476 - debra@win.tue.nl
Course web page:	http://wwwis.win.tue.nl/2ID55
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:	• lecture, 2 hours
Type of examination/ planning:	• Written and Assignment(s) • The written exams are partial exams.

Contents

Learning objectives:	Design, realization and evaluation of adaptive hypermedia systems and applications.
Contents:	Models for and architecture of adaptive hypermedia applications. Design and implementation of adaptive hypermedia systems and applications. Evaluation of adaptive hypermedia applications.

2ID99 Capita selecta databases and hypermedia

General information

Academic year:	2008/2009
Target group:	• Business Information Systems, Master's degree program (jaar 2), Optional, English • Computer Science & Engineering Master, Master's degree program (jaar 2), Optional, English • Embedded Systems, Master's degree program (jaar 1), Optional, English
ECTS credits BaMa:	5
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Lecturers:	• prof.dr. P.M.E. de Bra (responsible lecturer)
Information:	• prof.dr. P.M.E. de Bra - HG 7.72 - tel: 4476 - debra@win.tue.nl
Course web page:	http://wwwis.win.tue.nl/2ID99

Education and examination

Type of education:	-

Contents

Learning objectives:
- Specific enhancement of the knowledge in the area of databases and hypermedia.

Contents: The Capita Selecta Databases and Hypermedia offers the possibility to study a topic in the area of Databases and Hypermedia that is not part of any of the regular courses. The contents of the course is determined in cooperation by the student and the responsible teacher for this course and can essentially regard all relevant topics. For more information it is advised to timely contact the teacher. The course is not scheduled and can be attended at basically any time during the year.

2IF02 Verification of security protocols

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 2 Block D t/m Semester 2 Block F
- Information Security Technology, Master's degree program (jaar 1), Compulsory, English

ECTS credits BaMa: 6

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- dr. J.I. den Hartog (responsible lecturer)
- prof.dr. S. Etalle (co-lecturer)

Information:
- dr. J.I. den Hartog - HG 9.84 - tel: 2800 - j.d.hartog@tue.nl

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Written, Semester 2 Block F (3 hours), Semester Interim (3 hours) and Assignment(s)

Contents

Learning objectives:
- The student know the terminology regarding security protocols and knows what security requirements can put forward.
- The student is capable of designing, possibly by adapting existing components, a secure system for a given problem.
- The student is able to formulate the security goals of a protocol.
- The student can assess the safety of simple protocols.
- For this the student at least masters two techniques.

Contents: In this course the student learns how to verify security protocols. To this end the following topics will be addressed:
- Overview shared and public key systems (black box approach).
- Security goals such as authentication, non- repudiation.
- Model Checking with the Casper/FDR Chain
- Proofs within BAN logic
- Strands spaces or other method.

2IF03 Seminar information security technology

General information

Academic year:	2008/2009
Class planning/ Target group:	• Semester 2 Block D t/m Semester 2 Block F • Information Security Technology, Master's degree program (jaar 1), Optional, English
ECTS credits BaMa:	6
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Prior knowledge:	Technical writing (recommended).
Lecturers:	• dr. A. Serebrenik (responsible lecturer) • prof.dr. S. Etalle (co-lecturer)
Information:	• dr. A. Serebrenik - HG 5.71 - tel: 3595 - a.serebrenik@tue.nl
Course web page:	http://wwwis.win.tue.nl/2IF03
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:	• lecture, 2 hours • Introductory lectures, followed by an independent literature study. The study should result in oral and written presentations.
Type of examination/ planning:	• Assignment(s) and Oral • Oral and written presentations assessed by means of a peer review and lecturers' evaluation.
Course material:	• Scientific papers, to be chosen by the students and approved by the lecturers. (recommended)

Contents

Learning objectives:	After finishing the course successfully, a student is able to explore a new security topic on his/her own and present the exploration results in an oral and/or written form.
Contents:	In the course of the seminar we will discuss a number of information security-related subjects, such as side-channel attacks and security considerations in radio frequency identification applications. Lecturers will provide an introduction to the chosen subject(s). Students are responsible for choosing a topic related to the subject proposed, performing a literature study, and reporting on the findings in a proposed form (oral, written, oral and written). Participation in all meetings is obligatory. Participants are expected to contribute actively to the discussion as well as to review presentations by their peers.

2IF05 Introduction to computer security

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - Information Security Technology, Master's degree program (jaar 1), Compulsory, English

ECTS credits BaMa: 6

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Prior knowledge: To finish the course successfully a student must have the following qualifications to start with: Bachelor Computer Science, Electrical Engineering, Mathematics or closely related degrees.

Lecturers:
- Visiting lecturer(s) (responsible lecturer)
- Visiting lecturer(s) (co-lecturer)

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Written and Assignment(s)
- Exams will be given at University Twente. Students write an anonymous paper in teams of two. The students must then peer-review each others papers. The best papers get presented a mini-conference held during the last lecture of the course. Written examination 50%. Students earn the remaining 50% of the marks by writing an extended abstract or a paper on security. A short abstract must be submitted and approved prior to writing the paper.

Course material:
- R. J. Anderson, Security Engineering: A guide to building dependable distributed systems, John Wiley & Sons Inc, New York, 2001, ISBN 0-471-38922-6 (compulsory)
- Optional Literature: Various papers on recent developments in the field, updated every year. (recommended)

Notes:
- **Lecturers: Jerry den Hartog (jerry.denhartog@utwente.nl) and Pieter Hartel (pieter.hartel@utwente.nl)**
- **De informatie over het inschrijven bij verschillende universiteiten bij de IST master staat op de volgende web site: http://www.kerckhoffs-institute.org/admission.html**
- **Dit vak wordt geheel door de Universiteit Twente verzorgd.**

Contents

Learning objectives: Students will learn that security must be designed into a system right from the start. After finishing the course, students
- Have a thorough overview of the objectives of computer security, common threats and countermeasures.
- Analyse simple examples of security protocols and policies
- Have a good understanding of the most important security techniques
- Have improved research, writing and presentation skills

Contents:

- What is security engineering?
- Protocols (Authentication, attacks, Basic key management, The BAN logic, introduction to verification of security protocols)
- Passwords (Social Engineering, Dictionary attacks)
- Access Control (Operating system access controls, Groups and Roles, Access control lists, Unix, Windows, Capabilities, Sandboxing and proof-carrying code)
- Distributed Systems (Secure time, Fault Tolerance, Service denial attacks, Naming)
- Multilevel Security (Security Policy, Bell-La Padula, Trojan horses)
- Multilateral Security (Privacy protection, Chinese wall, Inference control)
- Monitoring Systems (Alarms, Threat model)
- Biometrics (Handwritten signatures, Face Recognition, Fingerprints, Grip patterns)
- Physical Tamper Resistance (Smart cards)
- Network Attack and Defence (Packet filters, intrusion detection, viruses)
- Protecting E-commerce Systems (Credit cards, electronic payment systems)
- Copyright and Privacy Protection (Pay-TV, DVD, DRM, Watermarking)

The approach to the subject of the course is to focus in particular on the following topics: System level engineering.

2IF06 Software security

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 2 Block D t/m Semester 2 Block F
  - Information Security Technology, Master's degree program (jaar 1), Compulsory, English

ECTS credits BaMa: 6

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- Visiting lecturer(s) (responsible lecturer)

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Written

Notes: **Lecturers: Erik Poll (erikpoll@cs.ru.nl) and Marko van Eekelen (marko@cs.ru.nl)(RU)**

- **The information about the subscription at the different universities for the IST master can be found at the web site: http://www.kerckhoffs-institute.org/admission.html**

Contents

Learning objectives: To understand system vulnerabilities at the software level.

Contents: What is software security? Common software vulnerabilities: lack of input validation (buffer overflows, SQL injections, etc.), race conditions, access control, etc. Design flaws. Implementation flaws. Deployment flaws. Case studies. Language level security: typing; tainting input data; untrusted code security. Application level security: runtime monitoring; static analysis; verification; JML, Spec#. Software evaluation.

2IF07 Security in organizations

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - Information Security Technology, Master's degree program (jaar 2), Compulsory, English

ECTS credits BaMa: 6

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- Visiting lecturer(s) (responsible lecturer)

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Written

Notes:

Lecturers: Martijn Oostdijk (martijno@cs.ru.nl)(RU)
- **Lecturers: Jerry den Hartog (jerry.denhartog@utwente.nl) and Pieter Hartel (pieter.hartel@utwente.nl)**
- **De informatie over het inschrijven bij verschillende universiteiten bij de IST master staat op de volgende web site: http://www.kerckhoffs-institute.org/admission.html**

Contents

Learning objectives: To learn the role and management of security in an organizational environment.

Contents: Security policies. Roles. Classifications. Assets and threats. Risk, vulnerability, control, attack, damage. Risk analysis. Methods/tools for risk analysis. CERTs. Risk assessment and risk management. Code of Practise for Information Security (BS7799). Evaluation of information security, like ITSEC and the Common Criteria. Security plan, attack trees, business continuity planning/incident recovery. Legal issues: patents and copyright.

2IF08 Network security

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - Information Security Technology, Master's degree program (jaar 2), Compulsory, English

ECTS credits BaMa: 6

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Prior knowledge: To finish the course successfully, students following the - Security masters track must have passed the exam of the course "Introduction to Computer Security". - Telematics, Computer Science, Electrical Engineering or similar master tracks must have passed the exam of the course "Telematics networks (262000)".

Lecturers:
- Visiting lecturer(s) (responsible lecturer)

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Written and Assignment(s)
- Written examination (50%) with complementary assignment and tests (50%). In addition to a traditional exam, students will write a survey (in teams of two) of some articles.

Course material:
- Network Security Essentials - Applications and Standards (2nd ed.), William Stallings, Prentice Hall, ISBN 0-13-120271-5 (all tracks). (compulsory)
- Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose & Keith W. Ross: ISBN 0-321-26976-4 (only Security track). (compulsory)
- Facultative Literature: A number of papers that will be selected and updated on a yearly basis. (recommended)

Notes: **Lecturers: dr.ir. A. Pras (pras@cs.utwente.nl and dr.ir. G. Karagiannis (Georgios.Karagiannis@ewi.utwente.nl)(UT)**
- **Lecturers: Jerry den Hartog (jerry.denhartog@utwente.nl) and Pieter Hartel (pieter.hartel@utwente.nl)**
- **De informatie over het inschrijven bij verschillende universiteiten bij de IST master staat op de volgende web site: http://www.kerckhoffs-institute.org/admission.html**

Contents

Learning objectives: In this course the principles behind network security, their main protocols as well as network security mechanisms and techniques, used in wired and wireless networks, will be discussed. The course covers: network protocols (MSc Security) / cryptography principles (others), IP security, Email security, Web security, secure management, Intruders, Viruses, Firewalls and Privacy. After finishing this course, students

- Have a basic understanding of network protocols (MSc Security track)
- Have a basic understanding of cryptography (other tracks)
- Have a good understanding of security mechanism within the popular network protocols
- Know how to apply the security mechanism within these network protocols
- Have a good understanding of how systems can be secured against viruses and attacks
- Have improved research and writing skills

Contents: The course has four main theme's:

- introduction to networking (Security track - 2 ECTS),
- introduction to cryptography (other tracks - 1 ECTS),
- security mechanisms within network protocols (all tracks - 2 ECTS), and
- systems security (all tracks - 2 ECTS).

The first theme (introduction to networking) is only intended for students following the MSc Security track; topics that will be discussed are IP, TCP, HTTP, SMTP, SNMP, DNS and routing. The second theme (introduction to cryptography) is intended for all students, except those following the Security track. Topics in this second theme are: authentication, authorisation and confidentiality. The third and last themes are intended for all students.

In the third theme (security mechanisms within network protocols) the following topics will be discussed: X.509, IPSec, secure email, secure web, SNMPv3 and security for wireless networks, such as ad-hoc wireless networks, UMTS and WLAN. The last theme (systems security) discusses topics like: intrusion, DOS attacks, viruses and firewalls.

2IF09 Biometric recognition

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - Information Security Technology, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 6

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Prior knowledge:
- Elementary Calculus and Mathematical Analysis
- Elementary Probability Theory and Statistics
- Elementary notion of signal processing

Lecturers:
- Visiting lecturer(s) (responsible lecturer)

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Assignment(s)
- - (MATLAB) exercises - practical assignment - end paper.

Course material:
- Selected book chapters and articles. (recommended)

Notes:

Lecturers: Raymond Veldhuis (r.n.j.veldhuis@utwente.nl) and Asker Bazen (a.m.bazen@utwente.nl)(UT)

- **Lecturers: Jerry den Hartog (jerry.denhartog@utwente.nl) and Pieter Hartel (pieter.hartel@utwente.nl)**
- **De informatie over het inschrijven bij verschillende universiteiten bij de IST master staat op de volgende web site: http://www.kerckhoffs-institute.org/admission.html**

Contents

Learning objectives:

- Understand biometric recognition and the most common approaches to it.
- Understand the role of biometric recognition in security and other applications.
  In particular:
- Statistical pattern recognition applied to biometrics.
- The problems that arise when a recognition system is trained from a limited set of examples.
- The pre-processing of biometric data in order to enhance recognition performance, such as alignment and normalization.
- Face recognition will be used through out as an example.

Contents:

1. Introduction
   - biometrics and its applications
   - overview of biometric recognition methods
2. The biometric recognition problem
   - Verification
   - Identification
   - Optimal classifiers
   - Other classifiers
   - Feature extraction
   - High- vs. low-level features.
   - Dimensionality reduction
3. Estimating the parameters of a classifier
   - Training
   - The small sample size problem
   - Dimensionality reduction
   - Principal component analysis
   - Linear Discriminant analysis
4. Pre-processing and signal conditioning
   - Object detection
   - Alignment (registration)
   - Normalization
5. “Hot topics”
   - 3d face recognition
   - active appearance models
   - TBD
6. Applications and their specific requirements
   Face recognition will be used throughout as an example.

Week content: Details too be announced.
- Students and lecturers will present lectures in an alternately: an introduction to a topic/problem by lecturers in one week and a presentation by students in the next.

2IF11 Distributed trust management

General information

Academic year: 2008/2009
Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - Information Security Technology, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 6
Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Prior knowledge: To finish the course successfully a student must have the following qualifications to start with: Bachelor Computer Science, Electrical Engineering, Mathematics or closely related degrees.
Lecturers:
- prof.dr. S. Etalle (responsible lecturer)

Information:
- prof.dr. S. Etalle - HG 9.83 - tel: 5016 - s.etalle@tue.nl

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Written, Semester 1 Block C (3 hours), Semester 2 Block F (3 hours) and Assignment(s)

Course material:
- Various seminal papers. (recommended)

Contents

Learning objectives: Students will learn how to manage trust in a distributed way.
After the course, students
- Have a thorough overview of the objectives and capabilities of trust management.
- Have a good understanding of the most important access control techniques.

Contents:
- Advanced access control methods
- Role-based access control
- Decentralized access control
- Public Key Infrastructures (X.509 certificates, PGP, SPKI)
- Trust management
- Decentralized trust management
- Practical examples (Policymaker, Keynote)
- SDSI/SPKI
- Role-based trust management (Credential chain discovery)

2IF13 Privacy seminar

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 2 Block D t/m Semester 2 Block F
- Information Security Technology, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 6

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Prior knowledge:
- 2IF05 - Introduction to computer security (compulsory)
- 2WC12 - Cryptography 1 (compulsory)

Lecturers:
- Visiting lecturer(s) (responsible lecturer)

Education and examination

Type of education:
- lecture, 3 hours
- Lectures will be given at the RU Nijmegen.

Type of examination/ planning:
- Assignment(s) and Oral
- No exam. Final grade is determined by scores on presentation, student paper, and review.

Course material:
- Selected papers, to be distributed in class. (compulsory)

Notes:
- For this seminar, a handful of topics has been selected, and key scientific publications for each of these topics are provided. To participate, and to complete the seminar successfully, you have to do the following. 1) Attend all lectures. 2) Give a 2 hour lecture on a topic of your choice. 3) Prepare a final paper on a different topic of your choice. 4) Act as a referee for the final paper of another student.
- **Lecturers: Jaap-Henk Hoepman (jhh@cs.ru.nl)(RU).**
- **Lecturers: Jerry den Hartog (jerry.denhartog@utwente.nl) and Pieter Hartel (pieter.hartel@utwente.nl)**
- **De informatie over het inschrijven bij verschillende universiteiten bij de IST master staat op de volgende web site: http://www.kerckhoffs-institute.org/admission.html**

Contents

Learning objectives: Privacy has always been a controversial topic. Governments and business want to collect information about their citizens and customers - for their own benefit as well their clients. In surveys, people claim that they value their privacy. In practise, people give away personal information very easily, either because they do not receive a service otherwise, or because they are unable to protect that information reliably. With the calls for ever increasing security - after the events of the last few years - privacy has eroded even further, it seems.

Contents: In this seminar we will explore the state of the art in privacy enhancing technologies (PET), and discuss theories (technical, legal and societal) of privacy.

2IF14 Hardware and operating system security

General information

Academic year:	2008/2009
Class planning/	• Semester 1 Block A t/m Semester 1 Block C
Target group:	• Information Security Technology, Master's degree program (jaar 2), Optional, English
ECTS credits BaMa:	6
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Lecturers:	• Visiting lecturer(s) (responsible lecturer)

Education and examination

Type of education:	• lecture • Lectures will be given at the RU Nijmegen.
Type of examination/ planning:	• Written, Semester 1 Block C (3 hours), Semester 2 Block D (3 hours)
Notes:	• **Lecturers: Eric Poll (erikpoll@cs.ru.nl)(RU)** • **Lecturers: Jerry den Hartog (jerry.denhartog@utwente.nl) and Pieter Hartel (pieter.hartel@utwente.nl)** • **De informatie over het inschrijven bij verschillende universiteiten bij de IST master staat op de volgende web site: http://www.kerckhoffs-institute.org/admission.html**

Contents

Learning objectives:	The objective of this course is to study security issues related to the hardware and operating system level.
Contents:	OS security basic (kernel/user model, memory protection, etc.). OS access control. OS-like functionality in middleware, eg .NET, Java, CORBA, MIDP. Trusted Computing. Security issues related to smaller devices: smart cards, mobile phones, RFID.

2IF15 Secure data management

General information

Academic year:	2008/2009
Class planning/	• Semester 1 Block A t/m Semester 1 Block C
Target group:	• Information Security Technology, Master's degree program (jaar 2), Optional, English
ECTS credits BaMa:	6
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Prior knowledge:	To finish the course successfully a student must have the following qualifications to start with: Bachelor Computer Science, Electrical Engineering, Mathematics or closely related degrees. Must be familiar with the basics of data management techniques including database query

processing, index, etc. (given in the Database course). Must also be familiar with the latest development of XML technology, particularly XML language (given in the Advanced Database course and/or XML Database course).

Lecturers:
- Visiting lecturer(s) (responsible lecturer)

Education and examination

Type of education:
- lecture

Type of examination/ planning:
- Written and Assignment(s)
- Written examination 70%. One practical group assignment 30%.

Course material:
- Reader (compulsory)
- Optional Literature: Various papers on recent developments in the field, updated every year. (recommended)

Notes:

Lecturers: Wim Jonker (jonker@cs.utwente.nl) and Ling Feng (ling@cs.utwente.nl)
- **Lecturers: Jerry den Hartog (jerry.denhartog@utwente.nl) and Pieter Hartel (pieter.hartel@utwente.nl)**
- **De informatie over het inschrijven bij verschillende universiteiten bij de IST master staat op de volgende web site: http://www.kerckhoffs-institute.org/admission.html**

Contents

Learning objectives: The spectacular development of processing, storage, and communication technologies has spawned an increased awareness of and interest in secure data management to our Networked Information Society.
This course is to introduce to students the fundamental knowledge of security in the context of XML data management, as well as user's privacy protection techniques.

Contents: Introduce the fundamental knowledge of security in the context of XML data management, including XML encryption, search in encrypted XML data, cryptography, private/public key management, access control, identity management, digital right management, privacy protection; etc. Practice the theories learned during the course in solving a real-world security problem, like building a secure email server with advertisement function, searching in encrypted data, etc.

2IF25 Formal methods

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - Business Information Systems, Master's degree program (jaar 1), Optional, English
  - Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
  - Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa:	5
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Prior knowledge:	Propositional and predicate logic, Hoare logic, and transition systems at bachelor level.
Lecturers:	• dr. R. Kuiper (responsible lecturer) • dr. S. Andova (co-lecturer) • dr. A. Serebrenik (co-lecturer)
Information:	• dr. R. Kuiper - HG 7.13 - tel: 4122 - r.kuiper@tue.nl
Course web page:	http://www.win.tue.nl/~andova/education/2IF25/2IF25.html
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:	• lecture, 4 hours
Type of examination/ planning:	• Written, Semester 1 Block C (3 hours), Semester 2 Block D (3 hours)
Course material:	• Lecture notes and handouts. (recommended) • Literature could be hand-outs as well as (a reader based on) M. Huth and M. Ryan, Logic in Computer Science (CUP), D.A. Peled, Software Reliability Methods Springer and E.M. Clarke, O. Grumberg, D.A. Peled, Model Checking, (MIT). (recommended)

Contents

Learning objectives: Understanding of fundamentals of program verification with emphasis on tool support.
Preparation for courses on special tool supported verification, like reducing the state space for model checking using advanced techniques like BDD's.
The basic ideas underlying model checking for modal logics and and theorem proving for, mainly, Hoare style logics are covered.
The course is self-contained in the sense that no prior knowledge beyond general bachelor material is required and also that a level is reached at which model checking and theorem proving tools can be used for program verification.

Contents:

1. Fundamentals of formal methods: Syntax and semantics of assertional formalisms (Hoare logics) and modal formalisms (LTL, CTL, CTL*).
2. a. Model checking and program verification. Labelling approach for CTL, automata intersection approach for LTL, combining these for CTL*. SMV or SPIN tooling.
   b. Theorem proving and program verification. Automated proofs for Hoare style verification. ESC/Java2 or Spec# tooling, connection to PVS.
3. Some more advanced topics to be chosen.

2IF35 Formal modeling in cell biology

General information

Academic year:	2008/2009
Class planning/	• Semester 1 Block A t/m Semester 1 Block C
Target group:	• Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English • Embedded Systems, Master's degree program (jaar 1), Optional, English
ECTS credits BaMa:	5
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Prior knowledge:	• 2IF25 - Formal methods (recommended) • 2IW20 - Requirement analysis, design and verification (recommended)
Lecturers:	• dr. E.P. de Vink (responsible lecturer)
Information:	• dr. E.P. de Vink - HG 7.32 - tel: 3146 - e.p.d.vink@tue.nl
Course web page:	http://www.win.tue.nl/~evink/education/2IF35

Education and examination

Type of education:	• lecture, 2 hours • Working groups
Type of examination/ planning:	• Assignment(s) • Presentation and deliverable of group work together with an individual evaluation.
Course material:	• Reader in preparation. (recommended)

Contents

Learning objectives: After finishing the course

- The student has acquitance of the basics of cell biology and related modelling techniques
- The student has knowledge of a number of applications of formal methods in the life sciences
- The student has experience with the application of tool-supported methods for the modelling and analysis of systems in the context of cell biology

Contents: An introduction to formal methods for the life science is given, based on a selection of a number of formalisms that are applied in cell biology, such as pi-calculus and rewrite logic. In working groups a number of case studies will be conducted using, for example, BioSpi, Maude, Prism for the analsys of a number of existent models. Presentations of the group work will be part of the course.

2IF45 Process algebra

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 2 Block D t/m Semester 2 Block F
  - Business Information Systems, Master's degree program (jaar 1), Optional, English
  - Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
  - Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- prof.dr. J.C.M. Baeten (responsible lecturer)

Information:
- prof.dr. J.C.M. Baeten - HG 7.19 - tel: 2904 - j.c.m.baeten@tue.nl

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Written, Semester 2 Block F (3 hours), Semester Interim (3 hours)

Course material:
- Syllabus, available at the selling shop for readers (recommended)

Contents

Learning objectives: The objective is to achieve that students can use process algebra in working with parallel and disributed systems. They can describe (specify) such systems, can analyse them and prove properties of them. They know how to add extra features to a process algebra.

Contents: Introduction. Preliminaries. Transition systems. Basic process theory (alternative composition, action prefix, termination, deadlock). Recursion. Sequential processes. Parallel and communicating processes. Abstraction. Timing. Data and states. Features. Semantics.

2IF65 Proving with computer assistance

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 2 Block D t/m Semester 2 Block F
  - Business Information Systems, Master's degree program (jaar 1), Optional, English
  - Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
  - Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Prior knowledge:
- 2IW15 - Automated reasoning (recommended)
- 2IW25 - Requirement analysis, design and verification (recommended)

Lecturers:
- prof.dr. J.H. Geuvers (responsible lecturer)

Information:
- Computer science, Design and Analysis of Systems - HG 6.74 - wsinf@tue.nl - tel. 5010
- prof.dr. J.H. Geuvers - HG 6.88 - tel: 2963 - j.geuvers@tue.nl

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Written, Semester 2 Block F (3 hours), Semester Interim (3 hours) and Assignment(s)

Notes: Please use the e-mail address H.Geuvers@cs.ru.nl.

Contents

Learning objectives: This course teaches primarily how to understand type systems, both from the of computational (or programmers) view, and form the logical interpretation. In particular type systems for the lambda-calculus will be the topic of discourse.
The secondary goal is to understand interactive theorem provers, and to learn how to use these to formalize and verify the correctness of programs (and mathematics in general) with the currently highest possible degree of correctness.

Contents:
- Type systems, esp. those of the simply typed first, second and higher order lambda calculi.
- Type systems in programming languages, such as implicit/explicit typing, polymorphic types, inductive and abstract data types.
- The typings algorithm of Milner and the unification algorithm of Robinson.
- The Curry-Howard isomorphism (or 'propositions as types' interpretation). Translation of logical propositions in first and higher order logic to a type system.
- The translation of a not too hard mathematical theorem to a type setting and the proof of the theorem to in an interactive theorem prover.
- The translation of a problem in computer science (e.g. the correctness of a distributed algorithm) to the typed setting of an interactive theorem prover and the proof of it.

2IF95 Seminar formal methods

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - Business Information Systems, Master's degree program (jaar 2), Optional, English
  - Computer Science & Engineering Master, Master's degree program (jaar 2), Optional, English

- Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- dr.ir. P.J.L. Cuijpers (responsible lecturer)
- dr. S. Andova (co-lecturer)

Education and examination

Type of education:
- tutorial, 2 hours

Type of examination/ planning:
- Assignment(s)

Contents

Learning objectives: In this seminar, a group of master students will get in touch with research in the area. This will be done in the following ways:
- Research papers and/or book chapters will be studied and presented by students, with a focus on research questions.
- Examples related to the presented material will be elaborated.
- If suitable, experiments related to these examples will be executed, either by using existing implementations or by developing ad hoc implementation.
- Conclusions of these experiments are formulated in a report.

Contents: Topics to be chosen are not fixed and may depend on the preference of the students. Topics will be proposed by several researchers in the group, and also supervision may be done by the researcher who proposed the topic.

2IF99 Capita selecta formal methods

General information

Academic year: 2008/2009

Target group:
- Business Information Systems, Master's degree program (jaar 2), Optional, English
- Computer Science & Engineering Master, Master's degree program (jaar 2), Optional, English
- Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- dr. S. Andova (responsible lecturer)

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education: -

Contents

Learning objectives: The goal of this course is to treat modern topics that are within the expertise of the Formal Methods group that did not yet find a place in the regular courses. The actual topic of this year course will be Modelling and Analysis of stochastic systems using formal methods and automatic tools, in particular methodologies such as stochastic and probabilistic process algebra, probabilistic model checking, probabilistic and stochastic automata, etc. The form, actual contents and way of examination is dependent on the preferred topic and will be determined separately for each student attending this course. In case of interest in this course send an e-mail to s.andova@tue.nl describing your interest and the list of courses you have already taken (with marks).

Contents: The Capita Selecta Formal Methods offers the possibility to study a topic in the area of Formal Methods that is not part of any of the regular courses. The contents of the course is determined in cooperation by the student and the responsible teacher for this course and can essentially regard all relevant topics. For more information it is advised to timely contact the teacher. The course is not scheduled and can be attended at basically any time during the year.

2II35 Web information systems

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - Business Information Systems, Master's degree program (jaar 1), Compulsory, English
  - Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
  - Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- prof.dr.ir. G.J.P.M. Houben (responsible lecturer)

Information:
- prof.dr.ir. G.J.P.M. Houben - HG 7.78 - tel: 2653 - g.j.houben@tue.nl

Course web page: http://wwwis.win.tue.nl/2II35

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- 9 weeks lecture, 2 hours
- The first part of the course contains of a number of classes/lectures of 2 hours (typically 6 classes). In the first part the students participate each week in these classes and do some homework on some of these subjects. Subsequently, in the second part, the students work (under supervision of the teacher) on an assignment on one of the subjects of the course.

Type of examination/ planning:
- Assignment(s)

Contents

Learning objectives: Students have learned important concepts from the area of Web Information Systems (WIS) and the technology available for the engineering of WIS. The students have learned the most important concepts from the area of Semantic Web. They got acquainted with aspects of research in this field and with the application of (WIS) technology in modern information systems.

Contents:
- Web and Web-based information systems (WIS)
- Engineering and design methodologies for WIS
- Semistructured data and metadata languages
- Multimedia & Presentation generation
- Data integration on the Web
- Semantic Web
  1. languages: RDF(S), SeRQL, OWL
  2. applications
- Web 2.0
- Trends in the Web

2II45 Software architecting

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - Business Information Systems, Master's degree program (jaar 1), Optional, English
  - Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
  - Electrical Engineering Master, Master's degree program (jaar 1), Compulsory, English
  - Embedded Systems, Master's degree program (jaar 1), Compulsory, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Prior knowledge:
- 2IP25 - Software engineering (recommended)

Lecturers:
- Not yet known (responsible lecturer)

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture, 2 hours
- assignment(s)

Type of examination/ planning:
- Written, Semester 1 Block C (3 hours), Semester 2 Block D (3 hours) and Assignment(s)

Course material:
- Len Bass, Paul Clements and Rick Kazman, Software Architecture in Practice, 2nd edition, Addison-Wesley, 2003 (compulsory)
- Eberhardt Rechtin and Mark Maier, The Art of Systems Architecting, CRC Press (London), 1997 (recommended)
- Copies of Relevant articles (recommended)

Contents

Learning objectives: The aim of the course is to provide insight into the software architecting process for complex software intensive systems and to learn to apply the most important methods and techniques. Using assignments and a case-study, students will gain some practical experience in applying the most important methods and techniques

Contents: The subjects covered in the course will include:
- Introduction to architecture
- The architecting process, requirements engineering
- Describing architectures
- Architectural styles
- Cases of important architectures
- Techniques for evaluation and analysis of architectures
- Basics of component technology

In parallel with the theoretical part, the participants will also work on an assignment that guides them through the architecting process. Thereby, the stakeholders will be represented by representatives from industry and/or staff members.

2II55 Business process management systems

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 2 Block D t/m Semester 2 Block F
  - Business Information Systems, Master's degree program (jaar 1), Compulsory, English
  - Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
  - Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Prior knowledge:
- 2IDo5 - Datamodeling and databases (recommended)
- 2IWo5 - Software specification (recommended)

Lecturers:
- prof.dr.ir. W.M.P. van der Aalst (responsible lecturer)

Information:
- prof.dr.ir. W.M.P. van der Aalst - HG 7.75 - tel: 4295 - w.m.p.v.d.aalst@tm.tue.nl

Course web page: http://wwwis.win.tue.nl/2II55

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture, 4 hours

Type of examination/ planning:
- Written, Semester 2 Block F (3 hours), Semester Interim (3 hours) and Assignment(s)
- The mark will be based on an assignment (3 points) and a written exam (7 points, 3 hours). The assignment expires after the first written exam. See the study guide for details.

Course material:
- W.M.P. van der Aalst and K.M. van Hee. Workflow Management: Models, Methods and Systems. ISBN 0-262-01189-, MIT Press, 2002 or ISBN 0-262-72046-9, MIT Press, 2004 (paperback) (recommended)
- Selected papers (recommended)
- Sheets (recommended)

Contents

Learning objectives: After taking this course students should be able to:
- have detailed knowledge of the functionality and architecture of WFM and BPM systems
- model complex workflows
- analyze complex workflows
- have deep knowledge of classical Petri net theory

Contents: This course focuses on enterprise information systems that are driven by models, i.e., instead of constructing code these systems are assembled, configured or generated using a model-driven approach. Of particular interest are so-called “process-aware” information systems. Typical examples are workflow management systems and the process engines of ERP, CRM, PDM and other enterprise information systems. Starting point for the course are the process modeling techniques taught in the Bachelor phase. In particular it is assumed that the students are able to model in terms of (high-level) Petri nets and are able to make object models. Nevertheless, a short refresher is offered to learn the main concepts.
The first part of the course focuses on the modeling and implementation of workflows. Different languages and systems are presented. Using the so-called workflow patterns students need to compare and evaluate languages and systems. Moreover, students need to model and implement non-trivial workflows in a specific workflow management system (e.g.,YAWL). It should be noted that although the focus is on pure workflow management systems, the knowledge and experience will also applicable to other process-aware information systems.
The second part of the course focuses on the analysis of workflows using Petri net theory.
One of the topics is workflow verification, i.e., How to automatically identify design errors and correct them? Here different tools are being used and, among others, the SAP reference model and its errors are used as examples. This requires an introduction to concepts such as WF-nets, various soundness notions, free-choice nets, reduction rules, etc.
The mark will be based on an assignment (3 points) and a written exam (7 points).

2II65 Metamodeling and interoperability

General information

Academic year:	2008/2009
Class planning/ Target group:	• Semester 1 Block A t/m Semester 1 Block C • Business Information Systems, Master's degree program (jaar 1), Optional, English • Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English • Embedded Systems, Master's degree program (jaar 1), Optional, English
ECTS credits BaMa:	5
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Prior knowledge:	basic knowledge of data and process modeling and software architectures
Lecturers:	• dr. N. Sidorova (responsible lecturer) • dr. M. Voorhoeve (co-lecturer)
Information:	• Computer science, Architecture of information Syst - HG 7.73 - wsinfsys@win.tue.nl - tel. 2733 • dr. N. Sidorova - HG 7.84 - tel: 3705 - n.sidorova@tue.nl
Course web page:	http://wwwis.win.tue.nl/2II65
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:	• lecture, 2 hours
Type of examination/ planning:	• Written, Semester 1 Block C (3 hours), Semester 2 Block D (3 hours) and Assignment(s)
Course material:	• handouts (recommended)

Contents

Learning objectives:	Learn to understand the role of models and metamodels in software engineering • Learn to specify modeling languages in metamodels • Learn to apply service-oriented modeling • Learn to create different types of services for SOA • Learn to check the compatibility of services.
Contents:	Independently developed applications based on different models and implemented on different platforms need to use each others services and share each other's data. Interoperability is therefore one of the buzz-words of the last years in Computer Science. Web services-driven Service-Oriented Architectures (SOA) have arisen as a solution to the interoperability problem. In this context, metamodeling became more important than ever, since the key to successful integration of inter-organizational enterprise information systems and interoperability lies in the intelligent use and management of metadata and metaprocesses. In this course we will consider and compare a number of industrial and academic modeling and metamodeling frameworks (such as UML, BPMN,

WS BPEL, EPC, Petri nets, Yawl, temporal logics) and their place within the SOA approach and learn to develop data and process (meta-) models for services. We will also study a number of analysis techniques to check the compatibility of (communicating to each other) services.

2II75 Business process simulation

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 2 Block D t/m Semester 2 Block F
- Business Information Systems, Master's degree program (jaar 1), Compulsory, English
- Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
- Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- dr. M. Voorhoeve (responsible lecturer)

Information:
- dr. M. Voorhoeve - HG 7.86 - tel: 2420 - m.voorhoeve@tue.nl

Course web page: http://wwwis.win.tue.nl/2II75

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Written, Semester 2 Block F (3 hours), Semester Interim (3 hours)

Contents

Learning objectives: After having attended the course, students are expected to possess the following attitudes, knowledge and skillls related to simulation.
- General understanding of the purpose and scope
- Awareness of the limitations and dangers
- Understanding of the simulation process
- Knowledge of the proper execution of simulation projects
- Modeling skills related to the construction of simulation models
- Knowledge of parameters (e.g. distributions) and parameter selection skills
- Basic statistical knowledge: mean, variance, independency etc.
- Skills in interpreting the simulation results

Contents: The course treats the basic principles of simulation and the organization of simulation projects. The various phases of a simulation project are walked through, with the appropriate techniques. Special attention is paid to verification and validation. Various examples illustrate the described approach.

2II85 IT-governance

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 2 Block D t/m Semester 2 Block F
  - Business Information Systems, Master's degree program (jaar 1), Compulsory, English
  - Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- W. Rietveld (responsible lecturer)

Information:
- W. Rietveld - HG 7.78 - tel: 2653 - w.f.rietveld@tue.nl

Course web page: http://wwwis.win.tue.nl/2II85

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Assignment(s)
- Written group report plus oral report presentation, both based on group assignments

Course material:
- Presentation slides + notes (recommended)

Contents

Learning objectives: After completing the course students should
- know:
  - a selection of terms and theories relating to organization structures, strategy, management science
  - integrated architecture approaches
  - main standards
- understand:
  - management is not an exact science
  - business choices are subject to changing perceptions and opinions
  - architecture can be used as an alignment mechanism; the means, not the objective
  - business architecture is a process, not a blueprint
  - information systems are business assets and must be managed as such
  - effectiveness = quality * acceptance
- recognize:
  - different organization structures
  - different approaches to strategy
  - different management styles
  - different approaches to architecture

- be able to:
  - describe the architecture process
  - use different architectural views to describe a (current or desired) situation
  - evaluate IT governance status and issues
  - translate findings in recommendations

Contents: IT has become a major issue for business management. Organizations have become highly dependent on the quality and availability of their information systems and infrastructure. IT- spending is high, IT-projects are complex and many fail. Furthermore IT enables new business models and new ways of working. IT may be embraced to build unique positions and competitive advantage, though with high business risk. Often IT-strategy is defensive, and companies are struggling to meet market requirements, practice of perish. The ITG-course provides an introduction to various issues in the business - IT relationship. Architecture is used as the central concept to define both business and IT structures, in such a way that they can be effectively governed and will contribute to the mission and ambition of the organization. Students are required to participate in group assignments, where they will work on an IT-governmance problem in an actual organization, and present conclusions and recommendations. IT has become a major issue for business management. Organizations have become highly dependent on the quality and availability of their information systems and infrastructure. IT-spending is high, IT-projects are complex and many fail. Furthermore IT enables new business models and new ways of working. IT may be embraced to build unique positions and competitive advantage, though with high business risk. Often IT-strategy is defensive, and companies are struggling to meet market requirements, practice of perish. The ITG-course provides an introduction to various issues in the business - IT relationship. Architecture is used as the central concept to define both business and IT structures, in such a way that they can be effectively governed and will contribute to the mission and ambition of the organization. Students are required to participate in group assignments, where they will work on an IT-governmance problem in an actual organization, and present conclusions and recommendations.

2II95 Seminar information systems

General information

Academic year: 2008/2009

Class planning/ Target group:

- Semester 1 Block A t/m Semester 1 Block C
  - Business Information Systems, Master's degree program (jaar 2), Optional, English
  - Computer Science & Engineering Master, Master's degree program (jaar 2), Optional, English
  - Embedded Systems, Master's degree program (jaar 1), Optional, English

- Semester 2 Block D t/m Semester 2 Block F
  - Business Information Systems, Master's degree program (jaar 2), Optional, English
  - Computer Science & Engineering Master, Master's degree program (jaar 2), Optional, English
  - Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- prof.dr. K.M. van Hee (responsible lecturer)
- dr. M. Pechenizkiy (co-lecturer)

Information:
- prof.dr. K.M. van Hee - HG 7.74 - tel: 4518 - k.m.v.hee@tue.nl

Course web page: http://wwwis.win.tue.nl/2II95

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- tutorial, 2 hours

Type of examination/ planning:
- Assignment(s)

Contents

Learning objectives: In this seminar, a group of master students will get in touch with research in the area of Information Systems.Topics to be chosen are not fixed and may depend (each semester) on the preference of a professor of the research area. The topics will be studied in the following ways:
- Lectures by staff members and guest lectures
- Research papers and/or book chapters will be studied and presented by students, with a focus on research questions.
- Examples related to the presented material will be elaborated.
- If suitable, experiments related to these examples will be executed, either by using existing implementations or by developing ad hoc implementations.
- A research paper or final presentation.

Contents: The first semester of the year 2007-2008 will be conducted by prof dr K. M. van Hee in cooperation with A. Kisjes RA and RE. The topic will be: IT auditing in relationship with software engineering.
IT auditing is a very important activity in which the IT systems and related business processes are critically evaluated. IT auditing is founded in the accounting discipline and many methods and techniques are coming from this area. In the seminar these methods and techniques will be studied and they will be related to the methods and techniques used in software engineering

2II99 Capita selecta architecture of information systems

General information

Academic year: 2008/2009

Target group:
- Business Information Systems, Master's degree program (jaar 2), Optional, English
- Computer Science & Engineering Master, Master's degree program (jaar 2), Optional, English
- Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Prior knowledge:
- 2II55 - Business process management systems (recommended)

Lecturers:
- prof.dr.ir. W.M.P. van der Aalst (responsible lecturer)

Information:
- prof.dr.ir. W.M.P. van der Aalst - HG 7.75 - tel: 4295 - w.m.p.v.d.aalst@tm.tue.nl

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education: -

Contents

Learning objectives: Acquire state-of-the-art scientific knowledge of a particular topic in the information systems domain. Typical topics are process modeling, workflow management, process mining, web services, service oriented architectures, language transformations, etc.

Contents: People interested in the 'process side' of information systems can take the course 'Capita selecta architecture of information systems'. This course will be organized in an ad-hoc manner taking into account the interests of the student. The focus will always be on a particular 'hot topic' in the information systems domain. The course can, in principle, be taken at any point in time. Send an e-mail to wsinfsys@tue.nl describing your interest and the list of courses you already took (with marks).

2IJ26 Algebra

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block B
  - Computer Science & Engineering Master (for homologation only), Master's degree program (jaar 1), Optional, Dutch
- Semester 2 Block D t/m Semester 2 Block F
  - HBO-minor Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
  - HBO-minor Computer Science and Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch

ECTS credits BaMa:	3
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science • Subdepartment: Mathematics
Components of this subject:	• 2XT25 - Discrete structures, partial examination A (Indien het vak gevolgd wordt in het 1e semester.) • 2YT25 - Discrete structures, partial examination B (Indien het vak gevolgd wordt in het 1e semester.)
Prior knowledge:	• 2IT05 - Logic and set theory (recommended)
Lecturers:	• prof.dr. H. Zantema (responsible lecturer) • dr. A. Blokhuis (co-lecturer)
Information:	• prof.dr. H. Zantema - HG 6.73 - tel: 2749 - h.zantema@tue.nl
Course web page:	http://www.win.tue.nl/~hzantema/alg.html
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:	• lecture • instruction • independent learning under supervision • College en instructie in Semester I, blok A en B. (Dit valt samen met de colleges en instructies van 2IT25.) Begeleide zelfstudie in Semester II.
Type of examination/ planning:	• Written, Semester 1 Block B (1.5 hours), Semester 1 Block C (3 hours), Semester 2 Block F (3 hours), Semester Interim (3 hours) • In Semester I afronding via 2 deeltentamens 2XT25 en 2YT25 (ieder 1,5 uur). Herkansing na blok C en F (3 uur). In Semester II tentamen na blok F.
Notes:	De inhoud van dit vak komt overeen met 2IT25 Discrete Structuren, blok A en B.

Contents

Learning objectives:	Knowledge of algebraic stuctures. Extend skills in giving formal proofs.
Contents:	Graphs, monoids, groups, lattices.

2IL05 Data structures

General information

Academic year:	2008/2009
Class planning/ Target group:	• Semester 2 Block D t/m Semester 2 Block F • Combined P Bachelor Mathematics/Computer Science, Bachelor's degree program (jaar 1), Optional, English • Computer Science & Engineering Master (for homologation only), Master's degree program (jaar 1), Optional, English • Computer Science and Engineering Bachelor, Bachelor's and four/five year program (jaar 1), Compulsory, English • Embedded Systems (for homologation only), Master's degree program (jaar 1), Optional, English
ECTS credits BaMa:	6

Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Components of this subject:	• 2IL06 - Introduction to algorithms
Follow-up subjects:	• 2IL15 - Algorithmics • 2IL25 - Distributed algorithms
Lecturers:	• dr. B. Speckmann (responsible lecturer) • dr. H.J. Haverkort (instructor) • dr. A. Wolff (instructor) • E. Mumford PDEng (instructor) • dr.ir. G. Zwaan (instructor)
Information:	• dr. B. Speckmann - HG 7.34 - tel: 3076 - b.speckmann@tue.nl
Course web page:	http://www.win.tue.nl/~speckman/2IL05.html
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:	• lecture, 2 hours • instruction, 4 hours • Instruction (2 x 2 hours per week, each with its own content - see the corse web page for additional details).
Type of examination/ planning:	• Written, Semester 1 Block C (3 hours), Semester 2 Block F (3 hours), Semester Interim (3 hours) and Assignment(s) • The exercises consist of obligatory homework - see the corse web page for additional details.

Contents

Learning objectives:	There are many aspects to the study of data structures, and the algorithms that operate upon them. In this course, the student will learn the basic skills and knowledge to develop efficient algorithms to solve computational problems and to make informed choices between different solutions for the same problem. These include standard data structures and algorithms for frequently appearing problems, algorithm design techniques, how to establish that an algorithm is correct, and how to analyse the efficiency of an algorithm.
Contents:	Design techniques: Incremental algorithms, recursion, divide & conquer. Correctness: induction and invariants. Efficiency analysis: O-notation, recurrences. Sorting: MergeSort, InsertionSort, HeapSort, sorting in linear time, lower bounds for sorting. Selection Algorithms. Data structures: abstract data structures, heaps, hashing, search trees (incl. red-black trees), augmenting data structures, union-find. Basic graph algorithms: adjacency list, adjacency matrix, DFS, BFS, topological sort, minimum spanning trees.

2IL35 I/O-efficient algorithms

General information

Academic year:	2008/2009
Class planning/ Target group:	• Semester 1 Block A t/m Semester 1 Block C • Business Information Systems, Master's degree program (jaar 1), Optional, English • Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English • Embedded Systems, Master's degree program (jaar 1), Optional, English
ECTS credits BaMa:	5
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Prior knowledge:	Students coming from the TUE computer science bachelor programme must have completed Ontwerp van Algoritmen 3 or Algorithms. Specifically experience with the following topics is expected: incremental algorithms, divide and conquer, greedy algorithms, proofs with induction and invariants, O-notation and recurrences, sorting, search trees, depth-first and breadth-first search, minimum spanning trees, shortest path algorithms.
Lecturers:	• dr. H.J. Haverkort (responsible lecturer)
Information:	• dr. H.J. Haverkort - HG 7.35 - tel: 8363 - h.j.haverkort@tue.nl
Course web page:	http://www.win.tue.nl/~hermanh/teaching/2IL35/
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:	• lecture, 2 hours • lectures, 2 or 4 hours/week. Notes: Part of this course will be taught as a seminar. Attendance at all lectures is mandatory.
Type of examination/ planning:	• Assignment(s) • assignments (including (at least) homework assignments, a case study, and a presentation), and participation in discussions in class.
Course material:	• various articles, links will be provided on the website (recommended)
Notes:	Registration for this course is mandatory. Registration should be done before the first lecture by e-mail to the lecturer. For details see the study indicator.

Contents

Learning objectives:	The course will make the students familiar with the basic concepts and techniques for the design of I/O-efficient algorithms and data structures. The students will learn to recognize I/O-bottlenecks in algorithms, learn basic techniques to alleviate such bottlenecks, and will get an idea of the orders of magnitude of the parameters involved. The students will practice finding, reading, interpreting and explaining advanced literature on the topic. Furthermore the course offers opportunities for students to practice their presentation skills.

Contents: Traditionally, the running time of an algorithm is analysed in terms of the number of computational steps it performs (comparisons, additions, etc.). However, when working with huge amounts of data that do not fit in main memory, the number of disk accesses is much more important for the running time than the number of computational steps. Even when the data fit in main memory at once, a significant part of the running time of an algorithm working on large amounts of data is determined by the way in which the algorithm exploits the cache: data that is cached can be accessed much faster than data that resides in main memory. In this course we study so-called I/O-efficient algorithms: algorithms and data structures that are designed in order to keep the number of disk accesses or cache misses as small as possible. We discuss models for the design and analysis of such algorithms, basic algorithms, data structures and paradigms, and applications where I/O-efficiency makes the difference between algorithms that work and algorithms that do not work in practice.

2IL45 Advanced algorithms

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
- Business Information Systems, Master's degree program (jaar 1), Optional, English
- Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
- Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Prior knowledge:
- 2IA20 - Design of algorithms 2 (recommended)
- 2IA30 - Design of algorithms 3 (recommended)

Follow-up subjects:
- 2IL35 - I/O-efficient algorithms
- 2IL55 - Geometric algorithms
- 2IL95 - Seminar algorithms

Lecturers:
- prof.dr. M.T. de Berg (responsible lecturer)

Information:
- prof.dr. M.T. de Berg - HG 7.39 - tel: 2150 - m.t.d.berg@tue.nl

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Assignment(s)

Course material:
- handouts

Notes: Registration for this course is mandatory. Registration should be done before the first lecture through studyweb; if you cannot register because of problems with studyweb, you should register by sending email to m.t.d.berg@tue.nl .

Contents

Learning objectives: After this course students should know a number of advanced techniques for the design and analysis of algorithms so that they can successfully attack algorithmic problems in a wide range of areas. In particular, students will learn how to design and analyze randomized algorithms, approximation algorithms, and geometric algorithms.

Contents: Randomized algorithms (e.g. randomized quicksort and selection, small-dimensional linear programming, skip lists), approximation algorithms (e.g. Euclidean TSP, load balancing, vertex-cover), geometric algorithms (e.g. convex hull, tsp tess, quad tress).

2IL55 Geometric algorithms

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 2 Block D t/m Semester 2 Block F
- Business Information Systems, Master's degree program (jaar 1), Optional, English
- Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
- Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Prior knowledge:
- 2IL45 - Advanced algorithms (recommended)

Lecturers:
- dr. A. Wolff (responsible lecturer)

Information:
- Computer science, Algorithms - HG 7.22 - winalg@tue.nl - tel. 5155
- dr. A. Wolff - HG 7.41 - tel: 5576 - a.wolff@tue.nl

Course web page: http://www.win.tue.nl/~awolff/teaching/2009-1/2IL55

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Assignment(s)
- The final grade will be based on two items:
  - Homework assignments that in total count for 60% of the final mark.
  - A research survey that counts for 40% of the final mark.

Course material:
- Book (compulsory): Computational Geometry: Algorithms and Applications. M. de Berg, M. van Kreveld, M. Overmars, and O. Schwarzkopf. Springer-Verlag, Heidelberg. Third edition, 2008. (compulsory)

Notes: Registration on studyweb is mandatory.

Contents

Learning objectives: At the end of this course participants should be able to decide which algorithm or data structure to use in order to solve a given basic geometric problem. Participants should be able to analyze new problems and come up with their own efficient solutions using concepts and techniques from the course.

Contents: In many areas of computer science such as robotics, computer graphics, virtual reality, and geographic information systems, it is necessary to store, analyze, and create or manipulate spatial data. This course deals with the algorithmic aspects of these tasks: we study techniques and concepts needed for the design and analysis of geometric algorithms and data structures. Each technique and concept will be illustrated on the basis of a problem arising in one of the application areas mentioned above.

2IL95 Seminar algorithms

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - Business Information Systems, Master's degree program (jaar 2), Optional, English
  - Computer Science & Engineering Master, Master's degree program (jaar 2), Optional, English
  - Embedded Systems, Master's degree program (jaar 2), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Prior knowledge:
- 2IL45 - Advanced algorithms (recommended)

Lecturers:
- dr. B. Speckmann (responsible lecturer)

Information:
- dr. B. Speckmann - HG 7.34 - tel: 3076 - b.speckmann@tue.nl

Course web page: http://www.win.tue.nl/~speckman/2IL95.html

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- tutorial, 2 hours
- After an initial introduction, each student will give two presentations of 45 min. based on material from the books mentioned below or additional papers provided by the instructor. The number of participants is limited to 12 students. Registration for this course is mandatory and places are assigned on a first-come-first-serve basis. Registration should be done before the first lecture through studyweb; if you cannot register because of problems with studyweb, you should register by sending email to b.speckmann@tue.nl

Type of examination/ planning:
- Assignment(s)
- The grade is based on the quality of the presentations given and on participation in class. Attendance is mandatory.

Course material:
- Graph Drawing: Algorithms for the Visualization of Graphs. G. Di Battista, P. Eades, R. Tamassia, and I.G. Tollis. Prentice Hall, 1999. (recommended)
- Planar Graph Drawing. T. Nishizeki and Md. S. Rahman. World Scientific Publishing Company, 2004. (recommended)

Contents

Learning objectives: The course will familiarize the students with basic graph drawing concepts and algorithms. In particular, each student will master one specific aspect of the material and will be able to explain it clearly and succinctly to her peers.

Contents: Graphs are widely used to represent information that can be modeled as objects and connections between those objects. By drawing these graphs automatically we can effectively visualize this information, which finds application in, for example, cartography, sociology, software engineering, and VLSI design. A typical graph drawing algorithm strives to lay out a graph while satisfying certain aesthetic criteria: minimize the number of edges crossings, separate vertices and edges so they can be distinguished visually, preserve properties like symmetry and distance, to name a few. This course covers basic graph drawing concepts and algorithms.

2IL99 Capita selecta algorithms

General information

Academic year: 2008/2009

Target group:
- Business Information Systems, Master's degree program (jaar 2), Optional, English
- Computer Science & Engineering Master, Master's degree program (jaar 2), Optional, English
- Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- prof.dr. M.T. de Berg (responsible lecturer)

Information:
- prof.dr. M.T. de Berg - HG 7.39 - tel: 2150 - m.t.d.berg@tue.nl

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education: -

Notes: Type of education: to be determined.

Contents

Learning objectives: The goal of this Capita Selecta is to treat a number of modern topics that did not yet find a place in the regular courses. The form, contents and way of examination is dependent on the topic and will be determined separately for each student attending this course. In case of interest in this course it is advisable to contact the responsible teacher.

Contents: In this Capita Selecta a number of topics is treated that do not have their places in the regular curriculum. It is especially intended for students who want to graduate in a certain discipline. The form can differ from attending group seminars, self-study, performing practical work, etc.

2IM00 Internship

General information

Academic year: 2008/2009

Target group:
- Computer Science & Engineering Master, Master's degree program (jaar 2), Optional, English
- Embedded Systems, Master's degree program (jaar 2), Optional, English

ECTS credits BaMa: 20

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- dr. C.J. Bloo (co-ordinator)

Information:
- dr. C.J. Bloo - HG 6.35 - tel: 4496 - c.j.bloo@tue.nl

Course web page: http://www.win.tue.nl/inf/onderwijs/2IM00

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- work training

Notes: In case the internship of a student in Embedded Systems is done within the Electrical Engineering department the code is 5L985.

Contents

Learning objectives: One or more of the following: gain insight into the pursuance of the profession and form a picture of the profession, gain experience in working in a team within an organization, further develop the ability to function independently, gain practical experience, gain and broaden theoretical knowledge.

Contents: Internship, duration 14 weeks, at a company, other university, research organization or government agency.

2IM31 Kick-off meeting Computer Science and Engineering

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A, Semester 2 Block D
- Computer Science & Engineering Master, Master's degree program (jaar 1), Compulsory, English

ECTS credits BaMa: 0
Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- dr. J.C.S.P. van der Woude (responsible lecturer)

Information:
- dr. J.C.S.P. van der Woude - HG 7.79 - tel: 5146 - j.c.s.p.v.d.woude@tue.nl

Education and examination

Type of education:
- 1 week lecture, 1 hours

Contents

Learning objectives: -
Contents: -

2IM32 Kick-off meeting Information Security Technology

General information

Academic year: 2008/2009
Class planning/ Target group:
- Semester 1 Block A, Semester 2 Block D
- Information Security Technology, Master's degree program (jaar 1), Compulsory, English

ECTS credits BaMa: 0
Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- dr. J.C.S.P. van der Woude (responsible lecturer)

Information:
- dr. J.C.S.P. van der Woude - HG 7.79 - tel: 5146 - j.c.s.p.v.d.woude@tue.nl

Education and examination

Type of education:
- 1 week lecture, 1 hours

Contents

Learning objectives: -
Contents: -

2IM91 Master project

General information

Academic year: 2008/2009
Class planning/ Target group:
- Semester 2 Block D t/m Semester 2 Block F
- Business Information Systems, Master's degree program (jaar 2), Compulsory, English
- Computer Science & Engineering Master, Master's degree program (jaar 2), Compulsory, English

- Embedded Systems, Master's degree program (jaar 2), Compulsory, English
- Information Security Technology, Master's degree program (jaar 2), Compulsory, English

ECTS credits BaMa: 30

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- dr. J.C.S.P. van der Woude (co-ordinator)

Information:
- dr. J.C.S.P. van der Woude - HG 7.79 - tel: 5146 - j.c.s.p.v.d.woude@tue.nl

Course web page: http://www.win.tue.nl/~japie/mc

Education and examination

Type of education:
- graduation project

Type of examination/ planning:
- (Final) report and (Final) presentation

Notes: In case the master project of a student in Business Information Systems is done within the Technology Management department the code is 1BM91. In case the master project of a student in Embedded Systems is done within the Electrical Engineering department the code is 5T746.

Contents

Learning objectives: The master project is the masterpiece at the end of the master program at this university of technology. Herein the student is to give evidence of his or her scientific and constructive maturity as a design directed researcher or as a research directed designer. By tackling a well formulated research or design problem, the student shows his or her competence in the relevant scientific domain and is able to find, master and increase the necessary specialistic knowledge and skills. He or she has a systematic, coherent and critical approach to the problems and the constructive road towards solutions.
Competence in structuring research and design, in documentation, reasoning and reflection is proven in the thesis and in discussions about the subject with fellow researchers.

Contents: Variable.

2IN25 Real-time architectures

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - Business Information Systems, Master's degree program (jaar 1), Optional, English
  - Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
  - Embedded Systems, Master's degree program (jaar 1), Compulsory, English

ECTS credits BaMa:	5
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Prior knowledge:	• 2IC05 - Computer systems (recommended) • 2IC15 - Computer networks (recommended) • 2IN05 - Operating systems (recommended)
Lecturers:	• dr.ir. R.J. Bril (responsible lecturer)
Information:	• dr.ir. R.J. Bril - HG 5.09 - tel: 5412 - r.j.bril@tue.nl
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:	• lecture, 4 hours
Type of examination/ planning:	• Written, Semester 1 Block C (3 hours), Semester 2 Block D (3 hours) and Assignment(s)
Course material:	• G.C. Buttazzo, "Hard real-time computing systems, predictable scheduling - algorithms and applications", Springer, 2004, ISBN 0-387-23137-4, 2nd edition. (recommended) • Slides (recommended) • Articles (see studeerwijzer) (recommended)

Contents

Learning objectives: Students: can *explain* the essentials of real-time systems; *know* the central concepts and can *explain* the standard problems that appear; can *explain:* which real-time problems were addressed in a number of example systems, how these problems have been solved, and (optionally) why these approaches were taken; can *analyze* a real-time system design; can *design* a real-time system; can *study* the literature independently [this will not be evaluated, however].

Contents: This course is organized around the issue of real-time requirements and their impact on the hardware-software architecture of a system. This includes:

- examples of applications with real-time requirements;
- an understanding, both functional and quantitavely, of architectural elements, hardware and software, that have a dominant impact on the real-time properties of systems;
- the techniques used to enforce real-time properties in a verifiable manner (e.g., realtime scheduling, Quality of Service management).

The considered system domain will be systems in hardware and the hardware software interface, most notably, networked embedded systems and (multi-)processor architectures. Applications are drawn from real-time control and multimedia applications such as video streaming.

2IN35 VLSI programming

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 2 Block D t/m Semester 2 Block E
- Business Information Systems, Master's degree program (jaar 1), Optional, English
- Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
- Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- prof.dr.ir. C.H. van Berkel (responsible lecturer)
- drs. R.H. Mak (co-lecturer)

Information:
- drs. R.H. Mak - HG 5.06 - tel: 3719 - r.h.mak@tue.nl

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- 5 weeks lecture, 2 hours
- 5 weeks lecture, 1 hours
- 5 weeks instruction, 3 hours
- block D: 5 * 2 hours lectures
  block E: 5 * (1 hour lecture + 3 hours laboratory work)

Type of examination/ planning:
- Assignment(s)

Course material:
- Design and Implementation. Wiley Inter-Science 1999. (recommended)
- Handouts (recommended)

Contents

Learning objectives:
- to acquire insight in the description, design, and optimization of fine-grained parallel computations;
- to acquire insight in the (future) capabilities of VLSI as an implementation medium of parallel computations;
- to acquire skills in the design of such parallel computations and in their implementation on FPGAs.

Contents: Massive parallelism is needed to exploit the huge and still increasing computational capabilities of Very Large Scale Integrated (VLSI) circuits. In this course:
- we focus on fine-grained parallelism (not on networks of computers);
- we assume that parallelism is by design (not by compilation);
- we draw inspiration from consumer applications, such as digital TV, 3D TV, image processing, mobile phones, etc.; (not general-purpose computing)
- we will use Field Programmable Arrays (FPGA) as finegrained abstraction of VLSI for practical implementation.

Major elements of the course:
- Classifications: linear/non-linear, time-(in)variant systems, 1D/2D.
- Representations and formalisms: data flow graphs, state-space forms, transfer functions, vector-parallel programs, parallel programs.
- Performance metrics and scalability: costs (silicon area), time metrics (throughput, latency), energy metrics (static/dynamic power and energy).
- Architectures: digital hardware, systolic arrays, VLIW, SIMD.
- Design & optimization: (software) pipelining, retiming, folding, unfolding, strength reduction, re-use of partial results, vectorization, etc.
- Implementation media: VLSI, FPGAs, (vector) Digital Signal Processors.

2IN95 Seminar systems architecture and networking

General information

Academic year:	2008/2009
Class planning/ Target group:	• Semester 1 Block A t/m Semester 1 Block C • Business Information Systems, Master's degree program (jaar 2), Optional, English • Computer Science & Engineering Master, Master's degree program (jaar 2), Optional, English • Embedded Systems, Master's degree program (jaar 1), Optional, English
ECTS credits BaMa:	5
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Lecturers:	• prof.dr. J.J. Lukkien (responsible lecturer)
Information:	• prof.dr. J.J. Lukkien - HG 5.07 - tel: 5147 - j.j.lukkien@tue.nl
Course web page:	http://www.win.tue.nl/~johanl/educ/2IN95
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:	• tutorial, 2 hours
Type of examination/ planning:	• Assignment(s)

Contents

Learning objectives: The intent of the seminar is to get SAN students involved in topics currently addressed in the research of SAN, or topics that are otherwise of interest, e.g. because they form a new and rising domain. The aim is to obtain knowledge of the field being studied, to learn how to study literature, to prepare presentations and to get involved into ongoing research. For the academic year 2007/2008 we will address the topic of Wireless Sensor Networks. For this particular case we can specify the goals as follows.

Knowledge. Students understand the aspects where WSNs differ from standard Local Area Networks. They understand the constraints coming from the low cost, low performance, low energy consumption of the nodes on the one hand, and the scale of the network expressed in the number of nodes on the other hand. They can study the literature and evaluate papers in this area.
Capabilities. Students are capable of separating the possibly conflicting aspects of the WSN design. They have a clear insight how the nodes of a WSN need to be programmed to create lightweight programs that collaborate massively to one shared purpose. They can choose the appropriate abstractions, as a function of the application and network characteristics.

Contents: The typical form is that student prepare presentations based on literature they study which are then presented to each other on weekly meetings. Particularly, for the academic year of 2007/2008 we study Wireless Sensor Networks where we have the following content. Overview of components of a WSN: Node CPUs, transceiver, energy consumption; OS and programming paradigm; Network design, and -optimization aspects; channels, MAC aspects: wireless communication, CSMA, duty cycles, SMAC, 802.15.4; Link layer aspects: energy consumption of protocol, error control; Time synchronization; Localization; Routing; Data centric program paradigm; Transport and Quality of Service. In addition there will be some practical exercises.

2IN99 Capita selecta systems architecture and networking

General information

Academic year: 2008/2009

Target group:
- Business Information Systems, Master's degree program (jaar 2), Optional, English
- Computer Science & Engineering Master, Master's degree program (jaar 2), Optional, English
- Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- prof.dr. J.J. Lukkien (co-lecturer)

Information:
- prof.dr. J.J. Lukkien - HG 5.07 - tel: 5147 - j.j.lukkien@tue.nl

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education: -

Contents

Learning objectives: The course aims to introduce new topics in the domain of the expertise area System Archtitecture and Networking. Typically, this is a way to explore current trends in the research domain or to teach a topic for which expertise is available while there is no regular course on the topic. The actual goal will be announced via the web pages of the university.

Contents: The course is usually taught as an ordinary course with lectures, an exam and a practical. The actual contents will be announced via the web pages of the university.

2IP45 Software project management

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 2 Block D t/m Semester 2 Block F
- Business Information Systems, Master's degree program (jaar 1), Optional, English
- Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Prior knowledge: Bachelor Technical Computer Science

Lecturers:
- prof.dr. M.G.J. van den Brand (responsible lecturer)
- dr. L.J.A.M. Somers (co-lecturer)

Information:
- prof.dr. M.G.J. van den Brand - HG 5.59 - tel: 2744 - m.g.j.v.d.brand@tue.nl

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture, 2 hours
- Alternating (compulsory) meetings of either ? hour or 2 hours to discuss the supervised SEP team and to discuss books related to software engineering project management, respectively.

Type of examination/ planning:
- Assignment(s)
- Participation in these meetings and evaluation by the supervised SEP team.

Course material:
- Books and papers on software project management and software estimation (compulsory)

Contents

Learning objectives: Getting acquainted with managing a group developing non trivial software that has to fulfill the customer requirements. The students are interviewed before they are allowed to participate.

Contents: The students are obliged to read a few books on software management related topics such as software estimation, etc.
Note: This course is only accessible and compulsory for students supervising SEP groups.

2IS15 Generic language technology

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
- Business Information Systems, Master's degree program (jaar 1), Optional, English
- Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
- Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- prof.dr. M.G.J. van den Brand (responsible lecturer)
- dr.ir. C. Hemerik (co-lecturer)

Information:
- prof.dr. M.G.J. van den Brand - HG 5.59 - tel: 2744 - m.g.j.v.d.brand@tue.nl

Course web page: http://www.win.tue.nl/~mvdbrand/courses/GLT/0809

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture, 4 hours
- assignment(s)
- Lecture 4 hours (Block A),hearing lecture 2 hours (Block B and C).

Type of examination/ planning:
- Written, Semester 1 Block C (3 hours), Semester 2 Block D (3 hours) and Assignment(s)

Course material:
- Papers, by D.A. Watt
- Programming Language Design Concept, Wiley & Sons, 2004

Contents

Learning objectives: Generic Language Technology is focused on the development of formalisms and tools to describe (programming) languages and to process programming languages. The applications of GLT are in the field of compiler construction, analysis and transformation of programs and language prototyping. The basic concepts of GLT will be taught: (programming) language description, advanced parsing technology, implementation of rewriting systems, and term representations. The goal is to be able to describe non-trivial programming languages and to transform these languages.

Contents: Introduction to generic language technology, introduction into the specification formalism ASF+SDF, advanced parsing technology (scannerless generalized LR parsing), interpretation and compilation techniques for term rewriting rules, intermediate tree representation, and implementation techniques for the generation of integrated development environments based on ASF+SDF. Furthermore, programming language concepts are discussed and illustrated by studying various mainstream programming languages.

2IS25 Distributed trust management

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - Business Information Systems, Master's degree program (jaar 1), Optional, English
  - Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
  - Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- prof.dr. S. Etalle (responsible lecturer)

Information:
- prof.dr. S. Etalle - HG 9.83 - tel: 5016 - s.etalle@tue.nl

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Written, Semester 1 Block C (3 hours), Semester 2 Block D (3 hours) and Assignment(s)

Contents

Learning objectives: Students will learn how to manage trust in a distributed way. After the course, students
- have a thorough overview of the objectives and capabilities of trust management.
- have a good understanding of the most important access control techniques.

Contents: -

2IS35 Verification of security protocols

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 2 Block D t/m Semester 2 Block F
  - Business Information Systems, Master's degree program (jaar 1), Optional, English
  - Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
  - Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- dr. J.I. den Hartog (responsible lecturer)
- prof.dr. S. Etalle (co-lecturer)

Information:
- dr. J.I. den Hartog - HG 9.84 - tel: 2800 - j.d.hartog@tue.nl

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Written, Semester 2 Block F (3 hours), Semester Interim (3 hours) and Assignment(s)

Contents

Learning objectives:
- The student know the terminology regarding security protocols and knows what security requirements can put forward.
- The student is capable of designing, possibly by adapting existing components, a secure system for a given problem.
- The student is able to formulate the security goals of a protocol.
- The student can assess the safety of simple protocols.
- For this the student at least masters two techniques.

Contents: -

2IS95 Seminar software engineering and technology

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - Business Information Systems, Master's degree program (jaar 2), Optional, English
  - Computer Science & Engineering Master, Master's degree program (jaar 2), Optional, English
  - Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Prior knowledge:	• 2IS15 - Generic language technology (compulsory) • 2IS99 - Capita selecta software engineering and technology (recommended)
Lecturers:	• prof.dr. M.G.J. van den Brand (responsible lecturer)
Information:	• prof.dr. M.G.J. van den Brand - HG 5.59 - tel: 2744 - m.g.j.v.d.brand@tue.nl
Course web page:	http://www.win.tue.nl/~mvdbrand/courses/seminar/0809
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:	• tutorial, 2 hours • Weekly (compulsory) meetings of 2 hours.
Type of examination/ planning:	• Assignment(s) • Written summary and presentations on scientific literature related to SET research.
Course material:	• Papers

Contents

Learning objectives:	The goal of the SET seminar is three-fold. First of all, getting acquainted with the various research topics of SET: verified software engineering, model driven engineering, source code analysis. Second, a preparation of your master thesis project, mainly via literature search. Third, a preparation in presenting scientific results obtained by literature reviewing, formulation of research questions, etc.
Contents:	Variable, but Software Engineering and Technology related.

2IS99 Capita selecta software engineering and technology

General information

Academic year:	2008/2009
Class planning/ Target group:	• Semester 1 Block A t/m Semester 1 Block C • Business Information Systems, Master's degree program (jaar 2), Optional, English • Computer Science & Engineering Master, Master's degree program (jaar 2), Optional, English • Embedded Systems, Master's degree program (jaar 1), Optional, English
ECTS credits BaMa:	5
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Prior knowledge:	Agility in elementary predicate calculus and love of mathematical perfection are welcome prerequisites.
Lecturers:	• prof.dr. M.G.J. van den Brand (responsible lecturer)
Information:	• prof.dr. M.G.J. van den Brand - HG 5.59 - tel: 2744 - m.g.j.v.d.brand@tue.nl
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:	• lecture, 2 hours
Type of examination/ planning:	• Written, Semester 1 Block C (3 hours), Semester 2 Block D (3 hours)
Course material:	• To be announced. (compulsory)

Contents

Learning objectives:	The SET group is the continuation of the Software Construction group which has a long traditional in rigid software construction. Design by contract is a way of constructing high quality software.
Contents:	Based on perfect developer, B-method and/or Eiffel the design by contract technique will be illustrated.

2IT05 Logic and set theory

General information

Academic year:	2008/2009

Class planning/ Target group:	• Semester 1 Block A t/m Semester 1 Block C
	  • Combined P Bachelor Mathematics/Computer Science, Bachelor's degree program (jaar 1), Compulsory, Dutch
	  • Computer Science and Engineering Bachelor, Bachelor's and four/five year program (jaar 1), Compulsory, Dutch
	  • Innovation Sciences (ICT), Bachelor's and four/five year program (jaar 2), Compulsory, Dutch
	  • Pre-master program Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
	  • Pre-master program Computer Science & Engineering, Bachelor's degree program (jaar 1), Compulsory, Dutch
	  • Pre-master program Embedded Systems, Bachelor's degree program (jaar 1), Compulsory, Dutch
	• Semester 2 Block D t/m Semester 2 Block F
	  • HBO-minor Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, English
	  • HBO-minor Computer Science and Engineering, Bachelor's degree program (jaar 1), Compulsory, English

ECTS credits BaMa:	6
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Components of this subject:	• 2XT05 - Logic and set theory, partial examination A • 2YT05 - Logic and set theory, partial examination B
Follow-up subjects:	• 2IA05 - Functional programming • 2ID65 - Hypermediastructuren en -systemen • 2IF55 - Semantiek en berekeningsmodellen • 2IL05 - Data structures • 2IL15 - Algorithmics • 2IT15 - Automata and process theory • 2IT25 - Discrete structures

Lecturers:
- dr. S.P. Luttik (responsible lecturer)
- Not yet known (instructor)
- Not yet known (instructor)
- Not yet known (instructor)
- Not yet known (instructor)

Information:
- dr. S.P. Luttik - HG 7.14 - tel: 5142 - s.p.luttik@tue.nl

Course web page: http://www.win.tue.nl/~luttik/Courses/LV

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture
- instruction
- tutorial
- • Semester 1: Block A: lectures, 4 hours instructions, 4 uur Block B: lectures, 2 hours instructions, 2 hours Block C: lectures, 2 hours instructions, 4 hours.
  - Semester 2: Block DEF: 4 hours combination between lectures en intructions (only for premaster students en HBO-minor students).

Type of examination/ planning:
- Written, Semester 1 Block C (3 hours), Semester 2 Block F (3 hours), Semester Interim (3 hours)

Course material:
- Rob Nederpelt, Fairouz Kamareddine: 'Logical Reasoning: A First Course. Texts in Computing, Volume 3, King's College Publications, London, 2004. ISBN 0-9543006-7-X, 400 pp (compulsory)
- Supplemented with handouts

Contents

Learning objectives: After completing the course, the student can work with formulas from propositional logic and predicate logic, and knows their meaning and use. In particular, the student can 'calculate' with logical formulas by replacing them by equivalent formulas, by strengthening formulas, or by weakening them, and the student can 'reason' with logical formulas in a system with assumptions, deductions and conclusions. The student can put his logical knowledge to work, in particular to calculate and reason with the formulas of set theory, having developed both the skills and the understanding of the fundamental mathematical abstractions in the area of sets, including relations, classes, partitions, functions, orderings and induction.

Contents: Subjects:
- Propositions, truth tables, equivalence, tautology and contradiction, standard equivalences, calculating with equivalences, strengthening and weakening propositions.
- Predicates, quantifiers, standard equivalences with quantifiers, substitution, Leibniz's law, variable binding. Logical derivation, reasoning with propositions and predicates, conclusion, assumption, context, validity.
- Set, subset, intersection and union, complement, difference, the empty set, powerset, cartesian product, sequence.
- Relation, equivalence relation, class, partition.

- Mapping (function), image and source, injection, surjection, bijection, inverse function, composition of relations and functions, closure.
- Ordering, linear ordering, partial ordering, well-ordering.
- Induction, strong induction, inductive definitions, structural induction, recursively defined functions.
- Cardinality, (non)denumerability, Cantor's diagonal argument.

2IT15 Automata and process theory

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - HBO-minor Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, English
  - HBO-minor Computer Science and Engineering, Bachelor's degree program (jaar 1), Compulsory, English
  - Pre-master program Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, English
  - Pre-master program Computer Science & Engineering, Bachelor's degree program (jaar 1), Compulsory, English
- Semester 2 Block D t/m Semester 2 Block F
  - Combined P Bachelor Mathematics/Computer Science, Bachelor's degree program (jaar 1), Compulsory, English
  - Computer Science and Engineering Bachelor, Bachelor's and four/five year program (jaar 1), Compulsory, English
  - HBO-minor Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, English
  - HBO-minor Computer Science and Engineering, Bachelor's degree program (jaar 1), Compulsory, English
  - Pre-master program Business Information Systems, Bachelor's degree program (jaar 1), Compulsory, English
  - Pre-master program Computer Science & Engineering, Bachelor's degree program (jaar 1), Compulsory, English

ECTS credits BaMa: 6

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Components of this subject:
- 2XT15 - Automata and process theory, partialexamination A
- 2YT15 - Automata and process theory, partial examination B

Prior knowledge:
- 2IT05 - Logic and set theory (recommended)

Lecturers:
- prof.dr. J.C.M. Baeten (responsible lecturer)
- dr. C.J. Bloo (instructor)
- dr.ir. J.W. Wesselink (instructor)
- dr.ir. M.A. Reniers (instructor)
- dr. S. Andova (instructor)

Information:
- prof.dr. J.C.M. Baeten - HG 7.19 - tel: 2904 - j.c.m.baeten@tue.nl

Course web page: http://www.win.tue.nl/~andova

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture
- instruction
- in odd weeks: 2 x 2 hours lecture, 2 hours instruction.
  in even weeks: 2 hours lecture, 2 x 2 hours instruction.

Type of examination/ planning:
- Written, Semester 1 Block C (3 hours), Semester 2 Block F (3 hours), Semester Interim (3 hours)

Course material:
- syllabus, available at the selling point for readers

Contents

Learning objectives: The student has an idea of the notion of computability. He/she knows what a computer can and cannot do, and what communication with or between computers means.
The student knows what is a model of computation. He/she has insight in the differences between models of computation such as automata and transition systems, knows how to use these models of computation and equivalences on these models.
The student can handle the notions finite automaton, pushdown automaton, Turing machine, regular expression, grammar, formal language.
The student can model a simple system, at different levels of abstraction, and formalise properties of such a system.

Contents:
1. Regular languages: finite automaton, recursive specification, grammar, deterministic automaton, internal step, iteration expression.
2. Context-free languages: parsing, ambiguity, normal forms, pushdown automaton.
3. Computable languages: Turing machine, Church-Turing thesis, undecidability.
4. Regular processes: bisimulation, interaction, protocols.
5. Abstraction: branding bisimulation.
6. Context-free processes.
7. Computable processes.

2IV05 Additional component computer graphics

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - Business Information Systems, Master's degree program (jaar 1), Optional, English
  - Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
  - Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:	• dr.ir. H.M.M. van de Wetering (responsible lecturer)
Information:	• dr.ir. H.M.M. van de Wetering - HG 6.83 - tel: 4268 - h.v.d.wetering@tue.nl
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:	• lecture, 2 hours
Type of examination/ planning:	• Assignment(s)

Contents

Learning objectives:	The students practice how to define, design, create and present an essentially non-trivial interactive graphical application.
Contents:	This course covers several advanced subjects in computer graphics. The students work on a project of which the goal is to design, construct, and test a software system which contains a strong computer graphics component. Several elements of algorithmics and computer graphics are to be covered by such a system, such as: 3D rendering and interaction; 3D geometric object modeling with implicit functions and/or polygonal meshes; simulation of 3D dynamic processes (particle-based, rigid bodies, collisions).

2IV35 Visualization

General information

Academic year:	2008/2009
Class planning/ Target group:	• Semester 1 Block A t/m Semester 1 Block C • Business Information Systems, Master's degree program (jaar 1), Optional, English • Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English • Embedded Systems, Master's degree program (jaar 1), Optional, English
ECTS credits BaMa:	5
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Lecturers:	• dr.ir. H.M.M. van de Wetering (responsible lecturer)
Information:	• dr.ir. H.M.M. van de Wetering - HG 6.83 - tel: 4268 - h.v.d.wetering@tue.nl
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:	• lecture, 4 hours
Type of examination/ planning:	• Written, Semester 1 Block C (3 hours), Semester 2 Block D (3 hours)

Contents

Learning objectives: The aim of this course is to introduce students to the theory and practice of data visualization. The course is intended at students who already have a good knowledge of computer graphics, programming and data structures, and a basic knowledge of linear algebra and analysis. At the end of the course, the students should be familiar with the aims and problematics of data visualization, and have a good knowledge of the theory, principles, and methods which are frequently used in practice in the construction and use of data visualization applications. Moreover, the students should be able to design, implement, and customize a data visualization application of average complexity in order to get insight in a real-world dataset from one of the application domains addressed during the lecture. On a practical side, the students should understand (and apply) the various design and implementation trade-offs which are often encountered in the construction of visualization applications.

Contents: The course covers the theory and practice of data visualization. This addresses several technical topics, such as: data representation; different types of grids; data sampling, interpolation, and reconstruction; the concept of a dataset; the visualization pipeline. In terms of visualization application, several examples are treated, following the different types of visualization data: scalar visualization, vector visualization, tensor visualization. Besides these, several additional topics are treated, such as: volume data visualization; domain modeling techniques; and a brief introduction to information visualization. The techiques treated in the course are illustrated by means of several practical, hands-on, examples.

2IV55 Interactive virtual environments

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 2 Block D t/m Semester 2 Block F
- Business Information Systems, Master's degree program (jaar 1), Optional, English
- Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
- Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- prof.dr.ir. R. van Liere (responsible lecturer)

Information:
- prof.dr.ir. R. van Liere - HG 6.32 - tel: 3549 - r.v.liere@tue.nl

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Assignment(s)

Contents

Learning objectives: The purpose of this course is to introduce students to the main concepts and practical issues in designing, implementing and evaluating Virtual Environments (VE). By the end of this course students should have an understanding of the core technial concepts in VEs and have constructed and validated a part of a VE. A central theme of the course will be that the trade-offs in the design of a VE can be best understood through the evaluation of the subject's responses to a VE experience.

Contents: The course will first provide an general introduction to components of a VE system, including the visual, auditory, haptic, tracking, types of displays in all modalities. This is followed by a detailed analysis of various VE components, in particular spatial interaction, tracking and haptics. Finally, pragmatical quidelines related to human factors and usability will be given. These will be applied to the evaluation of the techniques.

2IV95 Seminar visualization

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
- Business Information Systems, Master's degree program (jaar 2), Optional, English
- Computer Science & Engineering Master, Master's degree program (jaar 2), Optional, English
- Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- prof.dr.ir. J.J. van Wijk (responsible lecturer)

Information:
- prof.dr.ir. J.J. van Wijk - HG 6.72 - tel: 4579 - j.j.v.wijk@tue.nl

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- tutorial, 2 hours
- Bi-weekly meeting of 2 hours

Type of examination/ planning:
- Assignment(s)
- Reports, posters, and/or presentations on scientific literature

Course material:
- Papers

Contents

Learning objectives: In this seminar, students will get acquainted with research in the area of visualization and computer graphics. Papers and/or book chapters will be studied and presented by students, starting from research questions. Emphasis is on literature study, possibly performing experiments, and presenting results in the form of posters, presentations, and papers.

Contents: Topics will be chosen from visualization, computer graphics, and especially information visualization. These topics are not fixed and may depend on the preference of students.

2IV99 Capita selecta visualization

General information

Academic year: 2008/2009

Target group:
- Business Information Systems, Master's degree program (jaar 2), Optional, English
- Computer Science & Engineering Master, Master's degree program (jaar 2), Optional, English
- Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- prof.dr.ir. J.J. van Wijk (responsible lecturer)

Information:
- prof.dr.ir. J.J. van Wijk - HG 6.72 - tel: 4579 - j.j.v.wijk@tue.nl

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education: -

Contents

Learning objectives: Specific enhancement of the knowledge in the area of visualization.

Contents: Capita Selecta Visualization offers the possibility to study a topic in the area of visualization that is not part of any of the regular courses. The contents of the course is determined in cooperation by the student and the responsible teacher for this course and can essentially regard all relevant topics. For more information it is advised to timely contact the teacher. The course is not scheduled and can be attended at basically any time during the year.

2IW05 Software specification

General information

Academic year:	2008/2009
Class planning/ Target group:	• Semester 1 Block A t/m Semester 1 Block C • Computer Science & Engineering Master (for homologation only), Master's degree program (jaar 1), Optional, English • Computer Science and Engineering Bachelor, Bachelor's and four/five year program (jaar 2), Compulsory, English • Embedded Systems (for homologation only), Master's degree program (jaar 2), Optional, English
ECTS credits BaMa:	6
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Components of this subject:	• 2XW05 - Software specification, partial examination A • 2YW05 - Software specification, partial examination B
Prior knowledge:	• 2IP15 - Programming methods (recommended) • 2IT05 - Logic and set theory (recommended) • 2IT15 - Automata and process theory (recommended)
Lecturers:	• dr.ir. M.A. Reniers (responsible lecturer) • dr. M. Mousavi (co-lecturer) • Not yet known (instructor) • Not yet known (instructor)
Information:	• dr.ir. M.A. Reniers - HG 6.76 - tel: 2999 - m.a.reniers@tue.nl
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:	• lecture, 2 hours • instruction, 2 hours
Type of examination/ planning:	• Written, Semester 1 Block C (3 hours), Semester 2 Block F (3 hours) and Assignment(s)

Contents

Learning objectives:	The student can describe a wide range of existing software systems or software systems to be developed formally making use of mathematical formalisms introduced in the course.
Contents:	Method for software specification consisting of the description of data, functionality, and behaviour. Class diagrams are used for the description of data and functionality. Formal semantics uses Abstract Data Types and Z. Interaction of the (software) system with the environment is described by means of Message Sequence Charts (MSC) and High-level MSCs for normal scenarios and by means of StatCharts for a more complete description of the behavior.

2IW15 Automated reasoning

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 2 Block D t/m Semester 2 Block F
  - Business Information Systems, Master's degree program (jaar 1), Optional, English
  - Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
  - Electrical Engineering Master, Master's degree program (jaar 1), Compulsory, English
  - Embedded Systems, Master's degree program (jaar 1), Compulsory, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- prof.dr. H. Zantema (responsible lecturer)

Information:
- prof.dr. H. Zantema - HG 6.73 - tel: 2749 - h.zantema@tue.nl

Course web page: http://www.win.tue.nl/inf/onderwijs/2IW15

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Written, Semester 2 Block F (3 hours), Semester Interim (3 hours) and Assignment(s)

Contents

Learning objectives: Obtaining insight how various problems can be transformed to formulas, and can be solved automatically by computer programs manipulating these formulas.

Contents: Many problems, in particular in the area of verification of computer systems, can be expressed as proving that some big formula is always true. In this course we will concentrate on various methods for treating this kind of problems. Not only correctness and completeness of these methods will be considered, also efficiency and usability. In particular we will consider:
- Resolution as a proof rule to prove propositions, and algorithms for satisfiability of propositions based on resolution.
- Binary Decision Diagrams as efficient representation of boolean expressions.
- Unification; resolution on predicates.
- Reasoning modulo equations, term rewriting.

2IW25 Requirement analysis, design and verification

General information

Academic year:	2008/2009
Class planning/ Target group:	• Semester 1 Block A t/m Semester 1 Block C • Business Information Systems, Master's degree program (jaar 1), Optional, English • Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English • Electrical Engineering Master, Master's degree program (jaar 1), Compulsory, English • Embedded Systems, Master's degree program (jaar 1), Compulsory, English
ECTS credits BaMa:	5
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Lecturers:	• prof.dr.ir. J.F. Groote (responsible lecturer)
Information:	• prof.dr.ir. J.F. Groote - HG 6.75 - tel: 5003 - j.f.groote@tue.nl
Course web page:	http://www.win.tue.nl/~jfg/educ/educ.html
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:	• lecture, 4 hours
Type of examination/ planning:	• Written, Semester 1 Block B (3 hours), Semester 1 Block C (3 hours) and Assignment(s)
Course material:	• Modeling and analysis of reactive systems. J.F. Groote and M.A. Reniers. Will be handed out during the lectures. (compulsory)

Contents

Learning objectives:	The purpose of this course is to learn how computer steered system can be designed by mathematically modelling the behaviour of these systems and by verifying that this behaviour meets the requirements, before commencing to implement. The purpose is also to experience that the behaviour of contemporary systems is so complex, that without a proper a priori analysis of such systems, residual errors will most likely remain in the design of such systems.
Contents:	The course starts off with a crash course in process algebraic system description. Keywords are: Process algebra, interactions, behaviour, axioms, derivations, hiding and internal actions, data-process interaction. Linear processes. Cones and foci. Confluence. mCRL2 toolset. Modal logic and modelchecking. The first part will be terminated by an exam. In the second half of the course the focus shifts to the design of a small embedded system. First the requirements must be written down. Second a design of the system must be made and third the requirements must be proven to hold on the system, where faulty performance of some of the components must be taken into account.

2IW45 Programming by calculation

General information

Academic year:	2008/2009
Class planning/ Target group:	• Semester 1 Block A t/m Semester 1 Block C • Business Information Systems, Master's degree program (jaar 1), Optional, English • Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English • Embedded Systems, Master's degree program (jaar 1), Optional, English
ECTS credits BaMa:	5
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Computer science
Prior knowledge:	affinity with a formal, calculated style of reasoning is required
Lecturers:	• dr.ir. R.R. Hoogerwoord (responsible lecturer)
Information:	• Secr. Subdepartment of Computer science - HG 6.74 - wsinf@tue.nl - tel. 5010 • dr.ir. R.R. Hoogerwoord - HG 6.86 - tel: 4564 - r.r.hoogerwoord@tue.nl
Studyweb:	http://studyweb.tue.nl/

Education and examination

Type of education:	• lecture, 2 hours • homework assignments
Type of examination/ planning:	• Assignment(s)
Course material:	• handed out during the lectures (recommended)

Contents

Learning objectives:	Development of a calculational style of programming, with applications to functional, sequential, and parallel programs.
Contents:	Elementary techniques from functional programming: generalisation, recursion, tupling, additional parameters. The use of specifications. Datastructures: tuples, lists, trees. Operator folding and its applications. Tail recursion and iteration; transforming functional into sequential programs. Program inversion, applied to parser construction. Infinite lists and productivity, with applications.

2IW55 Algorithms for model checking

General information

Academic year:	2008/2009
Class planning/ Target group:	• Semester 1 Block A t/m Semester 1 Block C • Business Information Systems, Master's degree program (jaar 1), Optional, English

- Computer Science & Engineering Master, Master's degree program (jaar 1), Optional, English
- Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Prior knowledge:
- 2IW10 - Programming and modal logic (recommended)
- 2IW20 - Requirement analysis, design and verification (recommended)
- 2R880 - Automated reasoning (recommended)

Lecturers:
- dr.ir. T.A.C. Willemse (responsible lecturer)

Information:
- dr.ir. T.A.C. Willemse - HG 6.81 - tel: 2952 - t.a.c.willemse@tue.nl

Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Written, Semester 1 Block C (3 hours), Semester 2 Block D (3 hours)

Course material:
- Handouts (recommended)
- Book: Model Checking. Edmund M. Clarke, Jr., Orna Grumberg, and Doron A. Peled. MIT Press, ISBN 0-262-03270-8. (compulsory)

Contents

Learning objectives:
- Understand algorithmic aspects of model checking,
- Be able to apply algorithms for model checking and obtain knowledge on optimisation techniques for model checking.

Contents: Basic and advanced algorithms for model checking and closely related verification techniques will be reviewed. Several optimization techniques will be introduced, such as:
- partial-order reduction for reducing the state space,
- symbolic model checking by using Binary Decision Diagrams.

2IW95 Seminar design and analysis of systems

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
- Business Information Systems, Master's degree program (jaar 2), Optional, English
- Computer Science & Engineering Master, Master's degree program (jaar 2), Optional, English
- Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers:
- prof.dr. H. Zantema (responsible lecturer)

Information: • prof.dr. H. Zantema - HG 6.73 - tel: 2749 - h.zantema@tue.nl
Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education: • tutorial, 2 hours
Type of examination/ planning: • Assignment(s)

Contents

Learning objectives: In this seminar, a group of master students will get in touch with research in the area. This will be done in the following ways:
- Research papers and/or book chapters will be studied and presented by students, with a focus on research questions.
- Examples related to the presented material will be elaborated.
- If suitable, experiments related to these examples will be executed, either by using existing implementations or by developing ad hoc implementation.
- Conclusions of these experiments are formulated in a report.

Contents: Topics to be chosen are not fixed and may depend on the preference of the students. Topics will be proposed by several researchers in the group, and also supervision may be done by the researcher who proposed the topic.

2IW99 Capita selecta design and analysis of systems

General information

Academic year: 2008/2009
Target group:
- Business Information Systems, Master's degree program (jaar 2), Optional, English
- Computer Science & Engineering Master, Master's degree program (jaar 2), Optional, English
- Embedded Systems, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 5
Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Computer science

Lecturers: • prof.dr.ir. J.F. Groote (responsible lecturer)
Information: • prof.dr.ir. J.F. Groote - HG 6.75 - tel: 5003 - j.f.groote@tue.nl
Studyweb: http://studyweb.tue.nl/

Education and examination

Type of education: -
Course material: • In overleg. (recommended)

Contents

Learning objectives: Specific enhancement of the knowledge in the area of the design and analysis of systems.

Contents: The Capita Selecta Design and Analysis of Systems offers the possibility to study a topic in the area of the Design and Analysis of Systems that is not part of any of the regular courses. The contents of the course is determined in cooperation by the student and the responsible teacher for this course and can essentially regard all relevant topics. For more information it is advised to timely contact the teacher. The course is not scheduled and can be attended at basically any time during the year.

2WC12 Cryptography 1

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 1 Block A t/m Semester 1 Block C
  - Information Security Technology, Master's degree program (jaar 1), Compulsory, English

ECTS credits BaMa: 6

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Mathematics

Lecturers:
- prof.dr.ir. H.C.A. van Tilborg (responsible lecturer)

Information:
- prof.dr.ir. H.C.A. van Tilborg - HG 9.94 - tel: 2739 - h.c.a.v.tilborg@tue.nl

Education and examination

Type of education:
- lecture, 2 hours

Type of examination/ planning:
- Written, Semester 1 Block C (3 hours), Semester 2 Block D (3 hours)

Contents

Learning objectives: Knowledge of all modern standard techniques (both symmetric as asymmetric) for the protection of data against unauthorized thirds. Also acquiring the mathematics that is necessary for the design of such systems or for the evaluation of its strength.

Contents:
- Classical systems like Caesar and Vigenère, some simple cryptanalysis.
- The general structure of block ciphers, Feistel ciphers like DES, AES, the most suitable modes-of-use, e.g. CBC or OFB.
- Shift register sequences (linear and non-linear), the linear complexity of a periodic sequence, the Berlekamp-Massey algorithm.
- The principle of public cryptography.
- Diffie-Hellman key exchange, El Gamal, several methods to take discrete logarithms (baby-step giant-step method, the Pohlig-Hellman method, Pollard-rho and the index calculus method).
- Elliptic curve cryptosystems.
- The RSA system for encryption and signing, generating prime numbers by means of probabilistic primality tests, several factorisation algorithms (Pollard-(p-1), Pollard-rho, the random square method, the quadratic sieve method), and some insecure modes of RSA.
- Hash functions, Message Authentication Codes

2WC13 Cryptography 2

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 2 Block D t/m Semester 2 Block F
  - Information Security Technology, Master's degree program (jaar 1), Optional, English

ECTS credits BaMa: 6

Provided by:
- Department: Mathematics and Computer Science (responsible)
- Subdepartment: Mathematics

Components of this subject:
- 2XC13 - Cryptography 2, partial examination

Lecturers:
- dr.ir. L.A.M. Schoenmakers (responsible lecturer)
- dr. B.M.M. de Weger (co-lecturer)

Information:
- dr.ir. L.A.M. Schoenmakers - HG 9.90 - tel: 4769 - l.a.m.schoenmakers@tue.nl

Education and examination

Type of education:
- tutorial, 2 hours

Type of examination/ planning:
- Written and Assignment(s)

Contents

Learning objectives: In this course we extend the exploration of cryptography from basic cryptographic algorithms (covered in Cryptography 1) to cryptographic protocols, and more generally to cryptographic systems. Whereas cryptographic algorithms can be executed locally, by entities on their own, a cryptographic protocol requires two or more entities to interact by exchanging messages to jointly achieve a set of security (and privacy) goals. A typical cryptograpic system combines the use of several cryptographic algorithms and protocols to provide security services to the surrounding information systems.
The goal of this course is to treat a wide range of cryptographic protocols and to get a basic understanding of the cryptographic systems that are in use today. In some cases, the security goals will be defined formally, and some cryptographic protocols will be accompanied by a security proof showing that the goals are met.
Furthermore, practical examples of cryptographic systems will be treated showing how security goals such as message protection, transaction security, or access control can be achieved.

Contents: Key exhange:
- Basic key exchange protocols
- Authenticated key agreement
- Password-based authenticated key exchange

Commitment schemes
Blind signatures
Oblivious transfer

Challenge-response protocols:
- Identification protocols
- Zero-knowledge proofs

Secret sharing:
- Shamir secret sharing
- Verifiable secret sharing

Threshold cryptography
Secure multiparty computation
Public Key Infrastructure (PKI):
- X.509 certificate and key management

Public key cryptography systems:
- Network layer: IPSec
- Transport layer: TLS/SSL
- Application layer: e-mail security, XML security
- Identity based cryptography

Symmetric key cryptography systems:
- Passphrase based crypography
- Kerberos

Electronic payment systems:
- SET
- Digital cash
- Micropayments

Mobile security (time permitting):
- UMTS security
- Mobile agent security

2WC14 Linux kernel and hacker's hut

General information

Academic year:	2008/2009
Class planning/ Target group:	• Semester 1 Block A t/m Semester 1 Block C • Information Security Technology, Master's degree program (jaar 1), Optional, English
ECTS credits BaMa:	6
Provided by:	• Department: Mathematics and Computer Science (responsible) • Subdepartment: Mathematics
Lecturers:	• prof.dr. A.E. Brouwer (responsible lecturer)
Information:	• prof.dr. A.E. Brouwer - HG 9.38 - tel: 2642 - a.e.brouwer@tue.nl

Education and examination

Type of education:	• lecture, 3 hours
Type of examination/ planning:	• Assignment(s)

Contents

Learning objectives: To learn the safety aspects of computersystems.

Contents: System security can be approached from two sides - the viewpoint of the attacker and that of the defender. For a defender it is necessary to know what threats to defend against, no use installing a heavily shielded front door when intruders enter through unprotected backdoors and windows. The present course talks about security primarily from the hackers' point of view - it points out categories of weaknesses in various systems, shows how to learn about these weaknesses and how to exploit them. It is a hands-on course - students are expected to write some exploits themselves. Topics are for example Discovery, Active Data, Smashing the Stack, Local and Remote Root Exploits, Stealth, Unicode, Password Cracking, Denial of Service, Cross-site Scripting, DNS spoofing, etc. Most examples are formulated in a Unix context, but the concepts apply everywhere. Illegal activities are strongly discouraged.

2WX04 Communication skills

General information

Academic year: 2008/2009

Class planning/ Target group:
- Semester 2 Block D t/m Semester 2 Block F
- Computational Science and Engineering, Master's degree program (jaar 1), Compulsory, English
- Computer Science & Engineering Master (for foreign students only), Master's degree program (jaar 1), Optional, English
- Discrete Mathematics and Applications, Master's degree program (jaar 1), Compulsory, English
- Embedded Systems (for foreign students only), Master's degree program (jaar 1), Optional, English
- Statistics, Probability, and Operations Research, Master's degree program (jaar 1), Compulsory, English

ECTS credits BaMa: 3

Provided by:
- Department: General
- Department: Mathematics and Computer Science (responsible)

Lecturers:
- drs. J.M. Beenhakker (responsible lecturer)
- Visiting lecturer(s) (co-lecturer)

Information:
- drs. J.M. Beenhakker - HG 1.62 - tel: 4592 - j.m.beenhakker@tue.nl

Education and examination

Type of education:
- 6 weeks course/training, 3 hours

Type of examination/ planning:
- Assignment(s)
- Different assignments (presentations, interviews, and writing reports). At the end each student writes a self-reflection report, a final presentation and a final report.

Course material:
- Hand-outs (recommended)

Contents

Learning objectives:	Improve communication skills with regard to presentation techniques, interview techniques, group-skills, feedback and writing reports by means of theory, practice, reflection and feedback from fellow students and the teacher.
Contents:	During 6 training sessions the students will learn how to organize a presentation, to do an interview, how to work efficiently and effectively in project teams, rules for giving and receiving feedback and how to write a report. Each student has to give a presentation, do an interview (collect information and streamline a conversation). Furthermore they will practice working in a team. All presentations, interviews and group activities have to be described and evaluated in written reports by the students. All participants have to formulate goals and evaluate them half way and at the end.