Welcome

With pleasure we present you this booklet with the descriptions of the master’s programmes Computer Science, Telematics and Human Media Interaction of the University of Twente. Most readers, we assume, will be familiar with the Computer Science field. You know about the Computer Science fundamentals. You are aware of the impact Computer Science has and has had on our society and our every day life. In fact, you probably understand more of this impact than the average layman.

Master’s programmes are specialized. They are not about basic knowledge and skills in a broad area. They are about pushing boundaries; to gain (often relatively small) new insights, generally only in a small area. But each change contributes to the strength of the Computer Science field.

Pushing a boundary is hard work. You have to understand in detail what is going on at the edge of your field. There is a great variety of things that can slow down progress. Physics may seem to work against you, complexity and lack of proper analysis tools may be a hindrance, and of course all sorts of human factors can be a challenge. You have to be aware of methods and techniques that are available to solve the problems you encounter. And sometimes you simply have to get lucky: look at the obstacle that is in your way from the right perspective, and then you realize it is not an obstacle at all. There is a skill to develop here, one of the strong points of the creative expert is that he gets lucky more often than others.

In the course descriptions in this book you will not find the phrase “pushing boundaries”. But it is an important characteristic of taking a master’s degree. In a 120 EC programme, 2 years of full-time study, you learn what it is to push boundaries. And even if it does not look like it, that is what this book is about.

dr. Gerrit F. van der Hoeven
Programme director Human Media Interaction

dr. ir. Rom Langerak
Programme director Computer Science and Telematics
Department of Computer Science

Since 2002 Computer Science has been a department within the Faculty of Electrical Engineering, Mathematics and Computer Science (EEMCS) of the University of Twente. The department is organized into chairs, each covering a distinguishing part of the broad field of computer science. In addition to being involved in scientific research, the Computer Science Chairs are also responsible for the curriculum of the Bachelor of Science programme Computer Science and the Master of Science programmes Computer Science, Human Media Interaction and Telematics.

In this guide you can find information about the following master’s programmes:

1. Master of Science in Computer Science
2. Master of Science in Telematics
3. Master of Science in Human Media Interaction

In chapter 4 of this study guide you can find information about the chairs and chair holders of the Computer Science department.
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Section A
Master’s programmes
1 Computer Science
\[ \frac{db}{dt} = \frac{Ub}{Kn+S} - b(K_s + K_d) \]
1.1 Goals and aims of Computer Science

The common goals for the master’s programmes are established in the course rules. They are as follows. The master’s programmes aim to combine a scientific mindset with specialist technical knowledge, enabling graduates to analyze, design, validate and implement state-of-the-art ICT systems in their operational context. Graduates of the master’s programmes are trained to take a scientific, ethical and socially responsible approach to conducting and contributing to research in their specific area of study and to international trends in and related to their field of study. The master’s programmes aim to offer an engaging and challenging, research-oriented academic environment, enabling students to:

1. acquire extensive knowledge and insight; develop their professional and scientific mindset by taking the initiative in and assuming responsibility for the learning process

2. develop an inquisitive and reflective attitude

3. understand and gain practical experience with methods and technologies for modeling and describing systems and their properties

4. acquire a knowledge of, understand and gain practical experience with taking stock of the requirements of ICT systems (i.e. technology, design, validation and implementation) and of promising alternatives, and take informed decisions

5. develop a constructively critical attitude in which decisions are substantiated and discussed

6. work as part of a team in applying and/or developing theories, methods, technologies and tools pertinent to the development of ICT systems in their operational context

7. gain practical experience working in complex, dynamic settings in which the information required is not always immediately available or complete

8. be encouraged by means of an engaging curriculum (involving case studies, research projects, and discussions about research, trends and literature relevant to the discipline) to follow the trends in their field and use this information as a guide for and incorporate it into their own personal development
The master’s programmes also aim to encourage students who have the necessary affinity with and demonstrated talent for scientific research to continue on to pursue doctoral research. The course rules state the following domain-specific goals for the CS programme. The CS master’s programme strives to achieve the aims described below.

The CS master’s programme focuses on three themes:
- development of ICT systems in their commercial context
- technological aspects and applications of embedded systems
- development process of sophisticated software systems

Students will acquire specialist knowledge in one of these areas. The CS master’s programme is designed for students with a thorough understanding of technology and of the functional and qualitative properties of systems and ability to evaluate and predict these properties and their context dependencies. System security, performance and efficiency are key areas of focus.

1.1.1 Final qualifications

The common attainment targets for a graduate of any master’s programme in the department of Computer Science are established in the course rules as follows: graduates of the master’s programmes will be able to meet the following attainment targets:

• M 0. have an extensive knowledge of and understand the issues relevant to their specific field of study (i.e. programme-specific attainment targets),

• M 1. contribute to scientific research, and independently design, conduct and present the results of small-scale research,

• M 2. provide an original contribution to the development and/or application of the field of study,

• M 3. analyze complex problems (change problems) relevant to the field of study and obtain the required knowledge and information,

• M 4. design, validate and implement solutions/systems in their operational context; identify and apply relevant advanced knowledge, methods and techniques from their field of study,
• M 5. assess solutions/systems and their applications according to their properties and potential to solve problems even if they are new to or unfamiliar with the situation or lack information and/or reliable information; use this as a basis for (substantiation of) decisions,

• M 6. understand the ethical, social, cultural and public aspects of problems and solutions in their field of study; apply this insight in their international role as scholar,

• M 7. work as part of and play a leading role in a team; manage and plan a development process; document development and research processes,

• M 8. substantiate research results, designs and applications in writing and verbally; critically assess and participate in debates regarding the same,

• M 9. independently acquire new knowledge and skills; reflect on trends in their field of study, responsibilities and roles and use this insight as a guide for and integrate it into their own personal development,

• M 10. integrate information from other disciplines into their own work if necessary,

• M 11. take a critical approach to reading, incorporating information presented in and participating in debates regarding international scientific literature relevant to their field of study.

The word ‘original’ in M2 is understood to mean ‘demonstrative of a creative contribution’, not ‘pioneering’.

In addition to the general attainment targets, CS graduates will command a high level of scientific knowledge and understanding of computer science. This is demonstrated by their extensive knowledge and understanding of the technical aspects and design of ICT systems. In addition to a thorough understanding of these issues, CS graduates also have a specialist knowledge and understanding of the chosen track.
1.2 General outline

There are seven general rules to be observed by the student and study adviser in assessing the student’s possible course programme choices and in signing the finalized course programme. These general rules work differently according to programme, graduation subject field and track.

1. The student creates a programme of units of study totaling 120 credits. These units are selected from among the courses offered by the UT or, where beneficial, courses offered by other universities. All course programmes have to include a 30-credit graduation assignment, and a 10-credit research project. Students with a course programme totaling fewer than 120 credits or one lacking a graduation assignment of at least 30 credits will not successfully pass the master’s programme final assessment. There are no exceptions to this rule, except that the Examination Board may grant a student exemption from the mandatory 10 credits research project.

2. The admissions board may grant a student admission with additional requirements, imposing additional diploma eligibility requirements. These requirements differ from student to student. No more than 30 credits will be required to satisfy the conditions imposed by the admissions board. The master’s programme final assessment cannot be passed if the course programme of this category of students does not satisfy the additional requirements imposed. There are no exceptions to this rule.

3. Requirements apply to each course programme to ensure basic knowledge in the field of study and the track selected. The admissions board may adjust these requirements on the basis of the student’s prior education and training. Such an adjustment will never entail an intensification of the requirements. The master’s programme final assessment cannot be passed if the course programme does not satisfy the basic knowledge requirements. The only exception to this rule is when the admissions board lowers the basic knowledge requirements.

4. Requirements apply to each course programme to ensure sufficient depth of study in the track selected. The manner in which these requirements are satisfied is determined in consultation with the study adviser. This includes, where necessary, taking into account which chair/chairs will bear responsibility for the student’s graduation supervision. The master’s programme final assessment cannot be passed if the course programme does not satisfy the depth of study requirements. There are no exceptions to this rule.
5. Requirements apply to some course programmes governing the chair from which the student can complete his/her studies, according to the graduation subject field or track selected. The master’s programme final assessment cannot be passed if, during the course of study, the requirements for the composition of the graduation committee are not satisfied. There are no exceptions to this rule.

6. One guideline applicable to all course programmes is that continuing students (i.e. holders of a UT Bachelor’s diploma eligible for automatic admission to one of the master’s programmes) complete part of the programme’s 120 credits outside of the UT. The Examination Board may decide to exempt an individual from this guideline.

7. Computer Ethics is a mandatory subject for all students

The total number of credits completed at the UT or at another university or research institute approved by the study adviser, must be at least 90. The Examination Board may permit a student to deviate from this rule. Additional requirements with regard to the type of activities completed by students outside of the UT may be posed. For instance, the obligation that a student completes a traineeship. Such a requirement must involve no more than 30 credits. The master’s programme final assessment cannot be passed if the course programme does not satisfy the requirements imposed with regard to the units of study completed outside of the UT, unless an exemption has been granted.
1.3 Master’s programme

The master’s programme of Computer Science has six specializations. In the following paragraphs each specialization will be described.

1.3.1 Computer Security

Our society is dominated by the increasing role of computerised systems. However, as a side effect, the society becomes increasingly vulnerable to misuse of such systems. This explains the growing interest in and importance of computer security. The Kerckhoff’s Computer Security specialization aims at educating those who will occupy the leading positions in this field.

Programme mentor:
prof. dr. P.H. (Pieter) Hartel
Room: Zilverling 3001; Phone: 53 489 2411; E-mail: pieter.hartel@utwente.nl

This is a joint programme of three Dutch universities: the Radboud University Nijmegen (RU), the Technical University Eindhoven (TU/e) and the University Twente (UT). Participating students will have to take subjects and sit interim examinations at other universities. First semester subjects are offered on Mondays at UT and Fridays at TU/e. Second semester Mondays at TU/e and Fridays at RU. Third semester Mondays at RU and Fridays at UT. Finally the fourth semester the student will work on his final project at the students’ home university.
Content of the course programme: six basic subjects of 6 credits each:

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>192194100</td>
<td>Cryptography 1 (TU/e)</td>
</tr>
<tr>
<td>192195200</td>
<td>Security in organizations (RU)</td>
</tr>
<tr>
<td>192195100</td>
<td>Software security (RU)</td>
</tr>
<tr>
<td>192194200</td>
<td>Verification of security protocols (TU/e)</td>
</tr>
<tr>
<td>192150101</td>
<td>Introduction to computer security (UT)</td>
</tr>
<tr>
<td>192654001</td>
<td>Network security for Kerckhoffs students (UT)</td>
</tr>
</tbody>
</table>

At least three of the following nine advanced subjects of 6 credits each:

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>191210901</td>
<td>Biometric recognition (UT)</td>
</tr>
<tr>
<td>192110941</td>
<td>Secure data management (UT)</td>
</tr>
<tr>
<td>192195400</td>
<td>(Privacy) Seminar (RU)</td>
</tr>
<tr>
<td>192194110</td>
<td>Cryptography 2 (TU/e)</td>
</tr>
<tr>
<td>192195300</td>
<td>Hardware and operating systems security (RU)</td>
</tr>
<tr>
<td>192195500</td>
<td>Law in cyberspace (RU)</td>
</tr>
<tr>
<td>192194300</td>
<td>Linux kernel and hacker’s hut (TU/e)</td>
</tr>
<tr>
<td>192194400</td>
<td>Seminar information security theory (TU/e)</td>
</tr>
<tr>
<td>192150300</td>
<td>Security in Information Services</td>
</tr>
</tbody>
</table>

**Elective subjects:**
Other subjects to obtain the minimally required number of 120 credits may be chosen from the subjects offered by other specializations.

**Mandatory (45 EC):**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>192166500</td>
<td>Computer Ethics (5 EC)</td>
</tr>
<tr>
<td>192199508</td>
<td>Research Topics (10 EC)</td>
</tr>
<tr>
<td>192199978</td>
<td>Final Project (30 EC)</td>
</tr>
</tbody>
</table>

Graduation supervision is organized by the programme mentor.
1.3.2 Information Systems Engineering

Today's organizations are vitally dependent on their information systems, and the high demands placed on these systems require skilled technical specialists. “Information Systems Engineering” graduates are experts and can be found at all stages of a distributed information system’s lifecycle (requirement analysis, architecture design, realization and maintenance). The information systems of today's organizations manage large volumes of internal information, including structured data, multimedia data or geographic information. These systems encompass workflow, groupware and e-business processes and are often distributed across organizational units and physical locations.

Information system engineers are able to combine and configure basic software components, such as database management systems, transaction processing monitors, workflow management systems and middleware. In short, they know how to define a system on which an organization can truly depend without giving rise to any vulnerabilities.

Programme mentor:
Dr. A. (Andreas) Wombacher
Room: Zilverling 3098; Phone: 053 489 3772; E-mail:a.wombacher@twente.nl

Content of the course programme:

4 basic subjects:

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>192110902</td>
<td>Advanced Database systems</td>
</tr>
<tr>
<td>192110982</td>
<td>Database transactions and processes</td>
</tr>
<tr>
<td>192320111</td>
<td>Architecture of information systems</td>
</tr>
<tr>
<td>192320820</td>
<td>Design science methodology</td>
</tr>
</tbody>
</table>

At least one of the following 9 basic subjects:

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>192110720</td>
<td>Distributed data processing using MapReduce</td>
</tr>
<tr>
<td>192110880</td>
<td>Sensor Data Management 1</td>
</tr>
<tr>
<td>192110941</td>
<td>Secure Data management</td>
</tr>
<tr>
<td>192110961</td>
<td>XML &amp; Databases 1</td>
</tr>
<tr>
<td>192150300</td>
<td>Security in Information Services</td>
</tr>
<tr>
<td>192320501</td>
<td>E-commerce</td>
</tr>
</tbody>
</table>
At least 20 ECTS of the following advanced subjects:

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>192110860/61</td>
<td>XML &amp; databases 1/2</td>
</tr>
<tr>
<td>192110880/90</td>
<td>Sensor data management 1/2</td>
</tr>
<tr>
<td>192160400</td>
<td>Information retrieval</td>
</tr>
<tr>
<td>192320220</td>
<td>Advanced architecture of information systems</td>
</tr>
<tr>
<td>192320850</td>
<td>Advanced requirements engineering (follow up modules)</td>
</tr>
</tbody>
</table>

**Elective subjects:**
Other subjects to obtain the minimally required number of 120 credits may be chosen from the subjects offered by other specializations.

**Mandatory (45 EC):**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>192166500</td>
<td>Computer Ethics (5 EC)</td>
</tr>
<tr>
<td>192199508</td>
<td>Research Topics (10 EC)</td>
</tr>
<tr>
<td>192199978</td>
<td>Final Project (30 EC)</td>
</tr>
</tbody>
</table>

Graduation supervision is organized by the following chairs: Information Systems or Databases
1.3.3 Software Engineering

In our daily life we are surrounded by devices like television sets, DVD players, mobile phones, etc. These devices are actually computer systems that execute software programs in order to perform their functions. The proper working of these devices, therefore, strongly depends on the proper working of the software, which these devices execute. Since these devices are proliferating and interacting with other systems in order to serve us in a multitude of ways and circumstances, the quality of software already plays a crucial role in our lives. Therefore, Software Engineering focuses on applying techniques, guidelines, concepts, methods and tools that increase the quality of software in different products. The quality factors include, for example, performance, reliability, robustness and maintainability. The desired set of qualities usually conflict with each other and lead to trade-off decisions. The intricacies and intertwining of software qualities in different sorts of software systems make Software Engineering challenging and stimulating. The Software Engineering programme covers the state-of-the-art topics necessary to design and maintain high quality software systems. Graduates of this programme will be able to create successful software systems that will have the right balance of the desired qualities.

Programme mentor:
Dr. ing. C.M. (Christoph) Bockisch
Room: Zilverling 5098, Phone: 053 489 3918; E-mail: c.m.bockisch@ewi.utwente.nl

The course programme includes the following unit of study:
Basic subject: Software management (192340041)
At least 25 ECTS of the following basic subjects:

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>191511390</td>
<td>Algebra</td>
</tr>
<tr>
<td>191520751</td>
<td>Graph theory</td>
</tr>
<tr>
<td>191580752</td>
<td>Deterministic models in OR</td>
</tr>
<tr>
<td>192111092</td>
<td>Advanced logic</td>
</tr>
<tr>
<td>192111233</td>
<td>Aspect-oriented programming</td>
</tr>
<tr>
<td>192111332</td>
<td>Design of software architectures</td>
</tr>
<tr>
<td>192140122</td>
<td>System Validation</td>
</tr>
<tr>
<td>192170015</td>
<td>Testing Techniques</td>
</tr>
<tr>
<td>192320820</td>
<td>Design science methodology</td>
</tr>
<tr>
<td>192330301</td>
<td>Specification of information systems</td>
</tr>
</tbody>
</table>
At least 20 ECTS of the following advanced subjects:

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>192110280</td>
<td>Advanced programming concepts</td>
</tr>
<tr>
<td>192135310</td>
<td>Modeling and analysis of concurrent systems 1</td>
</tr>
<tr>
<td>192135320</td>
<td>Modeling and analysis of concurrent systems 2</td>
</tr>
<tr>
<td>192135400</td>
<td>ADSA-PLE</td>
</tr>
<tr>
<td>192135450</td>
<td>ADSA-MDE</td>
</tr>
<tr>
<td>192320850</td>
<td>Advanced requirements engineering</td>
</tr>
</tbody>
</table>

**Elective subjects**
Other subjects to obtain the minimally required number of 120 credits may be chosen from the subjects offered by other specializations.

**Mandatory (45 EC):**

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>192166500</td>
<td>Computer Ethics (5 EC)</td>
</tr>
<tr>
<td>192199508</td>
<td>Research Topics (10 EC)</td>
</tr>
<tr>
<td>192199978</td>
<td>Final Project (30 EC)</td>
</tr>
</tbody>
</table>

The programme should have a good balance between breadth and depth and has to be approved by the study adviser.

Graduation supervision is organized by the following chairs: Software Engineering or Formal Methods and Tools
1.3.4 Methods and Tools for Verification

The Methods and Tools for Verification (MTV) programme is targeted towards ambitious computer science students, who want to become

- validation engineers, who know a broad range of validation techniques and tools, and know when and how to apply these techniques and tools within a system’s life cycle, and/or
- researchers, who want to do theoretical and foundational research in the realm of formal methods, and/or
- tool builders, who are able to implement formal theories into working tools, which then can assist system- and validation engineers in developing correct systems.

Apart from the general attainment levels for the CS Master, MTV graduates demonstrate their specialist knowledge as follows.

- MTV graduates have a thorough knowledge of and understand the scope of formal methods as a scientific and design discipline.
- MTV graduates have a thorough knowledge of, understand and gain practical experience with the application of formal methods and tools in the development process of software, distributed and/or embedded systems.
- MTV graduates can apply formal methods and tools during system design on the basis of knowledge and insight, make an informed selection of these and contribute to their further development.
- MTV graduates have knowledge of and understand various aspects of theoretical computer science, including process algebra, type theory, proof systems and formal testing theory.
- MTV graduates have specialist knowledge and understanding of one or more sub-fields or aspects of the formal methods discipline, e.g. Process Algebra, Software Model Checking, Distributed Model Checking, Program Verification, Proof Systems, Testing, Quantitative Modeling and/or Analysis, Graph Transformations, Game Theory.
- MTV graduates have practical experience conducting scientific research into formal methods, contribute to such research, apply the results, follow the trends of this sub-field and contribute to its further development.

Programme mentor:
Dr. M. (Marieke) Huisman
Room: Zilverling 5027; Phone: 053 489 4662; E-mail: m.huisman@utwente.nl
The course programme includes the following units of study: 4 basic subjects:

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>192111092</td>
<td>Advanced Logic</td>
</tr>
<tr>
<td>192135310</td>
<td>Modeling and Analysis of Concurrent Systems 1</td>
</tr>
<tr>
<td>192140122</td>
<td>System Validation</td>
</tr>
<tr>
<td>192170015</td>
<td>Testing Techniques</td>
</tr>
</tbody>
</table>

At least 3 of the following 10 basic subjects:

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>191511410</td>
<td>Algebra &amp; Security</td>
</tr>
<tr>
<td>191520751</td>
<td>Graph Theory</td>
</tr>
<tr>
<td>191560561</td>
<td>Introduction to mathematical systems theory</td>
</tr>
<tr>
<td>191580752</td>
<td>Deterministic models in OR</td>
</tr>
<tr>
<td>192111233</td>
<td>Aspect-oriented Programming</td>
</tr>
<tr>
<td>192111332</td>
<td>Design of Software Architectures</td>
</tr>
<tr>
<td>192120100</td>
<td>Introduction to Computer Security</td>
</tr>
<tr>
<td>192620300</td>
<td>Performance evaluation 1</td>
</tr>
<tr>
<td>192130092</td>
<td>Fault tolerant digital systems</td>
</tr>
<tr>
<td>192130500</td>
<td>Quantitative Evaluation of Embedded Systems</td>
</tr>
</tbody>
</table>
At least 3 of the following advanced subjects:

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>192114100</td>
<td>Principles of Model Checking</td>
</tr>
<tr>
<td>192114200</td>
<td>Quantitative modeling and analysis</td>
</tr>
<tr>
<td>192114300</td>
<td>Program Verification</td>
</tr>
<tr>
<td>192135320</td>
<td>Modeling and Analysis of Concurrent Systems 2</td>
</tr>
</tbody>
</table>

At least one of the following advanced subjects:

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>191210441</td>
<td>Control engineering</td>
</tr>
<tr>
<td>192111700</td>
<td>Computability and Computational Complexity</td>
</tr>
<tr>
<td>192135450</td>
<td>ADSA Model driven engineering</td>
</tr>
<tr>
<td>192140700</td>
<td>The numbers tell the tale (meten=weten)</td>
</tr>
<tr>
<td>192661001</td>
<td>Patterns for software development</td>
</tr>
</tbody>
</table>

Elective subjects: Other subjects to obtain the minimally required number of 120 credits may be chosen from the subjects offered by other specializations.

Mandatory (45 EC):

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>192166500</td>
<td>Computer Ethics (5 EC)</td>
</tr>
<tr>
<td>192199508</td>
<td>Research Topics (10 EC)</td>
</tr>
<tr>
<td>192199978</td>
<td>Final Project (30 EC)</td>
</tr>
</tbody>
</table>

Final project: the course programme of MTV must include 30 credits Final Project (219997). Graduation supervision is organized by the chair of Formal Methods and Tools.
1.3.5 Embedded Computing Systems

This specialization is discontinued in September 2010. Only students who already have an approved individual programme by the study adviser before September 1st 2010 can continue with this track. For more information about this programme please contact the programme mentor: ir. B. (Bert) Molenkamp. You can find him in building Zilverling, room 4051; Phone: 053 489 3704, E-mail e.molenkamp@utwente.nl.

Alternatives for the Embedded Computing Systems programme are:

Master of Science in Embedded Systems
The programme coordinator for the master’s programme of Embedded Systems is ir. B. (Bert) Molenkamp. You can find him in building Zilverling, room 4051; Phone: 053 489 3704, E-mail e.molenkamp@utwente.nl.
For more information about the master’s programme of Embedded Systems, please check: http://onderwijs.cs.utwente.nl/Studenten/Masters/EmbeddedSystems

Wireless and Sensor Systems programme
This specialization is embedded in the master’s programme of Computer Science. The programme mentor is ir. H. (Hans) Scholten. You can find him in building Zilverling, room 4016; Phone: 053 489 3733, E-mail hans.scholten@utwente.nl.
For more information about the Wireless and Sensor Systems programme, please check paragraph 1.3.6.
1.3.6 Wireless and Sensor Systems

The Wireless and Sensor Systems programme addresses a new paradigm for bringing the flexibility of information technology to bear in every aspect of daily life. It foresees that people will be surrounded by embedded and flexibly (wirelessly) networked systems that provide easily accessible yet unobtrusive support for an open-ended range of activities, to enrich daily life and to increase productivity at work. These systems contain a mixture of hardware and software: their scope may be as simple as a sensor, or as complex as a portable device, or even an entire building or city. Cooperation is a necessity, to perform their tasks with sufficient quality or efficiency, and to reach the required functionality and support real time interactions. The specific nature of these systems require them to be open, scalable, adaptable and dependable, while integrating heterogeneous devices ranging from tiny actuators to larger computers. The programme WiSe studies not only the fundamentals of wireless and sensor systems, but also the context of the sensor systems. To this end, WiSe is a multidisciplinary and application oriented programme where you come in contact with different (technical as well as non-technical) disciplines and by doing so, it stimulates cooperation.

The WiSe master’s programme can also be followed as a Twente Graduate School programme, see paragraph 1.3.7.

Programme mentor:
prof. dr. P.J.M. (Paul) Havinga
Room: Zilverling 4010; Phone: 053 489 4619; E-mail: p.j.m.havinga@utwente.nl

The course programme includes the following units of study:

Compulsory core courses (25 EC):

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course title</th>
</tr>
</thead>
<tbody>
<tr>
<td>192620010</td>
<td>Mobile &amp; Wireless Networking I (DACS 5 EC)</td>
</tr>
<tr>
<td>191210750</td>
<td>System on Chip Design (CAES/ICD 10EC)</td>
</tr>
<tr>
<td>191211030</td>
<td>Mobile Radio Communication (TE/SRR 5EC)</td>
</tr>
<tr>
<td>192340041</td>
<td>Software management</td>
</tr>
</tbody>
</table>

Six courses (30 EC) that all belong to one of the following three tracks:
- Flexible and efficient communication
- Distributed wireless systems
- Distributed data processing and reasoning
Elective subjects (15 EC)
Other subjects to obtain the minimally required number of 120 credits may be chosen from the subjects offered by other specializations in masterprogramme’s of Computer Science, Electrical Engineering, Telematics and Embedded Systems.

Mandatory (45 EC):

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>192166500</td>
<td>Computer Ethics (5 EC)</td>
</tr>
<tr>
<td></td>
<td>Traineeship (20 EC)</td>
</tr>
<tr>
<td>192199978</td>
<td>Final Project (30 EC)</td>
</tr>
</tbody>
</table>
1.3.7 Twente Graduate School

The Twente Graduate School at the University of Twente offers an increasing variety of integrated master’s and PhD programmes for outstanding graduate students who aim at a career in scientific research. The programmes are set up in cooperation between faculties and research institutes. Through a broad selection of compulsory and elective courses, students are able to specialize in a research area of their interest and at the same to broaden their perspective on the societal context of technology and research. All these aspects are integrated into the Twente Graduate School (TGS) which aims to become a breeding ground for research talent. TGS sets high standards and has a strict selection procedure for both research and education programmes as well as prospective students. The structure of a graduate research programme includes a cursory component at master level that forms the basis for research concerning the subject in question, an international orientation on research, a preparatory and orientating master’s project, a cursory component provided by the involved research institute, the national research schools and/or other (inter)national networks, a number of broadening subjects such as ethics and philosophy, innovation and entrepreneurship, governance and project management, science and communication, etc., and a research project resulting in a doctoral degree.

A schematic overview of the building blocks of a graduate research programme:

For the master’s programme of Computer Science, TGS has four specializations. In the following paragraphs each specialization will be described.
1.3.7.1 Wireless and Sensor Systems

The Graduate Programme Wireless and Sensor Systems (WiSe) can be followed as a specialization programme within the master’s programme of Computer Science, as well as a specialization within the Twente Graduate School programme. For an overview of the WiSe programme see paragraph 1.3.6 of this study guide.

Programme mentor:
prof. dr. P.J.M. (Paul) Havinga
Room: Zilverling 4010; Phone: 053 489 4619; E-mail: p.j.m.havinga@utwente.nl

1.3.7.2 Dependable and Secure Computing

ICT systems are used as part of an ever-growing variety of applications and form a critical backbone of our societal infrastructure. Malfunctioning or sabotage of ICT systems incur economic expenses at best, cost lives at worse, or will even disrupt society.

An ICT-system is called dependable if reliance can justifiably be placed on the services it delivers. This should be possible despite the occurrence of physical faults, communication problems, software errors, human operator mistakes, or attacks by malicious intruders.

Dependability and security are interpreted in a broad sense. Depending on the application domain, it includes 7x24 availability, absolute safe and timely behavior, a guaranteed quality-of-service level, the protection of the integrity of financial transactions, enforcement of digital rights and the privacy of users.

Dependable ICT is a challenge, because applications tend to be geographically distributed, have increasingly complex and adaptive functionality, are connected via wired or wireless networks, and should be open for interaction with an unknown, sometimes malicious, environment.

In this Computer Science Graduate programme you will learn and develop traditional and novel methods and techniques for analyzing and constructing dependable and secure systems. Traditional means are fault and intrusion detection, prevention, prediction, removal, and tolerance, so that systems keep working even despite faults, errors, or hackers. Emphasis will be put on computational methods, in the following areas:

- Modeling, automated analysis and synthesis of dependable systems;
- Algorithms and protocols to enforce dependability and security;
- Design of dependable and secure software architectures.
Programme mentor:
prof. dr. J.C. (Jaco) van der Pol
Room: Zilverling 5049; Phone: 053 489 3017; E-mail: j.c.vanderpol@ewi.utwente.nl

The course programme includes the following units of study:

Compulsory core courses (25 EC):
- Fault Tolerant and Dependable Computing (new collective course (5 EC)
- System Validation (5 EC)
- Introduction Security (5 EC)
- Design of Software Architecture (5 EC)
- Control Engineering (5 EC)

Track A, B, or C (30 EC)

Track A
- Performance Evaluation 1 (5 EC)
- Modeling and Analysis of Concurrent Systems 1 (5 EC)
- Modeling and Analysis of Concurrent Systems 2 (5 EC)
- Quantitative Modeling and Analysis (5 EC)
- Model Driven Engineering (5 EC)
- Deterministic Models of Operations Research (5 EC)

Track B
- Network Security (5 EC)
- Secure Data Management (5 EC)
- Mobile & Wireless 1 (5 EC)
- Program Verification (5 EC)
- Cryptography (TU/e) (5 EC)
- Verification of Security Protocols (TU/e) (5 EC)

Track C
- Patterns for Software Development (5 EC)
- Aspect Oriented Programming (5 EC)
- Testing Techniques (5 EC)
- Model Driven Engineering (5 EC)
- Program Verification (5 EC)
- Modeling and Analysis of Concurrent Systems 1 (5 EC)
Elective courses (15 EC)
These consist of:
• Courses in the other tracks of “Dependable and Secure Computing”
• Courses from the following list
• Other courses in consultation with the programme mentor

<table>
<thead>
<tr>
<th>Course</th>
<th>Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Logic (FMT)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Advanced Programming Concepts (SE)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Algebra (DMMP)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Computational complexity (HMI)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Distributed systems (PS)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Fault Tolerant Digital Systems (CAES)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Graph Theory (DMMP)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Internet Management and Measurement (DACS)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Introduction to Bio-Metrics (SAS)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Introduction to Mathematical Systems Theory (MSCT)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Meten=Weten (Perf. Evaluation 2)(DACS)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Mobile &amp; Wireless 2 (DACS)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Physical Systems modelling of ES (CE)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Real-Time Software Development (EL)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Telematics Networks (DACS)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Systems Engineering (EL)</td>
<td>5 EC</td>
</tr>
</tbody>
</table>
1.3.7.3 Human-centred Interaction Technologies

The subject of the Graduate programme Human-IT is the interaction between humans and ICT. It considers both the interaction of humans with the system and the interaction between humans through the technology. The rapidly grown availability and use of ICT in all aspects of the personal, organizational and societal life sphere during work, learning or free time, calls for a multidisciplinary and interdisciplinary approach of the subject, in which computer science and other engineering disciplines team up with social sciences and the humanities. This is fully reflected in this Graduate programme. The Graduate programme considers the technological, psychological, sociological and philosophical dimensions of human-media interaction.

The core research concerns the design of intelligent interactive systems that improve the quality of the user experience as part of a human-centred development process. Besides the technological perspective this will thus involve considering the human in the loop. Therefore, also the assumptions underlying design and development (as they relate to ethical considerations for instance), the acceptance and use and the impact and implications of the technology on the direct interaction of humans with the system and the impact on a societal level are considered.

The technical and engineering programmes involved in the Graduate programme have an interest in building more and more involved computational models of users and user context for interpreting signals and processes that are considered meaningful for humans and for artificial intelligent interactive systems in some particular practice. A considerable research effort is spent attempting to interpret a user’s state of mind (by interpreting natural language text and speech, body language or brain signals, for instance) and acting upon this appropriately. To build such computational models, systems also resort more and more to the analysis of gigantic repositories of user interactions, such as user clicks logs, query logs, etc.

From the psychological and communicative perspective, the Graduate programme brings challenging questions to the fore about how meaning (embodied in the interface, content, actions, etc) is created, transferred and adapted in ICT-mediated environments, including questions of causal relations between technological or representational design decisions on the one hand and effects and affective impact on the other hand. From a cognitive-ergonomic point of view it is important to understand the neuro-cognitive possibilities and limitations of humans as they interact with conspecifics and technology. A firm grasp on cognitive strength and weaknesses of humans will allow for the design of interactive systems that act when humans cannot and efficiently support humans in areas where they already excel.
Programme mentor:
prof. dr. ir. A. (Anton) Nijholt
Room: Zilverling 2055; Phone: 053 489 3686; E-mail: a.nijholt@ewi.utwente.nl

Depending on the track chosen by the student, the MSc phase can either be 1 or 2 years. The Master phase of the project fulfils the requirements of one of the Master programmes participating in the Graduate Programme (either the Msc HMI – see chapter 3 of this study guide, or the Msc Computer Science, specialization Information Systems Engineering – see paragraph 1.3.2 of this study guide).

For more information about the course programme, please contact the programme mentor or check the following website: http://www.utwente.nl/tgs/programmes/human-centredinteractiontechnologies/

1.3.7.4 Services Science

Services science has emerged from the realization that the economy of physical products is being replaced by an economy of services that can be delivered with these goods. Information technology is the key enabling factor in this. It enables further globalization of commerce and production, but at the same time global connectedness in a service economy introduces new levels of architectural complexity and security risks, that need to be managed. Nowadays services can be found everywhere and experienced and used anytime, in daily life, professional life, at consumer and business levels, and at technology levels. Traditional examples are transportation services, health services and education services.

Some newer examples are ICT outsourcing services, in which design or programming tasks are outsourced to specialized companies, and helpdesk services, which concentrate large numbers of calls from clients asking for help with products. We observe nowadays a trend to package products in services, so that added value can be offered to potential clients. An example is in contract manufacturing, such as for the automotive industry, where parts and equipment are provided on behalf of an original equipment manufacturer, possibly covering a range of activities such as design, prototyping, assembly, and quality assurance for complete products.

ICT is an enabler for the further growth of the services sector. Most business services and processes are supported by ICT services. The shift from products to services often implies an ICT-enabled provision of e-services. High-speed networks and powerful computer systems have made these processes ubiquitous. From the methodological side, the advent of the Service-Oriented Architecture has facilitated the mapping from business processes to ICT services, with the benefits of effectiveness and flexibility.
Services are essential, important and becoming quite complex as more interrelated services appear and more stakeholders or parties get involved. This means that services have to be approached from scientific, management and engineering points of view. Our Services Science programme has Management Science and Computer Science as cornerstones. It offers two study tracks, one going through a BIT Master and the other going through an CS Master, with each track following the rules of its related master’s programme, but having a clear ‘services science’ signature.

Programme mentor:
prof. dr. R.J. (Roel) Wieringa
Room: Zilverling 2055; Phone: 053 489 3686; E-mail: a.nijholt@ewi.utwente.nl
The course programme includes the following units of study:

Compulsory core courses (20 EC):
• Architecture of Information Systems (5 EC)
• Advanced Database Systems (5 EC)
• E-commerce (5 EC)
• Design of Software Architecture (5 EC)

Five compulsory courses (25 EC) that belong to one of the two tracks:
A. Services Technologies
• Service-Oriented Architecture with Web Services (5 EC)
• Database Transactions and Processes (mandatory for CS\ISE track) (5 EC)
• Specification of Information Systems (elective 5/10 for CS\SE track, elective 1\9 for CS\ISE track) (5 EC)
• XML Technologies (5 EC)
• ADSA: Model Driven Engineering (5 EC)

B. Services in Business
• Business Process Integration Lab (mandatory for M-BIT) (5 EC)
• Information & Knowledge Exchange Services (elective 5/20 for M-BIT) (5 EC)
• Business Development in Networks (mandatory for M-BIT) (5 EC)
• Data Warehousing & Data Mining (5 EC)
• Design Science Methodology (mandatory for CS\ISE track, elective 5/10 for CS\SE track)

Five elective courses (25 EC)
A. Compulsory courses from the other track
B. Courses from the following list
C. Other courses in consultation with the advisor
<table>
<thead>
<tr>
<th>Course</th>
<th>Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Architecture of Information Systems</td>
<td>5 EC</td>
</tr>
<tr>
<td>(elective 10/20 for M-BIT, elective 20/20 for CS\ISE track)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Advanced Requirements Engineering</td>
<td>5 EC</td>
</tr>
<tr>
<td>(elective 5/20 for M-BIT, elective 20/20 for CS\ISE track)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Business Case Development for IT-projects (mandatory for M-BIT)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Computer Supported Cooperative Work (mandatory for M-BIT)</td>
<td>5 EC</td>
</tr>
<tr>
<td>E-Government: communication and organization</td>
<td>5 EC</td>
</tr>
<tr>
<td>E-Strategizing (mandatory for M-BIT)</td>
<td>5 EC</td>
</tr>
<tr>
<td>ICT Management (mandatory for M-BIT)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Implementation of IT in Organizations (mandatory for M-BIT)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Information Systems for the Financial Services Industry</td>
<td>5 EC</td>
</tr>
<tr>
<td>Information &amp; Knowledge Management</td>
<td>5 EC</td>
</tr>
<tr>
<td>IS Design Methodologies</td>
<td>5 EC</td>
</tr>
<tr>
<td>Java Middleware Technologies</td>
<td>5 EC</td>
</tr>
<tr>
<td>Knowledge Representation</td>
<td>5 EC</td>
</tr>
<tr>
<td>Managing Service Organizations</td>
<td>5 EC</td>
</tr>
<tr>
<td>Mobile E-health Applications and Services</td>
<td>5 EC</td>
</tr>
<tr>
<td>Production &amp; Logistics Information Systems</td>
<td>5 EC</td>
</tr>
<tr>
<td>Security in Information Services (elective 1\9 for CS\ISE track)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Specification of Information Systems (mandatory for M-BIT)</td>
<td>5 EC</td>
</tr>
<tr>
<td>Supply Chain Management &amp; ICT</td>
<td>5 EC</td>
</tr>
<tr>
<td>System Validation (elective 5/10 for CS\SE track)</td>
<td>5 EC</td>
</tr>
<tr>
<td>XML &amp; Databases 1 (elective 1\9 for CS\ISE track)</td>
<td>5 EC</td>
</tr>
</tbody>
</table>

Other obligations (50 EC)
- Individual specialization assignment for Track A or B (5 EC)
- International research orientation/ Traineeship (15 EC)
- Master thesis (including research proposal) (30 EC)
1.4 Programme guidelines

The student must complete the following steps to obtain course programme approval:

1. Orientation
   Students complete subjects and sit interim examinations as they see fit. In this phase only a few credits can be earned. During this phase, the student can be advised by the admissions board or, if the choice of track is clear, by a programme mentor (see second section under 3). If the student chooses subjects or projects during orientation without consultation of the admissions board or a programme mentor, he/she does so at his/her own risk. If 15 credits have been earned in the master’s programme, the orientation ends. At this point, permission from a programme mentor is required for a more complete programme of at least one year. Phase 2 begins. In case the student during orientation chooses only subjects and projects which are mandatory for any course programme (within a given graduation subject field or track), consultation with and approval by a programme mentor may be postponed to a maximum of 30 credits. No one can earn more than 30 credits in phase 1.

2. Approval of initial choices
   After receiving approval from the programme mentor, at least 60 credits of the course programme to be completed or already partially completed are laid down. The choice of graduation subject field or track is clear, as is the matter of whether a traineeship will be included in the course programme. The manner in which the credits for optional units of study are to be allocated and the chair/chairs from which the student will graduate may still be not entirely clear.

3. Approval of entire course programme
   The programme mentor approves the 120-credit course programme in its entirety. At this point it is clear which chair/chairs will bear responsibility for the student’s graduation supervision. Students may reduce the term of Phase 1 and skip Phase 2. Regardless of how the student wishes to proceed, once the limit established for the orientation phase has been reached (i.e. 15 programme credits earned or 30 credits for mandatory units of study only), the programme mentor must be contacted.
1.4.1 Traineeship

During the traineeship (external training) you apply your knowledge that you acquired in your master’s programme, working at a company or institution. The purpose is to work under circumstances, resembling the situation after your graduation as much as possible. Included in this working experience is also the process of finding a position and a short application procedure. The traineeship has a study load of 20 EC and will last therefore at least 14 weeks.

The following persons and organizations play a role during your external stage:

• The host organization, which is the company or institution where you will carry out the traineeship. The host organization assigns a staff member who will supervise your work.

• The Educational Supervisor is a lecturer of your master’s programme. He/she will monitor the scientific level of your traineeship. The Educational Supervisor should give approval to the traineeship before you make your final appointments with the host organization. After the traineeship, he/she will carry out the final assessment and decide about the mark.

• The traineeship office. The office consists of the traineeship traineeship coordinator and the mediator. They will supervise the student from the beginning of the searching process finding a position until the end of the traineeship, when the last documents should be archived.

Options for a traineeship

Many students will find a traineeship position at a company, but also an institution or university is possible. Traineeships can be done everywhere in the world, in Enschede but also in New Zealand or somewhere in between. “The sky is the limit”, unless you manage to find a position with NASA or ESA as an astronaut. The only place on earth definitely out of scope is the UT itself. In all cases, the host institute should provide an assignment that must be approved by the educational supervisor. Approval will only be given if the assignment has sufficient academic level.

How to find a position

One might distinguish three ways to find a host institute:

1. The database of the traineeship office: the office maintains databases containing companies and experience reports. These reports are written by students and describe their experiences during the traineeship.

2. A lecturer in a chair (research group): during research, lecturers often cooperate with companies and institutions that might also be willing to provide a traineeship position.
3. On your own: it is possible and allowed to find a traineeship position on your own. Many companies offer traineeship positions on their websites. Finding a position in this way may not be easy but it may lead to a surprising and rewarding traineeship.

In all cases the traineeship must be approved by a lecturer before you make your final appointments with the host institute. This is described above.

**Information talks**
Twice a year information sessions are held about the traineeship, in September and April. You can find them in the rosters of the master’s programmes.

**First contact**
Make an appointment with the traineeship mediator (stages@ewi.utwente.nl) if you start to think about a traineeship. During this talk, the course of things will be discussed and a planning will be made for the preparation, the traineeship and the completion after return. See your mediator at least half a year before you plan to go. After this talk, the Blackboard site with training positions will be opened for you.

**Web references**
*Static information*
http://www.ewi.utwente.nl/en/education/external_training/

*Blackboard site with training position database*
http://blackboard.utwente.nl.

**Traineeship Coördinator:**
Dr. M.J. (Maarten) Korsten  
Room: Zilverling 1022; Phone: 053 489 2779; E-mail: m.j.korsten@ewi.utwente.nl

**Traineeship Mediator:**
Mrs. B. (Belinda) Jaarsma  
Room: Zilverling 1030; Phone: 053 489 3887; E-mail: b.jaarsma-knol@ewi.utwente.nl
1.4.2 Final Project

The final project should enable the student to apply the expertise gained during prior courses, projects and practical training sessions to solve well-defined problems of sufficient academic difficulty. In completing the final project, students must be allowed to make their own decisions. Students must be able to address the problem systematically, achieve clear results and formulate clear conclusions. Students are expected to report, both orally and in writing, on their findings and read and process relevant literature critically. Students who choose the combined traineeship and final project may use part of their credits to focus on the project theme before leaving and work on their report after their return.

At the beginning of the final project, the student and the graduation supervisor make work agreements. The graduation supervisor ensures that the assignment is in line with the ‘mission’ of the student’s chosen specialization and arranges for adequate supervision. The student will meet with the supervisors regularly to discuss the progress of the final project. These meetings focus on both the content and the implementation of the final project (comparable to the job appraisal interviews students will encounter later in their career).

To complete the final project, the student must submit a written report and hold a public presentation. The report should also contain a text reflecting upon the relevance of the research work of the final project in the society.

The student contacts a chair, willing to take responsibility for the development, organization and supervision of the project and/or an external organization where the project can be performed. The programme mentor can help you find a chair. The chair can help you making arrangements with external organizations. The following conditions must be met prior to definitive admission to the final project:

- The programme mentor has approved the student’s course programme.
- A chair/chairs willing to take responsibility for the organization, supervision and assessment of the graduation project has/have been found.
- Outside of the final project or combined traineeship and final project, the student requires no more than 10 credits to be eligible for the master’s programme final assessment.

The programme mentor is responsible for ensuring that there is proper supervision and evaluation during the course of the final project.
1.4.3 Study Abroad

A student is allowed to study 30 credits externally. To gain international experience a student is given the chance to go abroad to another university or institute to follow courses or doing projects. The choice of courses or projects has to be approved by the programme mentor in the same way as the other part of the programme is approved.

Carrying out a traineeship abroad (as described in par. 1.4.1) is one way of gaining international experience. In some cases it is possible to carry out the final project abroad under joint supervision, where the lead in supervision will always be taken by the own chair. Our faculty has agreements with partner universities and institutes to accommodate students smoothly. Information about going abroad to partner or non-partner universities/institutes, the procedures and the possibilities of financial support can be given by the coordinator of internationalization:

Drs. J. (Jan) Schut.
Room: Zilverling A-108  Phone: 053 489 4350; E-mail: j.schut@utwente.nl

1.4.4 Teaching degree

Graduates of the MSc Science Education and Communication – specialization Computer Science Education – receive the teaching license in computer science in secondary education. This master degree can be obtained as a second master degree, together with the master’s programme of Computer Science, Embedded Systems or Human Media Interaction. Combining these two programmes takes an extra year. Students get an extra year of study finance. More information can be given by drs. N.M. (Nico) van Diepen, didactician computer science; e-mail: n.m.vandiepen@utwente.nl.
See also: http://graduate.utwente.nl/sec/
1.5 Organization

1.5.1 Programme Director

The programme director for the master’s programme Computer Science is dr. ir. R. (Rom) Langerak. You can find him in building Zilverling, room 5039; Phone: 053 489 3714; E-mail: r.langerak@utwente.nl

1.5.2 Programme Coordinator

The programme coordinator for the master’s programme Computer Science is drs. J. (Jan) Schut. You can find him in building Zilverling, room A 108; Phone: 053 489 4350, E-mail j.schut@utwente.nl

1.5.3 Programme Mentor

The diploma is earned by obtaining satisfactory assessment results for each of the various units of study. The Examination Board ultimately determines whether the student’s results make him/her eligible for the diploma. This determination includes an assessment of whether the subjects and projects completed satisfy the applicable requirements and whether the level of the results achieved merit the diploma. The student has a great deal of freedom in selecting the subjects and projects completed towards earning the diploma. The entire list of units of study selected and completed by the student is called the course programme. The conditions placed on selecting subjects and projects are sometimes easy to meet, but is still mandatory in all cases that the student obtains formal approval for the choices he/she makes. The Examination Board appoints programme mentors who, on its behalf, assess the choices made by students in completing their programme according to the applicable regulations and any additional requirements imposed by the admissions board. If assessed positively, the programme mentors then approve the students’ course programmes on behalf of the Examination Board.

The course programme conditions are presented in the ‘Course Programmes’ section below. The conditions placed on the course programmes differ according to programme, track and specialization. Every programme has its own programme mentor.

Programmes offering various specializations and graduation subject fields generally have programme mentors for each specialization and graduation field. You will find the name of your programme mentor in the ‘Course Programmes’ section.
1.5.4 Coordinator International Students

The coordinator for international students is drs. J. (Jan) Schut. He can be contacted for any questions about the programme; Room Zilverling A 108; Phone 053 489 4350; E-mail j.schut@utwente.nl

1.5.5 Study adviser

The study adviser is S.B.A.M. (Sharon) Vonk, MSc; Room Zilverling 1004; Phone: 053 489 5645; E-mail: s.b.a.m.vonk@utwente.nl
2 Telematics
2.1 Goals and aims of Telematics

Telematics (TEL) focuses on improving the interaction between people and/or automated processes over time and distance through the application of information and communication technology. Telematics lays the foundation for connecting today’s demanding users worldwide. Ever increasing bandwidth, growing mobility, new applications every day, a variety of standards having to work together without problems: these all are challenges for the telematics expert.

The Telematics programme has the following general scientific attainment levels:
1. Graduates have an extensive knowledge of and understand the issues relevant to their specific field of study (i.e. programme-specific attainment targets) described below.
2. Graduates can contribute to scientific research, and independently design, conduct and present the results of small-scale research.
3. Graduates can provide an original contribution to the development and/or application of the field of study.
4. Graduates can analyse complex problems (change problems) relevant to the field of study and obtain the required knowledge and information.
5. Graduates can design, validate and implement solutions/systems in their operational context; identify and apply relevant advanced knowledge, methods and techniques from their field of study.
6. Graduates can assess solutions/systems and their applications according to their properties and potential to solve problems even if they are new to or unfamiliar with the situation or lack information and/or reliable information; they can use their assessment as a basis for (substantiation of) decisions.
7. Graduates understand the ethical, social, cultural and public aspects of problems and solutions in their field of study; apply this insight in their international role as scholar.
8. Graduates can work as part of and play a leading role in a team; manage and plan a development process; document development and research processes.
9. Graduates can substantiate research results, designs and applications in writing and verbally; critically assess and participate in debates regarding the same.
10. Graduates can independently acquire new knowledge and skills; reflect on trends in their field of study, responsibilities and roles and use this insight as a guide for and integrate it into their own personal development.
11. Graduates can integrate information from other disciplines into their own work if necessary.
12. Graduates take a critical approach to reading, incorporating information presented in and participating in debates regarding international scientific literature relevant to their field of study.
13. The word ‘original’ in 3 is understood to mean ‘demonstrative of a creative contribution’, and not ‘pioneering’.
2.1.1 Final qualifications

The qualification under ‘1’ in the preceding paragraph, that graduates command a high level of scientific knowledge and understanding of Telematics, is demonstrated by their ability to:

TEL 1. apply in a structured manner, disseminate and incorporate in multidisciplinary projects extensive knowledge and understanding of technology, development and application of data transmission, data communication, networks, protocols and their interrelations,

TEL 2. maintain a comprehensive overview of and analyze the telematics service and application needs of organizations, incorporate these needs into the telematics application development process and integrate them into business processes,

TEL 3. assess sophisticated problems in the field of telematics, develop solutions/solution structures for them and translate these into concrete designs and implementation,

TEL 4. have a thorough knowledge of, understand and gain practical experience with the process and available methods and technologies for planning, managing and implementing system development for telematics systems and applications,

TEL 5. apply methods, techniques and design and development tools for the development of telematics applications, networks and services, make an informed selection of these, communicate the principles involved and contribute to their further development,

TEL 6. select and implement the methods, techniques and tools to formally specify, verify and test telematics systems,

TEL 7. have knowledge of and understand various aspects of telematics systems, including performance, security and reliability; be able to apply this knowledge,

TEL 8. integrate, both independently and as part of a team, telematics systems, services and networks into large-scale telematics infrastructures, and maintain a comprehensive overview of the consequences,

TEL 9. have knowledge of and understand the trends in the field of study and the interaction between technological innovations and the organizational context of their applications. Telematics graduates have specialist knowledge of telematics and practical experience with scientific research and are able to contribute and apply the results.
2.2 General outline

The total size of the master’s programme is 120 EC (European Credits, 1 Credit stands for 28 hours), divided over 2 years. These credits are divided over:

- 35 EC core courses (7 courses).
- 20 EC specialization courses (4 courses).
- 20 EC free courses.
  These courses may freely be selected by the student, and may also be from other master’s programmes. Instead of these free courses, the student may also select a Traineeship.
- 5 EC Computer Ethics (192166500)
- 10 EC Research topics.
  As preparation for the Masters project. A grade will be provided independent of the Masters project.
- 30 EC Masters project.

Notes:

- Although there is much room for choice in the ‘specialization’ and ‘free’ courses, the choices must be formally approved by the programme mentor (see below).
- In cases where the student’s Bachelor’s programme does not match the pre-requisites, some specific ‘homologation’ courses may be required instead of the free courses.
- Network Security has previously been a Bachelor course. Students who followed that course as part of their Bachelor’s programme, should instead select an extra free course.
2.3 Master’s programme

2.3.1 Core subjects

The programme contains 35 EC of core subjects. All subjects have 5 EC. See schedule below.

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>192140122</td>
<td>System validation</td>
</tr>
<tr>
<td>3</td>
<td>192620010</td>
<td>Mobile and wireless networking 1</td>
</tr>
<tr>
<td>1</td>
<td>192620250</td>
<td>Selected topics in P2P systems</td>
</tr>
<tr>
<td>2</td>
<td>192620300</td>
<td>Performance evaluation 1</td>
</tr>
<tr>
<td>3</td>
<td>192652150</td>
<td>Service oriented architecture with web services</td>
</tr>
<tr>
<td>4</td>
<td>192653100</td>
<td>Internet management and measurement</td>
</tr>
<tr>
<td>1</td>
<td>192654000</td>
<td>Network security</td>
</tr>
</tbody>
</table>

2.3.2 Specialization subjects

At least four of the following advanced subjects have to be part of the programme:

<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
</tr>
</thead>
<tbody>
<tr>
<td>191210780</td>
<td>Transmission systems</td>
</tr>
<tr>
<td>191211030</td>
<td>Mobile radio communication</td>
</tr>
<tr>
<td>191211710</td>
<td>Core networks</td>
</tr>
<tr>
<td>192110880</td>
<td>Sensor data management 1</td>
</tr>
<tr>
<td>192111301</td>
<td>Ubiquitous computing</td>
</tr>
<tr>
<td>192135450</td>
<td>ADSA MDE</td>
</tr>
<tr>
<td>192140700</td>
<td>The numbers tell the tale</td>
</tr>
<tr>
<td>192195200</td>
<td>Security in organizations</td>
</tr>
<tr>
<td>192170015</td>
<td>Testing techniques</td>
</tr>
<tr>
<td>191210800</td>
<td>Information Theory</td>
</tr>
<tr>
<td>192320111</td>
<td>Architecture of information services</td>
</tr>
<tr>
<td>192320550</td>
<td>XML Technologies</td>
</tr>
</tbody>
</table>
2.3.3 Elective subjects

Other subjects to obtain the minimally required number of 120 credits may be chosen from the subjects offered by other specializations.

2.3.4 Mandatory

Besides Research Topics (192199508/ 10 EC) and the Final Project (192199978/ 30 EC) the subject Computer Ethics (192166500/ 5 EC) is mandatory.

2.4 Programme guidelines

The programme guidelines for the master’s programme of Telematics are the same as for the master’s programme of Computer Science, see 1.4 of this study guide.
2.5 Organization

2.5.1 Programme Director

The programme director for the master’s programme Telematics is dr. ir. R. (Rom) Langerak. You can find him in building Zilverling, room 5039; Phone: 053 489 3714; E-mail: r.langerak@utwente.nl

2.5.2 Programme Coordinator

The programme coordinator for the master’s programme Telematics is drs. J. (Jan) Schut. You can find him in building Zilverling, room A 108; Phone: 053 489 4350, E-mail: j.schut@utwente.nl

2.5.3 Programme Mentor

The programme mentor for the master’s programme Telematics is dr. ir. P.J. (Pieter-Tjerk) de Boer. You can find him in building Zilverling, room 5016; Phone: 053 489 4327; E-mail: ptdeboer@cs.utwente.nl. You can make an appointment with him:

- if you are interested in following master’s programme Telematics.
- if you would like to tailor the master’s programme Telematics to your specific needs.
- to discuss and get approval for the courses you intend to follow as part of your master’s programme Telematics. Note that getting approval (thus a signature) is a requirement; see also the rules about this above.

2.5.4 Coordinator International Students

The coordinator for international students is drs. J. (Jan) Schut. He can be contacted for any questions about the programme. Room Zilverling A 108; Phone: 053 489 4350; E-mail: j.schut@utwente.nl

2.5.5 Study Adviser

The study adviser is S.B.A.M. (Sharon) Vonk, MSc; Room Zilverling 1004; Phone: 053 489 5645; E-mail: s.b.a.m.vonk@utwente.nl
3 Human Media Interaction
3.1 Goals and Aims of Human Media Interaction

Highlighting the interaction between people and technology, the HMI master’s programme studies this relationship from different perspectives. Special emphasis is placed on the manner in which people interact with technology (i.e. what are their requirements, abilities and limitations?) and on the identification of the best way to implement or further develop technical capabilities to meet the needs of users.

The HMI master’s programme focuses specifically on intelligent, multimodal systems offering a more natural form of interaction than currently possible with conventional monitors, mice and keyboards. By employing a broad range of input modalities to observe and intelligently interpret user actions, these intelligent interactive systems aim to automatically determine the user objectives and operational context and make the necessary adjustments. This multimodality applies both to system input and output; text, speech, haptic and visual feedback and all manner of communication media are integrated and presented to users in an intelligent manner.

The HMI programme combines technical expertise and skills in the field of interaction technology with knowledge and skills in user-oriented design methodologies and an understanding of how people interact with technology.

3.1.1 Final qualifications

The degree programme has the following general scientific attainment levels

1. Graduates have an extensive knowledge of and understand the issues relevant to their specific field of study.
2. Graduates can contribute to scientific research, and independently design, conduct and present the results of small-scale research.
3. Graduates can provide an original contribution to the development and/or application of the field of study.
4. Graduates can analyze complex problems (change problems) relevant to the field of study and obtain the required knowledge and information.
5. Graduates can design, validate and implement solutions/systems in their operational context; identify and apply relevant advanced knowledge, methods and techniques from their field of study.
6. Graduates can assess solutions/systems and their applications according to their properties and potential to solve problems even if they are new to or unfamiliar with the situation or lack information and/or reliable information; they can use their assessment as a basis for (substantiation of) decisions.
7. Graduates understand the ethical, social, cultural and public aspects of problems and
solutions in their field of study; apply this insight in their international role as scholar.

8. Graduates can work as part of and play a leading role in a team; manage and plan a
development process; document development and research processes.

9. Graduates can substantiate research results, designs and applications in writing and
verbally; critically assess and participate in debates regarding the same.

10. Graduates can independently acquire new knowledge and skills; reflect on trends in
their field of study, responsibilities and roles and use this insight as a guide for and
integrate it into their own personal development.

11. Graduates can integrate information from other disciplines into their own work if
necessary.

12. Graduates take a critical approach to reading, incorporating information presented
in and participating in debates regarding international scientific literature relevant to
their field of study.

The word ‘original’ in ‘3’ is understood to mean ‘demonstrative of a creative contribution’,
and not ‘pioneering’.

The qualification under ‘1’ above, that HMI graduates command a high level of scientific
knowledge and understanding of human media interaction, is elaborated as follows.

1. Graduates have a thorough knowledge and understandings of each of the sub-fields
listed below and identify and utilize any links:

   • methodology of user-oriented design, including the drafting of user requirements,
     user studies and usability engineering;
   • forms of natural interaction, including natural language and speech recognition
     technology, multimodal interaction and interaction via dialogue systems and
     conversational agents;
   • intelligent interaction employing techniques taken from artificial intelligence, e.g.
     intelligent multi-agent systems and learning systems;
   • media technologies, e.g. image processing, computer vision, graphics and virtual
     reality, enabling complex interaction.

2. Graduates can design, both independently and as part of a team, sophisticated
applications involving digital media and interactive systems and geared to the needs
of users

3. Graduates can use state-of-the-art techniques, methods and design and development
tools in developing sophisticated applications make an informed selection of and
contribute to the further development of these methods, techniques and tools
4. Graduates have knowledge of and gain practical experience with interaction design methods

5. Graduates have knowledge of and understand various aspects of the user context of digital media and interactive systems and, based on this, communicate effectively and efficiently with users during the various phases of the development process

6. Graduates have knowledge of and understand basic questions and research methods into human behavior (psychology and philosophy) and grasp the relevance of these fields of study to the design of interactive systems

7. Graduates can draft, transfer, document and communicate to technical designers specifications on the basis of a knowledge and understanding of the technical aspects of digital media and interactive systems

8. Graduates can assess systems for human media interaction according to their technical and operational aspects, incorporating a thorough knowledge and understanding of mathematics

9. HMI graduates have specialist knowledge of one or more of the four Human Media Interaction sub-fields outlined above and practical experience conducting, reporting about and applying the results of scientific research in developing innovative interactive systems and the relevant techniques and methods.
3.2 General outline

Staff and students use the name HMI to refer to the Human Media Interaction programme. The HMI curriculum is a two year curriculum with a study load of 120 credits (EC) in total. Each year comprises 60 EC.

The composition of the course programme is as follows:

a. Basic subjects, 40-50 credits,
b. Advanced subjects, 0-40 credits,
c. Elective subjects, 0-40 credits,
d. (Research) traineeship and/or Research topics, 10-40 credits,
e. Graduation work, 30 credits.

Each student has an individual course programme which meets the programme requirements (see paragraph 3.4). Each individual course programme needs the approval of the Examination Board. The programme mentor (see paragraph 3.5) is appointed by the Examination Board to advise students in their choices, and with the power to grant the approval.

The regulations for the approval of the student’s course programme (within the rules and restrictions of the programme) are in section 3.4.

The admissions board can influence the options students have to take a traineeship and/or electives, either by imposing additional requirements, or by issuing a requirements waiver.

The programme requirements distinguish Graduate School students (shortly GS students) as a particular type of student, to whom other requirements may apply than the general requirements for all students.

Graduate School students are students who have been admitted to the Human Centered Interaction Technologies (HCIT) programme of the Twente Graduate School, and for whom the HMI master’s programme constitutes the initial phase of their HCIT programme.
### 3.3 Master’s programme

#### 3.3.1 Basic subjects

The core units of the HMI master’s programme are outlined in Table 1 below. Students must choose their basic subjects among the core units of Table 1, totaling 40 EC in study load. Graduate School students must make their choice totaling 50 EC in study load. The choice for all students is limited by the following rules.

- The basic subjects must include units in the area Human Computer Interaction with a study load of at least 5 EC in total;
- The basic subjects must include units in the area Natural Interaction with a study load of at least 5 EC in total;
- The basic subjects must include units in the area Artificial Intelligence with a study load of at least 5 EC in total;
- The basic subjects must include units in the area Man, Media and Society with a study load of at least 10 EC and at most 15 EC in total. It is mandatory that Computer Ethics (191612680/192166500) is among the basic subjects in this area.
- The basic subjects must include a HMI project (192166100).

The subjects marked -i- in Table 1 are ‘introductory’ units of study. The number of introductory units of study included in the basic subjects is limited by the following rule: The course programme can include no more than 30 credits from ‘introductory’ units of study. For Graduate School students an additional requirement is imposed: The basic subjects of a Graduate School student must include all units in the Human Centered IT area.

<table>
<thead>
<tr>
<th></th>
<th>EC</th>
<th>Assessment</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Artificial Intelligence (AI)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>192320601 Multi agent systems</td>
<td>5</td>
<td>S, O</td>
<td></td>
</tr>
<tr>
<td>192160200 Knowledge Representation</td>
<td>10</td>
<td>S, O</td>
<td></td>
</tr>
<tr>
<td>192166420 Machine learning</td>
<td>10</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td><strong>2. Human Computer Interaction (HCI)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>201000113 User Centred Design of New Media</td>
<td>5</td>
<td>O, Pre 1</td>
<td></td>
</tr>
<tr>
<td>192166100 HMI project</td>
<td>10</td>
<td>O, Pre 1</td>
<td></td>
</tr>
<tr>
<td>201000076 User studies in human media interaction</td>
<td>5</td>
<td>O</td>
<td></td>
</tr>
</tbody>
</table>
## 3. Man, media, society (MMS)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>191612510</td>
<td>Introduction to philosophy of technology</td>
<td>5</td>
<td>S, O</td>
</tr>
<tr>
<td>192166500</td>
<td>Computer Ethics</td>
<td>5</td>
<td>S, O</td>
</tr>
<tr>
<td>192934110</td>
<td>Research methods C&amp;M</td>
<td>5</td>
<td>S, Pre</td>
</tr>
<tr>
<td>192165201</td>
<td>Media and technology</td>
<td>5</td>
<td>O</td>
</tr>
<tr>
<td>192934100</td>
<td>Media psychology</td>
<td>5</td>
<td>S</td>
</tr>
<tr>
<td>192934160</td>
<td>Ergonomical design</td>
<td>5</td>
<td>S, O, Pre</td>
</tr>
<tr>
<td>192934050</td>
<td>Computer games studies</td>
<td>5</td>
<td>O</td>
</tr>
</tbody>
</table>

## 4. Mediatechnologie (MT)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>192110371</td>
<td>Graphics &amp; virtual reality</td>
<td>5</td>
<td>O</td>
</tr>
<tr>
<td>19121091</td>
<td>Image processing and computer vision</td>
<td>5</td>
<td>O</td>
</tr>
<tr>
<td>192166400</td>
<td>Advanced graphics</td>
<td>10</td>
<td>O</td>
</tr>
<tr>
<td>192160400</td>
<td>Information retrieval</td>
<td>10</td>
<td>S, O</td>
</tr>
</tbody>
</table>

## 5. Natural Interaction (NI)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>192166310</td>
<td>Speech and language processing 1</td>
<td>5</td>
<td>S, O</td>
</tr>
<tr>
<td>192166320</td>
<td>Speech and language processing 2</td>
<td>5</td>
<td>S, O, 2</td>
</tr>
<tr>
<td>192166370</td>
<td>Conversational agents</td>
<td>10</td>
<td>O</td>
</tr>
<tr>
<td>201000078</td>
<td>Brain Computer Interfacing</td>
<td>10</td>
<td>O,Pre</td>
</tr>
</tbody>
</table>

## 6. Human Centred Interaction Technology (HCIT)

<table>
<thead>
<tr>
<th>Module</th>
<th>Credit</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 1</td>
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<tr>
<td>Module 2</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

### Others

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>192166200</td>
<td>Capita selecta HMI</td>
<td>5</td>
<td>O, Pre</td>
</tr>
</tbody>
</table>

**Prerequisites:**

1. This course is excluded from the provisions of article 4 under 3 of the Teaching and Examination Regulations. Students must have a Bachelor’s diploma and (or) a certificate of admission to sit the interim examination.

2. To be eligible for Speech and language processing 2 the student must have successfully completed Speech and language processing 1.
3.3.2 Advanced subjects

Advanced subjects are units of study chosen from the core HMI units in Table 1 that are not included in the basic subjects described in section c. The choice of subjects is limited by the following rules: Advanced subjects include no introductory units. The course programme includes no more than 15 EC units in the area Man, Media and Society.

3.3.3 Elective subjects and homologation courses

Elective subjects are subjects not taken from Table 1. They are chosen upon advice of the programme mentor. The choice of subjects is limited by the following rule: The course programme includes no more than 15 EC units in the area Man, Media and Society. In some cases the admissions board may issue a certificate of admission with additional requirements. Generally the student will use the space for elective subjects in his course programme to meet these additional requirements, usually called ‘homologation’. Consequently he can take less or no elective subjects.

3.4 Programme guidelines

There are nine general rules to be observed by the student and study adviser in assessing the student’s possible course programme choices and in signing the finalised course programme.

1. The student creates a programme of units of study totaling 120 credits. These units are selected from among the courses offered by the UT or, where beneficial, courses offered by other universities. All course programmes except for Graduate School students have to include a 30-credit graduation assignment, and a 10-credit Research Topics unit. Graduate School students have to include a 15 credit research internship and a 30 credit graduation assignment. Students with a course programme totaling fewer than 120 credits or one lacking a graduation assignment of at least 30 credits will not successfully pass the master’s programme final assessment. There are no exceptions to this rule, except that the Examination Board may grant a student exemption from the mandatory 10 credits Research Topics.

2. The admissions board may grant a student admission with additional requirements, imposing additional diploma eligibility requirements. These requirements differ from student to student. No more than 30 credits will be required to satisfy the conditions imposed by the admissions board.

3. The master’s programme final assessment cannot be passed if the course programme of this category of students does not satisfy the additional requirements imposed. There are no exceptions to this rule.
4. Requirements apply to each course programme to ensure basic knowledge in the field of study and the track selected. The admissions board may adjust these requirements on the basis of the student’s prior education and training. Such an adjustment will never entail an intensification of the requirements. The master’s programme final assessment cannot be passed if the course programme does not satisfy the basic knowledge requirements. The only exception to this rule is when the admissions board lowers the basic knowledge requirements.

5. Requirements apply to each course programme to ensure sufficient depth of study in the track selected. The manner in which these requirements are satisfied is determined in consultation with the programme mentor. This includes, where necessary, taking into account which chair/chairs will bear responsibility for the student’s graduation supervision. The master’s programme final assessment cannot be passed if the course programme does not satisfy the depth of study requirements. There are no exceptions to this rule.

6. Requirements apply to some course programmes governing the chair from which the student can complete his/her studies, according to the graduation subject field or track selected. The master’s programme final assessment cannot be passed if, during the course of study, the requirements for the composition of the graduation committee are not satisfied. There are no exceptions to this rule.

7. One guideline applicable to all course programmes is that continuing students (i.e. holders of a UT Bachelor’s diploma eligible for automatic admission to one of the master’s programmes) can complete part of the programme’s 120 credits outside of the UT. The Examination Board may decide to exempt an individual from this guideline.

8. The total number of credits completed at the UT or at another university or research institute approved by the study adviser, must be at least 90. The Examination Board may permit a student to deviate from this rule. Additional requirements with regard to the type of activities completed by students outside of the UT may be posed. For instance, the obligation that a student completes a traineeship. Such a requirement must involve no more than 30 credits. The master’s programme final assessment cannot be passed if the course programme does not satisfy the requirements imposed with regard to the units of study completed outside of the UT, unless an exemption has been granted.

9. Computer Ethics is a mandatory subject in the MMS area for all students.

10. It is possible to have more than one instance of a unit of study (e.g. HMI project, Capita Selecta) in a course programme. Of course the approval of the programme mentor is needed. The difference between the two must be clear to all parties.

11. To be eligible for 192166320 Speech and language processing 2 the student must have successfully completed 192166310 Speech and language processing 1.
Course programme approval
The student must complete the following steps to obtain course programme approval:

1. **Orientation**: students complete subjects and sit interim examinations as they see fit. In this phase only a few credits can be earned. During this phase, the student can be advised by the admissions board or, if the choice of track is clear, by a programme mentor (see section b under 3). If the student chooses subjects or projects during orientation without consultation of the admissions board or a programme mentor, he/she does so at his/her own risk. If 15 credits have been earned in the master’s programme, the orientation ends. At this point, permission from a programme mentor is required for a more complete programme of at least one year. Phase 2 begins. In case the student during orientation chooses only subjects and projects which are mandatory for any course programme (within a given graduation subject field or track), consultation with and approval by a programme mentor may be postponed to a maximum of 30 credits. No one can earn more than 30 credits in phase 1.

2. **Approval of initial choice**: after receiving approval from the programme mentor, at least 60 credits of the course programme to be completed or already partially completed are laid down. The choice of graduation subject field or track is clear, as is the matter of whether a traineeship will be included in the course programme. The manner in which the credits for optional units of study are to be allocated and the chair/chairs from which the student will graduate may still be not entirely clear.

3. **Approval of entire course programme**: the programme mentor approves the 120-credit course programme in its entirety. At this point it is clear which chair/chairs will bear responsibility for the student’s graduation supervision.

Students may reduce the term of Phase 1 and skip Phase 2. Regardless of how the student wishes to proceed, once the limit established for the orientation phase has been reached (i.e. 15 programme credits earned or 30 credits for mandatory units of study only), the programme mentor must be contacted. Standard forms for laying down the course programme are available from the Educational support office secretariat and on the website of the Faculty of EEMCS. Once the programme mentor and the student reach an agreement on the content of the course programme, they complete and sign the forms. The programme mentor signs on behalf of the Examination Board. The completed and signed form listing the course programme must be included in the student’s file at S&O (the Student & Education service centre). In principle, the student will earn the programme diploma if he/she completes the units of study listed in the course programme and earns results in line with the guidelines for passing the final assessment. If the course programme listed on a signed form does not satisfy the regulations described in this programme appendix and/or does not satisfy the conditions imposed by the admissions board, the Examination Board is authorized to impose additional diploma eligibility requirements.
3.4.1 Traineeship

Graduate school students must take a 15 EC research traineeship in their course programme. All students except Graduate School students may take a 20 EC traineeship in their course programme. A student who must take homologation courses can skip a traineeship to make space for the homologation. All students except the Graduate School students must take a 10 EC Research topics subject in their course programme. Students may start a traineeship only if they have passed the Bachelor’s audit. For further details please see section 1.4.1 of this study guide.

3.4.2 Final project

Students complete graduation work worth 30 credits. Graduation work consists of a final project, a final report, a summary of the report, and a presentation. Generally the Research topics of section ‘f’ above immediately precede the graduation work, and serve as a preparation for the final project. Students may start their final project only if they have completed all of the remaining components of the study programme. Faculty chairs take responsibility for supervision and assessment of graduation work. For the M-HMI programme the chair responsible is HMI.

The final project should enable the student to apply the expertise gained during prior courses, projects and practical training sessions to solve well-defined problems of sufficient academic difficulty. In completing the final project, students must be allowed to make their own decisions. Students must be able to address the problem systematically, achieve clear results and formulate clear conclusions. Students are expected to report, both orally and in writing, on their findings and read and process relevant literature critically. Students who choose the combined traineeship and final project may use part of their credits to focus on the project theme before leaving and work on their report after their return.

At the beginning of the final project, the student and the graduation supervisor make work agreements. The graduation supervisor ensures that the assignment is in line with the ‘mission’ of the student’s chosen specialization and arranges for adequate supervision. The student will meet with the supervisors regularly to discuss the progress of the final project. These meetings focus on both the content and the implementation of the final project (comparable to the job appraisal interviews students will encounter later in their career).

To complete the final project, the student must submit a written report and hold a public presentation. The report should also contain a text reflecting upon the relevance of the research work of the final project in the society.
The student contacts a chair willing to take responsibility for the development, organization and supervision of the project and/or an external organization where the project can be performed. The programme mentor can help find a chair. The chair can be of assistance in making arrangements with external organizations. The following conditions must be met prior to definitive admission to the final project:

- The programme mentor has approved the student’s course programme.
- A chair/chairs willing to take responsibility for the organization, supervision and assessment of the graduation project has/have been found.
- Outside of the final project or combined traineeship and final project, the student requires no more than 10 credits to be eligible for the master’s programme final assessment.

The programme mentor is responsible for ensuring that there is proper supervision and evaluation during the course of the final project.
3.4.3 Study Abroad

A student is allowed to study 30 credits externally. To gain international experience a student is given the chance to study abroad to another university or institute to follow courses or doing projects. The choice of courses or projects has to be approved by the programme mentor in the same way as the other part of the programme is approved. Carrying out a traineeship abroad (as described in par. 1.4.1) is one way of gaining international experience. In some cases it is possible to carry out the final project abroad under joint supervision, where the lead in supervision will always be taken by the own chair. Our faculty has agreements with partner universities and institutes to accommodate students smoothly. Information about going abroad to partner or non-partner universities/institutes, the procedures and the possibilities of financial support can be given by the coordinator of internationalization:

drs. J. (Jan) Schut.
Room: Zilverling A-108  Phone: 053 489 4350; E-mail: j.schut@utwente.nl

3.4.4 Teaching degree

Graduates of the MSc Science Education and Communication – specialization Computer Science Education – receive the teaching license in computer science in secondary education. This master degree can be obtained as a second master degree, together with the master’s programme of Computer Science, Embedded Systems or Human Media Interaction. Combining these two programmes takes an extra year. Students get an extra year of study finance. More information can be given by drs. N.M. (Nico) van Diepen, didactician computer science; e-mail: n.m.vandiepen@utwente.nl.
See also: http://graduate.utwente.nl/sec/
3.5 Organization

3.5.1 Programme Director

The programme director for the master’s programme Human Media Interaction is dr. G.F. (Gerrit) van der Hoeven. You can find him in building Zilverling, room 1096; Phone: 053 489 3708; E-mail: g.f.vanderhoeven@utwente.nl.

3.5.2 Programme Coordinator

The programme coordinator for the master’s programme Human Media Interaction is drs. J. (Jan) Schut. You can find him in building Zilverling, room A 108; Phone: 053 489 4350; E-mail: j.schut@utwente.nl.

3.5.3 Programme Mentor

The programme mentor is appointed by the Examination Board to advise students in their choices, and with the power to grant the approval of their course programme. Students can contact the programme mentor anytime to get advice on courses to take, internships, research topics or research assignments. The programme mentor for the master’s programme Human Media Interaction is dr. D. (Dirk) Heylen. You can find him in building Zilverling, room 2031; Phone: 053 489 3745; E-mail: d.k.j.heylen@ewi.utwente.nl.

3.5.4 Coordinator International Students

The coordinator for international students is drs. J. (Jan) Schut. He can be contacted for any questions about the programme. You can find him in building Zilverling, room A 108; Phone: 053 489 4350; E-mail: j.schut@utwente.nl.

3.5.5 Study adviser

The study adviser for HMI students is drs. T. (Thea) de Klijver. If you have questions about the regulations within the programme, or if you want to talk about study related issues, you can contact her. Zilverling, 1003; Phone: 053 489 3697; E-mail: t.h.dekluijver@utwente.nl.
4 Chairs
Voor gebruik we de Text-to-Speech machine.

Met de iCat de volgende tekst uitsprak: "Hello I am iCat"
4.1 Computer Architecture for Embedded Systems (CAES)

‘Energy efficient architectures’: Our mission is to perform research on energy-efficient dependable architectures for networked embedded systems, by combining efficient computer architectures, systems software, networking, and tools.

Energy-efficiency is important for streaming applications found in battery powered mobile devices (e.g. PDAs and portable multimedia players) but also in high-performance computers. The research on energy efficient architectures focuses on reconfigurable processors for streaming applications. In cooperation with Recore Systems, a spin-off company of our group, we developed an energy efficient reconfigurable architecture called the Montium®. In real life the Montium is a Chameleon, a reptile that adapts to its environment, also our Montium adapts to its environment. In cooperation with Atmel, specialist in design and manufacture of advanced semiconductors, a reconfigurable multi-processor System-on-Chip (MPSoC) called the Annabelle is produced that contains 4 reconfigurable Montium tiles in CMOS technology (2 mm² per Montium). An interesting high-performance streaming application is medical image processing. For example: a doctor wants in real time X-ray images of the patient during surgery. Also signal processing for phased array antennas (for radar and radio astronomy) is part of our research.

In MPSoC systems for streaming applications dependability (i.e. availability, reliability, integrity and maintainability) techniques play an important role. One of the problems in manufacturing a MPSoC with millions of transistors using deep-submicron technologies (90 nm and below), is an increase in the probability of defects in silicon, which results in decreasing manufacturing yield. We develop methods to deal effectively with the increased defect density for fault detection, localization, and fault tolerant architectures implemented on-chip. Not only mobile devices can profit from energy efficient solutions. In cooperation with E.ON, Essent and HOMA software, we work on the successor of the classic (high-efficiency) boiler in your home: the Micro Combined Heat and Power System (microCHP). The microCHP produces heat but also electricity, that can be used during peak load or during power outage.

Due to the reduced peak load energy is generated more efficiently. We concentrate on the peak load reduction within a single household, scheduling a fleet of microCHPs and islanded operation in case of power outage.

prof. dr. ir. G.J.M. Smit
4.2 Design and Analysis of Communication Systems (DACS)

‘Avoid the rain’: One of the first things I’ll do every morning, is to go to the living room and take a look at the screen of my Apple notebook. This screen not only gives the latest news, but also shows the radar pictures that predict whether and where rain will fall within the next few hours. Depending on these pictures, the decision is made whether I’ll go by bike, or by car to the UT.

Next to me, there are everyday millions of users worldwide that depend on infrastructures like the Internet and GSM/UMTS networks for making decisions. Although these infrastructures are continuously getting faster, the key challenge however is to make these infrastructures more reliable. The Design and Analysis of Communication Systems (DACS) group therefore focuses on dependable networked systems. Research and education within DACS covers the whole spectrum of network technologies: from well-established technologies (like the wired Internet), via technologies that are under development (such as wireless networks) to emerging technologies (like embedded network systems). In the case of well-established technologies, research concentrates on operational aspects, here, in particular, of the wired Internet. Specific topics include bandwidth allocation, accounting, self-management of lambda switches and protection against scans, denial-of-service attacks and phishing. Taking and interpreting measurements plays an important role in research. For technologies under development, research focuses on the design, evaluation, and prototype implementation of new protocols and algorithms for wireless and ad-hoc networks. Topics include algorithms for context- and power-aware routing in ad-hoc networks, and, lately, more and more on car-to-car communications and wireless sensor networks. The research on embedded networking technologies focuses on system specification and evaluation techniques to describe such systems, and the resource constraints (performance, dependability, energy usage) they have to operate under, this includes the development of new stochastic model checking techniques and the application thereof to predict dependability and performance properties. Such models are applied, for example, to analyse control networks for critical infrastructures, such as the water and electricity networks. Whenever possible, within DACS M.Sc. projects are part of bigger projects, facilitating close collaboration between M.Sc. and Ph.D. students. In the past this has resulted into several joint papers by M.Sc. and Ph.D. students, and presentations of these papers by M.Sc. students at international conferences.

dr. ir. Aiko Pras
4.3 The Database Group (DB)

Our mission is to provide data management to create added value on top of autonomous data sources.

Nowadays huge amounts of data are produced by both humans ("prosumers") and devices connected to the Internet. This has led to information overload and a decrease in the trust of data (lack of quality: inaccuracy, ambiguity, and even inconsistency), as well as an increase of privacy threats. At the same time applications need data of high quality, and a way to deal with privacy sensitivity. Our approach is to extend database systems with data management functionality that filters and computes relevant information out of the data, reduces the unreliability of the data, and protects the privacy.

The core competence of the group is data management. On top of that, individual members of the group have expertise in database technology, information retrieval, security, XML, and streaming data. This combined expertise makes it possible to work on our mission. To address query processing and information retrieval meet. To deal with a lack of trust we work on enriching uncertain data, and finally to deal with privacy threats we work on Security and Privacy.

Search on semi-structured data
With the rise in application of XML technologies, the need arises for management of large collections of XML documents. Our research on querying and searching of semi-structured data aims to extend relational technology for processing XML data. The group primarily addresses XML query optimization and search and ranking. Future work will be on Large-scale distributed search, Social search for communities, and Spatial search.

Enriching uncertain data
Uncertain data can be found in many flavors. Data integration matches schemas and data of different sources, possibly leading to ambiguities and conflicts. Processing multimedia data introduces uncertainty, e.g. by the quality of feature extractors. The same applies for acquired sensor data, e.g. the location of a person acquired by a localization system. The processing, querying, and retrieval of extracted metadata must acknowledge uncertainty in the data. We investigate how to increase certainty by relating uncertain data with additional knowledge from the context, application, and community knowledge, in particular pertaining to context aware systems, location based services, and multimedia retrieval. In the near future we intend to investigate data integration, entity matching/identification/resolution, streaming data processing specification, evolution and provenance, and data quality improvement with user & system feedback.
Security and Privacy

Work is done in the following areas: search in encrypted data, access control and privacy protection. Regarding search in encrypted data, we investigate the problem how personal, sensitive data can be securely stored on a (third party, attractive but) untrustworthy server. Regarding access control, we investigate how secret keys, stored by authorized users and used for cryptographic enforcement of access control mechanisms, can be distributed and managed. In the future we aim to address secure handling of healthcare data, and investigate amongst others key management and distribution in medical applications. Regarding privacy protection, our idea is to subject data to progressive degradation while preserving the intended usability of the data. Progressive degradation is a refinement of limited retention (an “all-or-nothing” approach). We want to show that data degradation is practically feasible.

More information about the Database group can be found at: http://db.cs.utwente.nl

prof. dr. P.M.G. Apers
4.4 Distributed and Embedded Security (DIES)

Our research focuses on the analysis and design of distributed and embedded systems. These are complex, heterogeneous, networked systems that operate in often hostile environments, and under severe resource constraints. We are primarily interested in security properties.

Our teaching focuses on the systems oriented courses of the computer science curriculum. For example at bachelor level we teach operating systems, and at master level we teach system security.

Our interest in security properties stems from the fact that security is important for applications but very delicate. For example only one leak is sufficient to spoil the security of a system. It is therefore imperative to control the security properties of all components of a system. This is hard because (1) there might be a large number of components, and (2) we do not even know all the components of a system that interacts with the outside world. Interaction with the world around occurs, for example when people are required to use passwords that are not easy to guess, or when the network is wireless, and thus shares the airwaves with everybody else.

As in all scientific endeavours we aim to develop clear and concise theories that can explain the behaviour of our object of study. Distributed and embedded systems are often so complex that theoretical development must be driven by experiments. As a basis for experiments we develop models of different types, for example logical models of security protocols, or simulation models of network protocols. We use various types of tools to validate these models. To study qualitative aspects of systems we use model checkers such as SPIN to help us construct, explore and verify abstract models of systems. To study quantitative aspects of systems we use Matlab. A new generation of model checkers, such as Uppaal supports the analysis of both qualitative and quantitative aspects, particularly timing. Where necessary we build our own tools such as CoProve for security protocol verification. As always the proof of the pudding is in the eating, so we build prototypes of systems to validate our models, which more often than not leads to a complete overhaul of the models until after a number of iterations, when we are satisfied that we have gained a deep understanding of the system under investigation. Since modelling is
central to our work we are also investigating methods for systematic and effective model construction. We target our work at a variety of applications, ranging from smart guns, via smart surroundings to smart homes and vehicles. The smartness in each case refers to a specific property of the application that somehow improves the application far beyond what is possible today. For example a smart gun is smart because it will recognise the rightful owner. This means that if a gun is lost, stolen or wrestled out of the hands of the owner, it will simply refuse to fire. Our surroundings are smart when they anticipate on, and contribute to the activities of the people in these surroundings. For example, when sensors in a building can detect changes in environmental conditions such as temperature, and humidity to which the system can react adequately.

prof. dr. P.H. Hartel
4.5 Formal Methods and Tools (FMT)

‘The Quest for Correctness’
All human endeavor is imperfect. But software bugs are extremely annoying, costly, or even dangerous. Desktop computers can simply be restarted if they reach a blue screen; buggy tv’s and remote controls can still be recollected by their manufacturers. For aviation software, railway controllers, nuclear power plants and medical equipment, failing systems are simply unacceptable. Can we avoid errors at all, or should we tolerate them? What are effective methods to spot errors? Is it possible to prove the absence of error?

Software correctness
The research and education of the Formal Methods and Tools group aims at applying rigorous techniques to improve the quality of software-intensive systems by all means. To avoid errors, requirements specifications and early designs are scrutinized with powerful tools, such as model checkers and theorem provers. On the other side of the development lifecycle, an emerging field is software verification at the level of source code or the generated byte-code.

Even further down the line, an effective method to detect bugs is by applying systematic testing techniques. An important goal is to learn which method is most effective in some phase of the software life cycle. Of course this depends on the type of system and the particular aspect that one wants to study, e.g. correctness, security, timing, dependability. For embedded systems, quantitative and hybrid aspects come into play as well.

Theory
There’s nothing more practical than a good theory. The theory behind software verification stems from discrete mathematics and logic. These fields provide us with the reasoning capabilities to prove beyond all doubt that a system is correct, or to establish coverage criteria of test suites. Nasty errors typically arise from interactions between concurrent subsystems. Therefore, concurrency theory is a fundamental background for our research and teaching.

Central themes are process algebra, (timed/hybrid) automata, and temporal logics. Also algorithmic game theory provides fundamental insights in interacting systems (players) and environments (the adversary).
Tools
Software verification is really challenging from a computational point of view. The devil is in the details. Our tools should analyze all possible scenarios. However, there are exponentially many! So the tools that we build contain non-trivial data structures (such as binary decision diagrams), complicated algorithms (e.g. symmetry reduction) and clever implementation techniques (incremental hashing). We are also constructing parallel algorithms for clusters of workstations and multi-core machines, to tackle large problem instances by brute-force hardware solutions. It is an engineering challenge to combine all these ingredients effectively!

Interested?
We offer broad courses for students in Software Engineering and Embedded Systems. These are aimed at modeling notations, and the effective usage of verification tools.

Become a verification engineer!

For the theoretically inclined, we offer the track MTV, Modeling and Tools for Verification. The specialized courses aim at understanding and extending the theory and algorithms behind the tools, and form an excellent background to become a researcher in this field. FMT is coordinating the graduate school programme “Dependable and Secure Computing”.

We also offer exciting projects for both theoretically and practically oriented students.

prof. dr. J.C. van de Pol
4.6 Human Media Interaction (HMI)

‘Computing Power and the Fabrics of Everyday Life’

“The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.” This is a famous quotation from a paper called “The Computer for the 21st Century” written by Mark Weiser.

“Computer technology that weaves itself into the fabric of everyday life.” This is also the vision of Prof. Anton Nijholt whose goal is to realize this idea of invisible computing technology. In his view the fabric of future everyday life includes what we now see around us: other people, animals, furniture, clothes, walls, and devices that support us and our children in our daily home, recreational, office, and mobile activities. But in this fabric we will have intelligent sensors that detect what we are doing, share knowledge amongst themselves, and interpret what is going on. In addition to this ‘invisible’ intelligence embedded in the environment we will have human-like robots and also virtual humans displayed in virtual and mixed reality environments that interact with their human partners in human-like ways.

Home and other environments, humanoids, and devices that see, hear, and feel what we are doing will become familiar with us. They will know about our background and history, they will know about our preferences, our moods and emotions, and they will therefore be able to anticipate what we want. Hence, we enter the area of artificial intelligence and of affective and empathic computing. That is, computers embedded in environments, furniture, pets and physical and virtual humanoids that display rational and social intelligence, and that show empathy.

Sensor-equipped environments allow implicit and explicit interaction. We have implicit interaction if the environment understands and anticipates our actions and activities. Anomalies of daily activities can be detected and the environment and its devices may decide to inform or ask the inhabitant about what is going on, it may autonomously take action to repair or recover from a certain situation or it may issue a warning to a monitoring system. Recommender systems may suggest activities or commands based on preferences of inhabitants of smart environments.

Human Media Interaction research is multi-disciplinary research. Traditional computer science research is of course important. We need to design and implement interfaces, whether they are invisible or not. In particular this design should address the issue of ‘natural interaction’ for the human user. That is, we need to look at verbal and nonverbal behavior of humans when they interact with each other, their children, and their pets. We should understand what roles are played by gaze, head orientation, gestures, posture,
and verbal interaction and these roles should also be modeled in order to embed similar capabilities into synthesized environments and humanoids. Clearly, as human media interaction researchers, for that we need to cooperate with scientists from behavioral sciences. We need to cooperate with cognitive scientists about mental activities of inhabitants of our future smart environments. And we need to cooperate with (social) psychologists about designing environments and humanoids that can show empathy and that allow the emergence of social relationships between humans and their ‘artificial’ partners.

prof. dr. ir. A. Nijholt
4.7 Information Systems (IS)

‘Value creation for organisations requires new information system architectures’
Commercial and public organisations no longer view information technology only as a way to save costs in their processes, but also as a resource to create additional value. According to prof. dr. Roel Wieringa, chair of the Information Systems Group, this ‘calls for new architectural designs in the information function of organisations’.

‘This phenomenon started in the 1980s with the advent of EDI networks, accelerated in the 1990s with the opening of the Internet, and today is widespread across the globe. This calls for continuous rethinking of business process and information technology effectiveness in value creation. Often these value networks are decentralized, meaning that they consist of equal partners, without a central authority. Information systems therefore need to be designed in accordance with the goals of a disparate set of independent stakeholders. In this context, information systems should support processes within and across organizations that may or may not be fully specified. And at the same time, they should avoid harm to security and privacy of the actors involved.’ ‘Our mission is to develop methods, concepts, and tools for the efficient and effective design of information systems in decentralized networks, and to provide bachelor- and master-level teaching in these areas. We also take responsibility in transferring the results of our research to society.’

‘We have three kinds of research projects. In a number of projects we work with companies to develop tools and techniques for value web creation, that is, the creation of networks of profit-and-loss responsible partners. For example, we work with companies in the music business and in the electricity supply business to redesign their value webs, redesign their cooperation processes, and redesign their IT architecture to enable working on a pay-per-use basis. In a second group of projects we develop mobile and context-aware technology that provides services to clients in health care organizations. In a third group of projects we develop information risk assessment tools and techniques for companies that work in a value web, and that need to assess the risks they take in compromising their information systems.’ ‘we work with financial companies, organizations in health care, consultancy companies, manufacturing companies and with government organizations. We take care that in our research we follow sound methodological principles, as well as that we produce results that are relevant for society.’

prof. dr. R.J. Wieringa
4.8 The Pervasive Systems Group (PS)

The Pervasive Systems group investigates a new paradigm for bringing the flexibility of information technology to bear in every aspect of daily life. It foresees that people will be surrounded by embedded and flexibly (wirelessly) networked systems that provide easily accessible yet unobtrusive support for an open-ended range of activities, to enrich daily life and to increase productivity at work.

Sensors are tiny devices capable of capturing physical information, such as heat, light or motion, about an environment. Rapid advances in technology have enabled a new generation of tiny, inexpensive, networked sensors, or Smart Objects. Embedding millions of such smart objects into an environment creates a digital skin or wireless network of sensors, each sensor capable of capturing physical information about its immediate space. These massively distributed networks of smart objects communicate with one another and summarize the immense amounts of low-level information to produce data representative of the overall environment. Such pervasive systems present information in a qualitative, human-interpretable form, which allows the system and the people to respond intelligently. Cooperation is a necessity, to perform their tasks with sufficient quality or efficiency, and to reach the required functionality. The specific nature of these systems require them to be open, scalable, adaptable and dependable, while integrating heterogeneous devices ranging from tiny sensors to larger computers; and support real time interactions. Collaborative smart objects will be an important building block to bridge the gap between the physical and digital world by providing information about aspects of their physical environment.

Current industrial and academic research indicates that pervasive systems might soon become an integral part of our daily lives with applications in economically and societal important areas such as retail, supply chain management, asset management, safety critical situations in work places and healthcare.

While systems of smart objects clearly will need to build on emerging technologies such as RFID and wireless sensor networks, the envisioned ubiquity of smart objects raises important questions about the digital representation of physical artefacts, their cooperation paradigms, their adaptation to the dynamic environment, and the applications that will benefit and influence their design and development.
The supporting architectures should be open, distributed and scalable, naturally integrating heterogeneous devices ranging from tiny actuators to large computers. The research themes are focused on the following topics and their interaction:

- Wireless networked embedded systems, dealing with the networking aspects of pervasive systems, and
- Distributed data processing and reasoning, dealing with the processing and interpretation of distributed data

The common theme in these areas is on the development of large-scale, heterogeneous, wireless, distributed systems. Research questions cover architectures, protocols, programming paradigms, algorithms, and applications. The general research vision we have is that a multidisciplinary approach is necessary as many of the identified challenges need to be addressed in an all-inclusive way that considers systems, environment and users in close correspondence. Therefore, in the research of the group fundamental research activities that address the need for new methods, models, and tools are interwoven with experimental projects.

prof. dr. P. Havinga
4.9 Software Engineering (SE)

‘Designing and maintaining large and complex software systems: An analogy with dinosaurs’

Dinosaurs are now extinct. However, once upon a time, and for millions and millions of years, they were the rulers of our world. Some were unimaginably big. Some were small like a chicken. But each sort was a survivor against harsh competition.

Now imagine that you know nothing about dinosaurs and you want to create one of them. And you are lucky; somebody gave you the specifications of a dinosaur sort called T-Rex: It is big, has sharp teeth and makes noise. Since you have never seen a T-Rex in your life, you may shape your T-Rex quite different than it actually was. Let us assume that you put his brain under his foot instead of placing it in his skull. You verify the T-Rex before it comes to life. All his functions seem to be OK! But once it starts to walk, run and jump with the joy of being alive, it crushes its brain, painfully. This means “the structure of dinosaurs does matter” for its survival.

Software is everywhere; in your TV, music set, mobile phone, camera, car, banking system, and even in your electrical tooth brush. Software rules the world; nobody can imagine the world without software.

Software is like dinosaurs. Mostly it is huge. Millions of lines of code sit already in your modern TV. You need know how to build and deal with complex and large software systems. In fact, “the structure of software does matter” for its survival.

Software is like dinosaurs. You need to shape it well. All relevant concerns must be separated from each other. If you decompose your software wrongly, it will die sooner than you expected.

Software is like dinosaurs. It must be resilient to downsides of life. It must recover from crushes.

Software is like dinosaurs. It must run fast. Too slow ones will be surpassed by the competitors.

Software is like dinosaurs. It must be adaptable to all conditions.

Software must evolve. Otherwise it will perish sooner than expected.
The Software Engineering group carries out research projects with a number of industrial partners to deal with huge software systems. We investigate means to shape software optimally so that your “smart home” and “web-services” live rather than die. We try to make software resilient to crushes so that your “modern TV” keeps on showing your favourite programme, in real time. To keep your “printer” functioning optimally, we search for software adaptable to changing conditions. We have a project to let the software in “medical equipment” evolve smoothly.

The Software Engineering group has structured its research activities in complementary and partially overlapping research areas, identified by considering abstraction levels (from programming to architectures), application domains (from embedded to distributed systems), and relevant quality factors and supporting techniques. These areas have also been identified taking into consideration the expertise and interest of the scientific staff, and have allowed the group to acquire national and international projects. The research areas are: Programming Languages, Architecture Design, Service Architectures and Verification and Optimization.

Our master education program in software engineering covers the state-of-the-art topics necessary to design and maintain high quality software systems. Once you graduate, it is likely that you will work as a software engineer, like most of our graduates do. Every graduate can write some software. No problem in that. But most importantly, do you know how to create successful software systems that will have the right balance of the desired qualities? Or do you want to create a malformed dinosaur which will perish in short time?

prof. dr. ir. Mehmet Aksit
Section B

Appendices
1 The Faculty of EEMCS

The Faculty of Electrical Engineering, Mathematics and Computer Science (EEMCS) comprises three disciplines, each of which again has connections with other disciplines. Besides teaching, research is carried out in the faculties by our research groups/chairs. This research is entirely clustered in the university research institutes Institute for Nanotechnology (MESA+) and the Centre for Telematics and Information Technology (CTIT), IMPACT and MIRA.

1.1 Organisation chart EEMCS
Dean
Dean of the faculty of EEMCS is prof.dr.ir. Ton Mouthaan. With him rests ultimate responsibility for all of the faculty’s educational programmes.

Faculty Council EEMCS
The Faculty Council EEMCS is a representative advisory body of the faculty. The Council consists of eight students and eight staff members. The students are elected annually, the staff members serve on the Faculty Council for a period of two years. Nominations for the Council take place in April, the elections are held in June. The Council’s term of office runs parallel to the academic year. Depending on the subject at hand, the Faculty Council has advisory powers or the right of consent about the proposed decisions of the faculty dean. If he wants to take decisions about the outlines of personnel policy, regulations in the field of terms of employment and the occupational health and safety policy, the dean requires the consent of the Faculty Council beforehand. The dean also requires the Faculty Council’s consent beforehand if he wants to take decisions on setting or modifying the faculty Education and Examination Regulation (OER), rules in the field of safety, health and well-being or policy on students’ facilities.

For more information concerning the Faculty Council, please refer to: http://www.ewi.utwente.nl/organisatie/bestuur/faculteitsraad/

The Board of Professors
The Board of Professors consists of all professors and programme directors of the faculty.
1.2 Educational programmes

The faculty offers the following educational programmes:

- **Bachelor’s programmes:**
  - Electrical Engineering (EE)
  - Computer Science (CSC)
  - Applied Mathematics (AM)
  - Creative Technology (CreaTe)

- **Master’s programmes:**
  - Applied Mathematics (AM)
  - Computer Science (CSC)
  - Electrical Engineering (EE)
  - Embedded Systems (EMSYS) (3-TU)
  - Human Media Interaction (HMI)
  - Mechatronics (MT)
  - Systems and Control (SC) (3-TU)
  - Telematics (TEL)

At the head of every educational programme is a programme director. He marks the outlines of the educational programme and is responsible for the content of the educational programme and its courses.

For EE (BSc and MSc) this is dr.ir. W. Olthuis (Wouter)
For AM (BSc and MSc) and SC this is dr. J.W. Polderman (Jan Willem)
For CSC (BSc and MSc) and TEL this is dr.ir. R. Langerak (Rom)
For CreaTe en HMI this is dr. G.F. van der Hoeven (Gerrit)
For EMSYS this is prof.dr.ir. G.J.M. Smit (Gerard)
1.3 Services and units

The faculty has a number of EEMCS-wide service groups which are under the direction of the director of operations, ing. H. van Egmond.

SAFETY AND HEALTH CARE EEMCS

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Phone number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinator</td>
<td>ing. S. Visser (Sjoerd)</td>
<td>053 489 3153</td>
</tr>
<tr>
<td></td>
<td>ir. F. Houweling (Frans)</td>
<td>053 489 3583</td>
</tr>
</tbody>
</table>

OFFICE OF THE DEAN OF THE FACULTY OF EEMCS (BFD-EEMCS)

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
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</tr>
</thead>
<tbody>
<tr>
<td>General e-mail address</td>
<td><a href="mailto:BFD_ewi@ewi.utwente.nl">BFD_ewi@ewi.utwente.nl</a></td>
<td></td>
</tr>
<tr>
<td>Dean</td>
<td>prof. dr. ir. A.J. Mouthaan (Ton)</td>
<td></td>
</tr>
<tr>
<td>Director of Operations</td>
<td>ing. H. van Egmond (Harm)</td>
<td></td>
</tr>
<tr>
<td>Faculty secretariat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>director of operations and MT</td>
<td>E.C. Bosch-van der Heijden (Els)</td>
<td>053 489 4602</td>
</tr>
<tr>
<td>Dean</td>
<td>L. Tunc-Katalanc (Lena)</td>
<td>053 489 4427</td>
</tr>
</tbody>
</table>
## EDUCATION SUPPORT OFFICE EEMCS (BOB-EEMCS)

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Phone number</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manager of Education</strong></td>
<td>H.J. van Laar (Jolanda)</td>
<td>053 489 4466</td>
</tr>
<tr>
<td><strong>Internationalization</strong></td>
<td>drs. J. Schut (Jan)</td>
<td>053 489 4350</td>
</tr>
<tr>
<td><strong>Traineeship</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traineeship coordinator</td>
<td>dr. M.J. Korsten (Maarten)</td>
<td>053 489 3887</td>
</tr>
<tr>
<td>Traineeship mediator</td>
<td>B. Jaarsma-Knol (Belinda)</td>
<td>053 489 3887</td>
</tr>
<tr>
<td><strong>Quality assurance</strong></td>
<td>drs. J.H. Romkema (Hans)</td>
<td>053 489 2774</td>
</tr>
<tr>
<td><strong>Student advisers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer Science and</td>
<td>S.B.A.M. Vonk MSc (Sharon)</td>
<td>053 489 5645</td>
</tr>
<tr>
<td>Applied Mathematics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creative Technology</td>
<td>T.H. de Kluijver M.A. (Thea)</td>
<td>053 489 3697</td>
</tr>
<tr>
<td>and Electrical Engineering</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Secretariat</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student advisers,</td>
<td>R. Assink (Remke)</td>
<td>053 489 3426</td>
</tr>
<tr>
<td>Internationalization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality assurance</td>
<td>A. de Bruin-van Willigen (Annemieke)</td>
<td>053 489 3725</td>
</tr>
<tr>
<td>Programme directors</td>
<td>K. Veldhuis (Karin)</td>
<td>053 489 5450</td>
</tr>
</tbody>
</table>

## COMMUNICATIONS

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<tbody>
<tr>
<td><strong>Manager of Communications</strong></td>
<td>H. Barry-Mulder (Hinke)</td>
<td>053 489 2807</td>
</tr>
<tr>
<td><strong>Bachelor Electrical Engineering</strong></td>
<td>H. Barneveld-Hobbelink (Henriëtte)</td>
<td>053 489 2408</td>
</tr>
<tr>
<td><strong>Bachelor Applied Mathematics</strong></td>
<td>D. Dalenoord (Diana)</td>
<td>053 489 3450</td>
</tr>
<tr>
<td><strong>Bachelor Computer Science</strong></td>
<td>L. Jonker (Linda)</td>
<td>053 489 2745</td>
</tr>
<tr>
<td><strong>Bachelor CreaTe + Masters</strong></td>
<td>S. Bosch (Sarah)</td>
<td>053 489 3586</td>
</tr>
<tr>
<td><strong>Webeditor</strong></td>
<td>M. van Grinsven (Marloes)</td>
<td>053 489 1067</td>
</tr>
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PREMISES MANAGEMENT

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Premises Manager</td>
<td>ir. M.J.B. ten Bulte (Michel)</td>
<td>054 489 2800</td>
</tr>
<tr>
<td>Service desk</td>
<td>Servicedesk. <a href="mailto:Zilverling@fb.utwente.nl">Zilverling@fb.utwente.nl</a></td>
<td>054 489 4100</td>
</tr>
</tbody>
</table>

LIBRARY & ARCHIVE

Library & Archive is a service centre of the University Library of the University of Twente

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Phone number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Specialist</td>
<td>Mw.drs. P. de Willigen (Petri)</td>
<td>+31 53 489 2085</td>
</tr>
<tr>
<td>Computer Science, Applied Mathematics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Engineering</td>
<td>ir. W.C. Oosterling (Wim)</td>
<td>+31 53 489 2079</td>
</tr>
</tbody>
</table>

FACILITY SERVICE CENTRE

The Facility Service Centre is a shared service centre that offers its services within and for the various faculties, including EEMCS.

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Phone number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service desk</td>
<td>Servicedesk. <a href="mailto:Zilverling@fb.utwente.nl">Zilverling@fb.utwente.nl</a></td>
<td>054 489 4100</td>
</tr>
<tr>
<td>Contact</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hogekamp, Zilverling, Carré</td>
<td>N.C.M. Heijnekamp (Nancy)</td>
<td>053 489 5768</td>
</tr>
<tr>
<td>Citadel</td>
<td>M. Drewes (Martine)</td>
<td>053 489 6838</td>
</tr>
</tbody>
</table>
ICT SERVICE CENTRE (ICTS)

ICTS is a shared service centre within the University of Twente. The following contacts apply for the faculty of EEMCS.

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Phone number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accountmanager</td>
<td>ing. A.B. Tibben (Tonnie)</td>
<td>053 489 3724</td>
</tr>
<tr>
<td>EEMCS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICTS Servicedesk</td>
<td><a href="mailto:icts.servicedesk@utwente.nl">icts.servicedesk@utwente.nl</a></td>
<td>053 489 5577</td>
</tr>
<tr>
<td></td>
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</tbody>
</table>

STUDENT & EDUCATION SERVICE CENTRE

The Student & Education Service Centre performs tasks on a central level as well as within the various faculties. The Student & Education Administration (S&OA) EEMCS deals with all sorts of educational affairs and is part of this service centre. The Student & Education Administration is also known as the Bureau Onderwijszaken (BOZ, Educational Affairs Office).

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Phone number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team leader S&amp;EA EEMCS</td>
<td>M.H. Huiskes - Borghuis</td>
<td>053 489 4605</td>
</tr>
<tr>
<td></td>
<td>(Miranda)</td>
<td></td>
</tr>
<tr>
<td>OSIRIS/Blackboard</td>
<td>D. Muller (Diane)</td>
<td>053 489 2681</td>
</tr>
<tr>
<td>key user</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Education support

Education support is provided by the university Student & Education Service Centre (S&O) and the Education Support Office (BOB) of the faculty. The education administration is part of the Bureau Onderwijszaken (BOZ/S&O). See also section 4.1.

EEMCS-wide coordination in the fields of Internationalization, Quality assurance, Traineeship and Study advice takes place from the BOB.
1.4 Facilities

PC-rooms
For practical courses the faculty of EEMCS has a number of PC-rooms available. The W-zaal (West-room) and the flexoffice of SmartXP, situated in Zilverling/Hal A, are mainly scheduled for Electrical Engineering and Creative Technology practicals. Furthermore, in the Zilverling building rooms are situated on floor 2 (room 2042), floor 3 (3042) and floor 4 (4054) containing 12, 24 and 36 PCs respectively. During lecture hours a room assistant is present in room 3042. At night this room is open until 20.30h. After 18.00h, you can obtain entrance at the night porter at the main entrance of the Zilverling building. Please note that near the course rooms in the Zilverling building staff rooms are situated. So please keep quiet in the building, do not use your phone in the corridors but, for example, go to the stairwell or the Educafe instead, and limit talking in the corridors. Eating is prohibited in the PC-rooms; drinking is allowed, using lockable bottles.

Year room
For first-year bachelor students of Applied Mathematics a year room is available in the Citadel building (T100); most of their training will take place there. In the Citadel building (T300), there is also a year room available for the Creative Technology programme. Outside lecture hours this room can be used for self-study or as a project space by CreaTe students.

Smart XP Lab
In this new multifunctional area in the Zilverling building, it is possible for both parties of the faculty of EEMCS and exterior parties to conduct research in an interactive manner. The lab is a true research playground and offers ample opportunity for testing and experimenting. It is the intention that scientists from different disciplines become acquainted with each other’s fields, which may be to the benefit of their own research. This lab is, as it were, a meeting point where every possible research set-up is imaginable.

Educafé
Next to the (main) entrance of the Zilverling building, you will find the Educafe: a space where you can study, work in groups and relax with your fellow students. There are computer workspaces and you can grab a drink or snack from the vending machines. In short: this is an ideal environment to work together on projects. On the first floor, the EEMCS student associations are situated: Scintilla (Electrical Engineering), Abacus (Applied Mathematics) and Inter-Actief (Computer Science). At present, the study association for the Bachelor’s programme Industrial Design, Daedalus, still accommodates the new bachelor’s programme CreaTe.
The Educafe also hosts two shops: IAPC and Stores. IAPC is a non-profit shop where you can turn to when you have questions about or want information on computers. Besides, you can buy laptops and all sorts of computer parts there for reasonable prices. ‘Stores’ sells components (such as resistors and capacitors) and office supplies. Furthermore, IAPC as well as Stores sells study books. Both shops are run entirely by volunteers and they are open during weekday lunch breaks for most of the year.
2 The organization of education

2.1 Students’ Charter

As every institute for higher education in the Netherlands, the University of Twente also holds a Students’ Charter. The Students’ Charter is legally based in art. 7.59 of the Dutch Higher Education and Research Act (WHW). The Dutch text of the Students’ Charter is law-making. This means that in case of problems or conflicts you can appeal to the content of the Dutch text of the Students’ Charter (or Studentenstatuut). The Students’ Charter contains a programme-specific section (the OSS) and an institute-specific section. The institute-specific section of the Charter is at all times available in its most up-to-date form on the website http://www.utwente.nl/studentenbalie/regelingen_statuut/charter/.

If you would like to have a printed version of the Charter, it is available on request from the Red Desk: the information desk of the Student Counselling Service. For the programme-specific section of the Charter (OSS), which contains the Education and Examination Regulation (OER), please refer to the regulations and forms section on the website of your programme. http://www.ewi.utwente.nl/en/education/

2.2 Student Enrolment/Re-enrolment

Each academic year you are required to re-enrol at the University of Twente using Studielink. This re-enrolment is grafted on to the regulations in the Dutch Higher Education and Research Act (WHW) and it must be completed before 1 September. As soon as your request for re-enrolment by Studielink is received by the Central Student Administration (CSA), it will be verified whether you satisfy the conditions for enrolment. If you qualify for enrolment, your enrolment will be completed as soon as all enrolment documents have been submitted and the payment of your tuition fees is processed.

If you wish to be sure of your enrolment as from 1 September, you must complete all enrolment formalities in time – preferably before 1 August.

When your enrolment is complete, as proof of enrolment you will receive your student card and two declarations of enrolment. The declaration contains, among other things, the programme(s) and the period for which you are enrolled.

On the university level there are various student service centres, which are united in the Student & Education Service Centre (S&O). The student desk accommodates the service centres. The main services are mentioned below.
2.2.1 Student Services

Student Services offers various support services: you can go there to have your digital picture taken for your student card, to register, enrol or de-enrol. Student Services is situated in the Vrijhof building. See also: http://www.utwente.nl/studentenbalie/en/.

Student Counselling Service
The desk of the Student Counselling Service (the “Rode Balie”) is responsible for individual care and support of UT students at a coordinating level (besides the care educational programmes take for their “own” students). This includes for example a student psychologist, various courses (“self management”, graduating, job application) and the student counsellor.

Student psychologist
You can get help from the student psychologist when you need to talk to someone, for instance when you experience personal problems such as problems in your relation with your parents, friends or fellow students. You do not need a referral: you can make an appointment yourself. The student psychology service aims at having the first session within a week after the student contacted them.

Student counsellor
The student counsellor offers help when you have questions about, for instance, student grants, UT financial support, switching disciplines, problems involved with switching from a school for Higher Vocational Education to University, personal problems, appeal procedures, studying abroad, studying with a disability, and entrance examination (colloquium doctum). In order to make an appointment you need to telephone the secretariat. You have to take the initiative yourself to make an appointment with the student counsellor.

The “Rode Balie” is situated in the Bastille building. For more information, go to: http://www.utwente.nl/studentenbalie/en/.
2.3 Communication and Information

When you want to take up a study at the University of Twente, from the very start you will be faced with various means of communication the university, the faculty and your programme use to communicate with you. As soon as your preliminary enrolment at the University of Twente is received, you will be provided with an e-mail account, user name and password. You will also be provided with some writing space of your own, where you can save your documents and where you might put your own home page. The Internet is by far the most important means of communication of the programme and the university.

E-mail
Whenever the programme or a particular lecturer wants to communicate quickly with a particular student or a small group of students, this will be done by e-mail.

The Student & Education Service Centre (S&O) also uses e-mail to communicate with large groups of students. This occurs, for instance, when a lecture is suddenly cancelled or when an examination has to be rescheduled. In those situations, S&O is unable to contact the students in time through the usual channel of communication of the educational programmes, which is the Education announcement. S&O also uses e-mail to announce, for example, information sessions about study-related matters.

UT students in general have e-mail addresses like: <student name>@student.utwente.nl. In this address <student name> is replaced with a person’s initials and surname. Exceptions do occur, especially when a number of UT students have identical initials and surnames. You can find e-mail addresses of UT students and staff on the UT website.
Go to http://my.utwente.nl/.

MyUniversity
MyUniversity, the UT student portal, gives access to all UT data systems (OSIRIS, Blackboard). You can log on at http://my.utwente.nl/.
Besides, the portal gives access to the timetables for teaching and to some other services.

Education announcements
Changes in the timetables for teaching and examination are announced by means of an ‘Education announcement’ (Onderwijsmededeling). Every Education Announcement is spread through the Internet. The same applies for announcements concerning graduation colloquia and presentations of bachelor’s and master’s assignments. You can read them via the MyUniversity portal.nl. The Education announcement is the programme’s main means of communication to communicate with all of its students. It is important to check if there are any changes in the timetable every day, in order to be informed as much as possible and to prevent sitting in the wrong lecture-room at the wrong time.
Timetable for teaching activities
The portal MyUniversity gives access to the timetables for teaching activities.

OSIRIS (Student information system)
OSIRIS is the new self-service student information system which has recently been put into use by the UT. Via MyUniversity you can log in on OSIRIS using an ‘s’ plus your student number and the corresponding password. You can find a user manual on http://www.utwente.nl/so/osiris/english/Manual%20Osiris%20Student.pdf

If you have any questions, you can turn to Student Services (Vrijhof building). http://www.utwente.nl/studentenbalie/en/student_services/

Blackboard
Blackboard is the digital learning environment of the UT. It offers all the information you need to follow a course, such as the timetable, the contents of the lectures and additional information on the course material and the examination or assignment. Within a Blackboard site you can also communicate with fellow students and lecturers or work together on assignments.

Blackboard is a lecturer’s main means of communication to communicate with his students about a course. On this site you may also find important announcements and news items on the course.

You will need to sign up for each course you will take via Blackboard. To get access to the courses, you will need an account. After your registration at the CSA, the ICTS will usually provide you with a user name and password, the so-called ICT account, which you will receive by letter within 10 workdays.

If you were not provided with an ICT account or if you lost your password, please report this at the ICTS servicedesk, located at Horstring W122 (icts.servicedesk@utwente.nl, phone number +31 53 489 5577) and keep your student card at hand.

If you have any questions on Blackboard or OSIRIS, within the faculty you can turn to S&O, Diane Muller, the Zilverling building, room A104, phone +31 53 489 2681.

2.4 Student card

The student card issued by the University of Twente is valid proof of identity within the UT and it is also a proof of enrolment. You are required to show the student card at request when making use of university facilities such as attending lectures, taking examinations, or visiting libraries. You will receive your student card and two declarations of enrolment through the post as soon as you are registered. So please see to it that the Student Administration (CSA) has your correct address.

Toepassingen collegekaart:

- **Student card**
  The card is a valid proof of enrolment for the academic year 2010-2011
- **Library pass**
  The student card barcode enables the card to serve as a library pass.
- **Xtra-card**
  If you want to make use of the sports and cultural facilities in Enschede via http://www.xtra-card.nl/en, the card serves as Xtra card as well. See http://www.xtra-card.nl/en.

**Declaration of enrolment**
With a declaration of enrolment you can prove your enrolment (for instance to get a student grant or at your insurance company). The declaration contains, among other things, the programme(s) and the period for which you are enrolled.

**Theft/loss**
In case of theft or loss of the card, you can apply for a new student card on payment of EUR 5.- at the Student Services desk in the Vrijhof building.

**No student card yet?**
If your enrolment has not yet been fully completed, no student card will be produced. In addition to your enrolment the CSA requires a digital photograph. On workdays between 09.00 and 17.00h you can have your picture taken at the Student Services desk in the Vrijhof building (room 239B), across the library.
2.5 Year’s schedules

The year is divided into two semesters, each of which is divided into two quarters. Most courses will take one quarter and will be completed in the same quarter, mostly through a written examination. In every quarter 15 ECTS-credits are scheduled. The quarters run as follows:

- Quarter 1 from week 35 (30 August 2010) until week 44 (7 November 2010)
- Quarter 2 from week 45 (8 November 2010) until week 04 (30 January 2011)
- Quarter 3 from week 05 (31 January 2011) until week 15 (17 April 2011)
- Quarter 4 from week 16 (18 April 2011) until week 26 (03 July 2011)

For the exact schedule of courses see the timetables on the website http://myutwente.nl/ut/.

For a brief summary in English:
2.6 Lectures

The lecture hours have been altered as of the last academic year 2009-2010. This resulted in identical lecture hours on a 3TU level at all three institutes. This facilitates the exchange of education between the 3TU institutes by means of real time video conferencing.

The new lecture hours fit in very well with a very simple and straightforward model: all lecture hours start at a quarter to the hour and end at the half hour.

There are fifteen-minute breaks between lecture hours, lunch and dinner breaks last 75 minutes. Starting times of written examinations fit in with this schedule. The longer breaks between the morning and afternoon lectures and the afternoon and evening lectures respectively, are included in a consecutive numeration.

<table>
<thead>
<tr>
<th>Period</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st period</td>
<td>08:45 - 09:30 uur</td>
</tr>
<tr>
<td>2nd period</td>
<td>09:45 - 10:30 uur</td>
</tr>
<tr>
<td>3rd period</td>
<td>10:45 - 11:30 uur</td>
</tr>
<tr>
<td>4th period</td>
<td>11:45 - 12:30 uur</td>
</tr>
<tr>
<td>5th period = lunch break</td>
<td>12:45 - 13:30 uur</td>
</tr>
<tr>
<td>6th period</td>
<td>13:45 - 14:30 uur</td>
</tr>
<tr>
<td>7th period</td>
<td>14:45 - 15:30 uur</td>
</tr>
<tr>
<td>8th period</td>
<td>15:45 - 16:30 uur</td>
</tr>
<tr>
<td>9th period</td>
<td>16:45 - 17:30 uur</td>
</tr>
</tbody>
</table>

2.7 Taking courses

You will need to sign up for each course via Blackboard. To get access to the courses you require an account. The ICTS will provide you with a user name and password.

2.8 Knowing your way on campus

All of the faculty of EEMCS teaching takes place in rooms situated in buildings which are spread all over campus. In the time tables the lecture rooms are indicated using a code in which the first two letters indicate the building where the room is situated. The list below contains the most frequently occurring abbreviations of buildings. The computer practicals generally take place in one of the Zilverling rooms.
2.9 Study material

Textbooks, lecture notes, readers or syllabuses are required for virtually every course. For those you can turn to the student association and the UnionShop. The lecture notes, readers and syllabuses will be sold from the beginning of every semester at the UnionShop. You can check the website to see if they are in stock:
http://www.studentunion.utwente.nl/en/

2.10 PC-privé scheme for UT students and PC, laptop and printer purchase

As a student you are entitled to take part in a special subsidized PC purchase scheme (referred to as the PC-privé scheme) offered by the UT. You can take part in this scheme cheaply with an interest-free loan. Every regular full-time student enrolled at the UT can take part in the PC-privé scheme as follows.

Principal requirement:
Once in the bachelor’s phase and once in the master’s phase, provided the student in question is 60 ECTS-credits or more away from the degree in the respective phase.
Exceptions:
1. When attending a one-year master’s course, the student may sign up for the scheme no later than one month after the beginning of the programme;
2. Students enrolled in a bachelor’s programme who take courses in the bachelor’s phase as well as in the master’s phase and who still have to attain at least 60 ECTS-credits for both phases taken together are also entitled to take part in the scheme. Taking part in the scheme is then regarded as taking part during the master’s phase.
Note: this also includes students entering a programme via an alternative route who are attending a so-called ‘bridging programme’.

As a UT student you can purchase a high-quality PC and communication equipment in the IT shop at a highly competitive price. The University of Twente will lend you a maximum of EUR 1,362.- interest-free, which is to be repaid in a number of monthly instalments. Whether the student is required to repay the loan in 12 or up to 24 months depends on the remaining duration of the course. If the remaining study duration is 12 months, the loan has to be repaid in 12 months. A graduated calculation related to the remaining duration of the course may mean that the repayment term is longer. Via the Notebook Service Centre general UT software (such as Maple, Virusscanner, SPSS) can be downloaded. Special software may be available via your faculty. For more information on the PC-privé scheme, refer to:
http://www.utwente.nl/studentenbalie/regelingen_statuut/charter/appendix_57_pc_privet_scheme_fo.html
2.11 Examinations

At the start of the academic year, for every student a timetable of teaching activities and examinations is available. This timetable shows, among other things, the weeks in which examination are held (see also section 2.5). The timetables for teaching are also available on the websites of the programmes. Any changes, such as, for instance, the examination dates, will be announced via the Blackboard sites of the courses concerned and through Education announcements. So no new timetables will be distributed among the students if any changes might occur.

For the sake of students’ and teachers’ clarity the starting time of written examinations is identical to the first morning or afternoon lecture respectively. So:

- morning examinations start at 08.45h
- afternoon examinations start at 13.45h

Timetables of examinations are available via: http://my.utwente.nl/.

General rules

1. The student himself is responsible for registering or deregistering for the examinations.
2. Twice a year students are given the opportunity to take written and oral examinations belonging to a particular educational unit. Practical training can be completed at least once a year. The rules that apply for practical training will be communicated at the start of the educational unit.
3. The student who has not gained a mark 6 or higher after two markings by an educational unit and who still wishes to gain such a mark, is to appeal to the examination board for permission to take another examination in the educational unit concerned. This appeal must be accompanied by a working plan drawn up by the student in consultation with the examiner of the educational unit concerned and the study advisor. The examination board will decide on the appeal.
4. On the authority of the examination board at least one month before the start of the semester the timetable of examination of that semester will be announced, in which dates and times of the examinations are fixed.
5. The examination board may give permission to deviate from the number of times an examination will be held and the way in which examinations can be taken.
6. Rescheduling an examination to a time different from the one indicated in the timetable is only permitted after the examination board’s consent.
3 UT regulations

3.1 Studiefinanciering (Dutch student grant)

The contribution of the Dutch government towards the cost of education is called studiefinanciering. It consists of either a conditional grant plus an additional loan (the so-called blended studiefinanciering), or just a loan. The grant of IBG (Informatie Beheer Groep, the government institution responsible for the Dutch student grants) allows students to receive part or all of their training outside the Netherlands. The entitlement to studiefinanciering depends on your first year of enrolment. In any case, you have to be enrolled as a student and you should not be over 30.

3.2 Transitional arrangements

If courses are radically changed or if they are cancelled, at the beginning of the academic year you will be informed in writing about the consequences which this entails.

3.3 Garantiebeurs

The ‘Regulation Guarantee Grants First-year Students’ is meant for students who start an educational programme at the UT from VWO (Dutch pre-university secondary education) and who make a serious effort for the educational programme. If such a student decides to discontinue his educational programme before 1 February of the first year of study at the UT, the UT offers the opportunity to start a new educational programme with only limited loss of studiefinanciering possibilities (with as many equal opportunities as possible). The background of this regulation is that a lot of VWO students who would make good university students tend to choose for Higher Vocational Education nonetheless because they are under the impression that they will run less financial risk doing so.

3.4 Regulation graduation support

Students at the UT with certain special circumstances can make use of the Regulation graduation support. Students can appeal to this regulation when they have run into a delay due to recognized special circumstances during a period of blended studiefinanciering. The blended studiefinanciering concerns the period for which the studiefinanciering can partially be converted to a gift; in other words: the period in which the student is entitled to the basisbeurs (basic grant). To apply for graduation support you can contact the student counsellor in the Bastille building.


3.5 Top-level sport

Combining university-level studies and top-level sport can be problematic for many students. It generally proves impossible to postpone either academic studies or a career in sport until later; both activities require the practitioner to achieve results within a relatively short period of time. The UT is aware of the problems involved and has developed a policy covering the practice of top-level sport.

See also:

3.6 Regulation encouragement student activism

Within the framework of encouragement of student activism there is a special regulation for active students. This involves the individual readjustment of educational obligations for active students, in order for them to have more flexibility in their studies and so that they will run into less delay because of their activism. If you want to know if you qualify for this regulation or if you want more information, go to:
http://www.utwente.nl/studentenbalie/regelingen_statuut/charter/.
3.7 Studying with a disability

Being disabled, following an educational programme is not always easy. However, the UT makes a serious effort to enable the disabled to study. Physically or sensory disabled students or dyslexic students are given the opportunity to take examinations in a way that is tailored to the requirements of their personal disabilities as much as possible.

Students who fall under this regulation have been brought to the attention of S&O/BOZ and the EEMCS lecturers concerned through a letter of the study advisor.

See also: www.utwente.nl/studentenbalie/rode_balie/handicap
and http://www.onderwijsenhandicap.nl/

In general, being disabled, it may be wise to talk to the student counsellors and the study advisor of the faculty before the start of your studies. This may prevent any disappointments.
4 UT facilities

4.1 Educational Affairs Office EEMCS

The Educational Affairs Office (BOZ, Bureau Onderwijszaken) of the faculty of EEMCS is part of the Student & Education Service Centre (S&O) and assists the faculty in registering study results, supervising the (individual) students’ study programmes, organizing everything surrounding final assessment, making timetables, organizing examinations and organizing administrative systems.

BOZ is situated on the ground floor of the Zilverling building, room A104-A116. You can turn to them with most of your practical questions. They are reachable by telephone number +31 53 489 3794 or by e-mail boz@ewi.utwente.nl. In addition to this, you can turn to Student Services on the first floor in the Vrijhof building with any questions concerning education.

4.2 Union Shop

The Union Shop is situated on the ground floor in the Bastille building. The Union Shop sells lecture notes, readers and syllabuses. It also runs a copy service. In the self-service section not only copies can be made, but also reports can be bound, flyers cut, etc.

4.3 Notebook Service Centre

Nowadays, a notebook is virtually indispensable to any student at the University of Twente. You require your notebook to communicate with others, to collect information, to make calculations and drawings, to perform simulations and even to take examinations. Are you planning to buy a notebook in July or August? Every year in the summer, the ICTS Notebook Service Centre of the UT selects notebooks which most assuredly will meet the requirements of your educational programme! For more information, go to: http://www.utwente.nl/icts/en/nsc/
Service Desk

All students and university staff members can turn to the ICTS Service desk if they have problems or questions in the field of ICT. The ICTS Service desk is open from 08.30 until 17.00h and is reachable by telephone number +31 53 489 5577.

The service desk is situated in Horstring W122 (next to the Notebook Service Centre). With ‘general’ questions on ICTS you can turn to icts.servicedesk@utwente.nl. For more information, go to: http://www.utwente.nl/icts/en/servicedesk/.

4.4 Library/information specialist EEMCS

The central library of the University of Twente, situated in the Vrijhof building, contains books and journals on a number of disciplines. In addition, it contains study facilities such as study places in the reading rooms, quiet study places, working areas and PC work areas. The University Library catalogue, which includes the faculty libraries and the central library, is available online (www.utwente.nl/ub). Here you can also consult the catalogues of all Dutch University Libraries.

You need a student card if you want to lend publications or if you want to make use of the study facilities, for the student card serves as a library pass. Further information on lending or ordering publications is available at the desk of the library. The University of Twente is working on the accessibility of scientific journals. More and more journals can be consulted through the Internet.

The opening hours of the central library are from 08.30 until 22.00h on workdays, and from 11.30 until 16.30h on Saturdays (for study purposes only, during examination periods). The information desk is open from Monday to Friday from 08.30 until 17.00h. You will find more information on www.utwente.nl/ub.

The University of Twente has a team of information specialists who offer support in the purchase of books, provide information on how to use the (digital) library and how to find scientific information on research and education for both staff and students. For EEMCS, the information specialists are:

- Mrs drs. P. (Petri) de Willigen, Citadel building H203, phone +31 53 489 2085
4.5 Student restaurant

In the Waaier building, the student restaurant of the UT is situated. The restaurant is based on the so-called free-flow system, which means that at various free-standing points of distribution a broad assortment is offered. Here you can get a hot day’s menu, the Dagmenu. You can also choose to have the more luxurious menu, or select from a broad assortment of sandwiches, rolls, snacks, desserts and hot and cold drinks.
5 Student activism

Organizing various activities requires qualities and skills which you may benefit from for the rest of your life. So being active in an association (being on a committee or a board) will always beneficial to your CV. In the professional field, surely students will be watched for who did more than just study.

Being active also helps you getting introduced to people you might never meet otherwise. Moreover, board members often have a specific position, such as chairman, secretary or treasurer. Positions like this will teach you how to draw up an agenda, to chair meetings, to take minutes or, for instance, to draw up an estimate.

5.1 Student associations

Every educational programme has its student association. They all organize all sorts of study-related activities, such as lectures, excursions and conferences. But also recreational activities are laid on, such as get-togethers and parties. In addition, the student association for instance takes care of the book sale. The student association for Electrical Engineering is Scintilla, for Creative Technology it is (for the time being) Daedalus, Abacus is the student association for Applied Mathematics and Inter-Actief for Computer Science.

5.2 Student participation and other committees

Within the faculty of EEMCS you may become a member of various committees, such as:

The Faculty Council (see also page 1 of this appendix)
Programme Committee
Support Committee for Programme quality
Although every effort has been made to ensure that all the information presented is correct, information in this study guide is subject to changes. No rights may be derived from the information in this guide. For up-to-date information refer to: www.ewi.utwente.nl/onderwijs/