Study and Examination regulations for the master's degree program in Informatics from the Faculty of Mathematics and Informatics at Freie Universität Berlin

Preamble

On the basis of § 14 Par. 1 No. 2 of the Partial Basic Regulations (Trial Model) of Freie Universität Berlin of 27 October 1998 (FU Announcements No. 24/1998), the Department Council of the Faculty of Mathematics and Informations of Freie Universität Berlin on July 16 2014 issued the following Study and Examination Regulations for the Master's Degree Course in Informatics of the Faculties of Mathematics and Informatics of Freie Universität Berlin:*

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§ 1
Scope

(1) These regulations stipulate the objective, contents and structure of the Master's degree program in Informatics of the Faculties of Mathematics and Informatics of Freie Universität Berlin (Master's degree program), and in supplementation to the framework study and examination regulations of Freie Universität Berlin (RSPO), requirements and procedures for examination performances (credit points) in the Master's degree program.

(2) This is a consecutive master's degree program as per § 23 para. 3 no. 1 letter a) of of the law relating to universities in the state of Berlin (Berlin Higher Education Act) in the version of 26 July 2011 (GVBI. [Law and Ordinance Gazette] p. 378), which is research-oriented.

§ 2
Qualification objectives:

Graduates of the master's degree program can boil down tasks from applications back to their informatics-related content then systematically resolve these by using abstractions and suitable models. For this purpose they have advanced knowledge and skills in areas where informatics currently plays an essential role, and they are able to apply their knowledge in these areas. They consider important aspects such as security, efficiency, usability, and correctness. They can plan and manage a software project. They are aware of the state of research in selected sub-areas and also have research experience themselves. In addition, graduates also have individual skills and insights within an application field such as the natural sciences, humanities, economics, law, or the social sciences.

(2) Graduates are also capable of taking responsibility for managing tasks and problems - even in teams. In particular, they can also take gender and diversity aspects into account. They master techniques of scientific research, in reading and compiling German and foreign-language scientific texts, in holding presentations and lectures. They can work in a team and have communication skills. They can specifically, professionally, and clearly present results of work to different customer groups both orally and in writing.

(3) Graduates can aim for a further academic qualification (doctorate) and are qualified for activities in the fields of information and telecommunications technology, such as in research and development. Due to their skills in abstract and analytical thinking, graduates are not restricted to a specific occupational profile but are qualified for leadership positions in a wide range of professions.

§ 3
Study contents

(1) The course provides knowledge and skills within the sub-disciplines of practical, technical, and theoretical informatics, as well as within an application area. Knowledge and skills are acquired at a more advanced

* This regulation was confirmed by the Executive Board of the Freie Universität Berlin on 12 August 2014.

level within a sub-discipline. During studies, students focus on reliability, security, and efficiency. They are encouraged to take societal aspects into consideration with current challenges such as how to illustrate autonomous systems in robotics or huge data quantities from the network, from large experiments, or the economy. They have the opportunity to specialize in current research.

(2) In software projects, students work together in a team to solve a more complex problem within a specified time period. The course provides the necessary insights into gender and diversity aspects that are required for teamwork and time management. Responsibility for sub-tasks is also taken. Oral and written presentations of scientific results are practiced with different target groups.

§ 4
Student advisory and course advisory service

(1) The general student advisory service is provided by the Central Student Advisory and Psychological Advisory Office of the Free University of Berlin.

(2) Academic subject advising is done by professors who provide such events during regular consultation hours.

(3) Every student is assigned to a personal course advisor from the group of professors who are mainly involved in that field. This will be made known in an appropriate manner by the Chairperson of the Examining Board.

(4) Students are recommended that they should visit the student advisory service at least once per year and discuss the level of performance achieved along with planning of the rest of the course.

(5) Before completion of the module in the application part as per § 7 paragraph 7 advice should be given by the personal course advisor as per paragraph 3 covering the examinations that should be completed as a result. This should cover the availability of the programs, the modules and courses to be completed; the examinations assigned to the modules and the courses are discussed and a schedule is created. If modules and courses from other universities, departments, or such have to be completed as part of the elective part along with access restrictions then permission from the location providing the positions has to be documented.

§ 5
Examining Board

The examining board set up by the Faculty of Mathematics and Informatics at Freie Universität Berlin for the master's degree program is responsible for organizing examinations and for the other tasks stated as part of the RSPO.

§ 6
Standard Study Period

The standard study period is four semesters.

§ 7
Structure and Outline

(1) A total of 120 credit points (CP) must be earned in the Master's degree program. The Master's degree program comprises:

1. the informatics part with a scope of 70 CP,
2. the application area with a scope of 10 CP,
3. the elective part with a scope of 10 CP, and
4. the Master's thesis along with presentation of the results with a scope of 30 CP.

(2) The Informatics part is divided into the following three study areas with the following modules:

1. Practical informatics with a scope of 20 to 50 CP, with the modules:
   - Module: Image processing (5 CP),
   - Module: Computer graphics (10 CP),
   - Module: Computer vision (5 CP),
   - Module: Database technology (5 CP),
   - Module: Empirical assessment within informatics (5 CP),
   - Module: Start-up in the IT industry (5 CP),
   - Module: Foundations of testing software (5 CP),
   - Module: Foundations of managing IT projects (5 CP),
   - Module: Artificial Intelligence (5 CP)
   - Module: Medical image processing (5 CP),
   - Module: Model-driven software development (5 CP),
   - Module: Pattern recognition (5 CP),
   - Module: Network-based information systems (5 CP),
   - Module: Project Management (5 CP)
   - Module: Project Management - advanced module (5 CP)
   - Module: Computer security (10 CP),
   - Module: Semantic business process management (5 CP),
   - Module: Software Processes (5 CP),
   - Module: Compiler construction (10 CP),
   - Module: Distributed systems (5 CP),
   - Module: XML technologies (5 CP),
   - Module: Practices of professional software development (5 CP)
   - Module: Software project - Practical computer

science A (10 CP),

- Module: Software project - Practical computer science B (10 CP),
- Module: Scientific work within practical informatics A (5 CP),
- Module: Scientific work within practical informatics B (5 CP),
- Module: Current research topics in practical computer science (5 CP),
- Module: Special aspects of Practical Computer Science (5 CP),
- Module: Special aspects of data management (5 CP),
- Module: Special aspects of software development (5 CP),
- Module: Selected topics in Practical Computer Science (10 CP).

2. Theoretical informatics with a scope of 10 to 40 CP, with the modules:
   - Module: Higher algorithmics (10 CP),
   - Module: Model Checking (10 CP),
   - Module: Current research topics in Theoretical Computer Science (5 CP),
   - Module: Algorithmic geometry (10 CP),
   - Module: Selected topics in Theoretical Computer Science (10 CP),
   - Module: Advanced topics in Theoretical Computer Science (10 CP),
   - Module: Special aspects of Theoretical Computer Science (10 CP),
   - Module: Cryptology and security in distributed systems (10 CP),
   - Module: Semantics of programming languages (5 CP),
   - Module: Software project - Theoretical computer science A (10 CP),
   - Module: Software project - Theoretical computer science B (10 CP),
   - Module: Scientific work within theoretical informatics A (5 CP), and
   - Module: Scientific work within theoretical informatics B (5 CP).
3. Technical informatics with a scope of 10 to 40 CP, with the modules:
   - Module: Operating Systems (10 CP),
   - Module: Microprocessor internship (10 CP),
   - Module: Mobile communication (5 CP),
   - Module: Robotics (5 CP),
   - Module: Telematics (10 CP),
   - Module: Software project - Technical computer science A (10 CP),
   - Module: Software project - Technical computer science B (10 CP),
   - Module: Scientific work within technical informatics A (5 CP),
   - Module: Scientific work within technical informatics B (5 CP),
   - Module: Current research topics in technical computer science (5 CP),
   - Module: Special aspects of Technical Computer Science (5 CP), and
   - Module: Selected topics in Technical Computer Science (10 CP).

(3) Modules worth at least 20 CP should be selected and completed within the Practical Informatics study area, whilst modules worth at least 10 CP should be selected and completed from within the Theoretical and Technical Informatics study areas.

(4) One of the three fields of study should be covered at a more advanced level. Additional modules with a scope of 20 CP should be selected and completed within this study area. An additional 10 CP can be freely selected and completed from the three study areas.

(5) Two to four modules from the six modules offered in “Scientific Work” should be selected and completed. In this case at least one of the modules to be selected as per clause 1 should come from the advanced study area as per para. 4.

(6) One or two modules from the six offered in “Software Project” should be selected and completed.

(7) Modules with a scope of 10 CP should be completed in the application area. All modules in scientific study areas except informatics are possible for the application area. Completion of modules from the study areas of mathematics, bioinformatics, physics, philosophy, psychology, or chemistry are particularly recommended.

(8) In the elective part, informatics modules as per para. 2 or other academic study areas as per para. 7 with a scope of 10 CP should be selected and completed.

(9) Modules from a bachelor’s degree course up to a scope of 15 CP can be used. Modules that are identical to those already completed in the bachelor’s degree program in Informatics from the Faculty of Mathematics and Informatics at Freie Universität Berlin should not be selected or introduced. The “Project Management” (5 CP) module cannot be selected if the “Foundations of managing IT projects” (5 CP) or “Project Management - Advanced” (5 CP) module are selected or entered.

(10) In the master's degree program modules with a total of 60 to 65 CP in exams graded separately, as well as modules with a total of 25 to 30 CP in exams not graded separately or with no module exam should be selected and completed.

(11) The module descriptions in Annex 1 provide information for the modules in the module offerings regarding admission requirements, contents and qualification objectives, forms of teaching and learning, time requirements, forms of active participation, examination work required alongside studies, obligations regarding regular participation in the forms of teaching and learning, credit points assigned to the relevant modules, normal duration, and frequency of offering. For the “Start-up in the IT industry” and “Foundations of

managing IT projects" modules, reference is made to the Study and Examination Regulations for the bachelor's degree program in Informatics at the Faculty of Mathematics and Informatics of Freie Universität Berlin. Reference is made to the relevant Study and Examination Regulations of the corresponding courses from Freie Universität Berlin for the modules of the application area as per par. 7 and the elective part as per par. 8.

(12) The examples of courses of full-time study in Annex 2 provide information on the recommended study sequence.

§ 8
Forms of teaching and learning

(1) The following forms of teaching and learning are provided:

1. In lectures (L), the material for the relevant event is presented and explained by the instructor, whereupon the students deepen their knowledge via regular preparation and follow-up.
2. Exercises (E) take place in groups alongside lectures and are generally carried out by scientific staff under the supervision of the instructor for the relevant lecture. Task sheets appear at regular intervals regarding a lecture, and these should be done by students independently as homework or in small groups that are organized by the students themselves. The solutions, or approaches to solving the problems, are stated in workgroups and then discussed. The purpose of workgroups is to deepen knowledge of the material covered in the lecture, as well as practicing methods and techniques.
3. Internships (I) are used to acquire skills and to successfully use problem solving methodology within informatics based on several practical tasks. This includes specification of problems and breaking it down into subproblems. Solutions and results should be demonstrated, worked out in writing, and presented. The purpose of internships is to have a secure grasp of acquired knowledge.
4. In project seminars (PrjS), students carry out a large task and solve it using techniques and methods that were generally learned in an accompanying or previous event. This covers formal specification of problems, breaking it down into subproblems, establishing interfaces, as well as the use of project management methods. Students regularly report on their progress in self-organized groups. Well-documented, working programs and a summarizing project report showing individual performance should be submitted at its conclusion. A project seminar is also useful for enhancing knowledge of cooperative work techniques and gender and diversity competence, alongside acquisition of skills for independent application of learned skills and problem-solving methods within informatics on a specific task.
5. A specific topic area is explored between the participants and the lecturer in advanced seminars. Every student also is largely responsible for preparing a presentation that is prepared in writing and then presented and discussed during the seminar. The primary purpose of an advanced seminar is to learn how to carry out independent academic work as well as continuing to develop communication and rhetorical skills.
6. Tuition in seminars (TiS) is used to convey application-oriented insights into a specific subject area; in this case a task is worked on independently, and the results of it are demonstrated by the students and then critically discussed together.
7. A method course (MC) is used to teach scientific or practical engineering work methods, then discussed and practiced with specific examples.

(2) The forms of teaching and learning in line with Par. 1 can be used in blended learning arrangements. The on-campus studies are linked with electronic Internet-based media (e-learning). In this case, selected teaching and learning activities are offered via the central e-learning applications of the Freie Universität Berlin and either carried out by students independently on their own or in a group, and/or with other support. Blended learning can be used in the execution phase (exchange and discussion of learning objects, solving tasks, intensification of communication between learner and instructor), or in the follow-up phase (monitoring learning outcomes, transfer support).

§ 9
Master's Thesis

(1) The purpose of the Master's Thesis is to demonstrate that the student is capable of working independently on a question from the field of informatics at an advanced level, as well as presenting and assessing the results obtained from this work competently in written and oral form.

(2) Students will be admitted to work on a Master's Thesis upon application if they can prove at the time of application that they

1. were most recently matriculated in the Master's Program of the Free University of Berlin and
2. have completed modules with a scope of at least 60 CP in a Master's degree program.

(3) The application for admission to the Master's Thesis must be accompanied by proof of fulfillment of the conditions as per Par. 2 as well as confirmation by an instructor entitled to administer examinations of intent to supervise the Master's Thesis. The Examination Committee decides on the application. If no confirmation of intent to supervise the Master's Thesis as per Phrase 1 is submitted, the Examination Committee will appoint a supervisor accordingly.

(4) The Examination Committee assigns the theme of the Master's Thesis in consultation with the supervisor. The theme and set tasks must be of such a nature that the work can be completed within the assigned period. The assignment and compliance with the submission deadline are to be recorded and the information kept on file.

(5) The work can also be done externally in a suitable operation or scientific facility as long as scientific supervision is ensured as per Par. 3.

(6) The written part of the Master's Thesis should be between 50 and 80 pages. Preparation time for the written part of the Master's Thesis is 23 weeks. It can be in either German or English. If a student has been prevented from working on the thesis for a period of more than eight weeks for a valid reason, the examining board will decide whether the Master's thesis must be begun afresh. The examination performance with regard to the Master's Thesis is considered to be not carried out if the examining board requires it to be resubmitted.

(7) The assigned period begins on the date on which the theme is assigned by the Examination Committee. The theme can be returned once within the first four weeks and is then considered unassigned. When the thesis is submitted, the student must affirm in writing that he or she has written the Master's thesis independently, using only the sources and aids listed. The written part of the Master's thesis should be issued in three typewritten, bound versions as well as in electronic format as per § 12.

(8) The written part of the Master's thesis shall be evaluated in a written statement within four weeks by two examiners appointed by the examining board. The supervisor of the Master's thesis should be one of the examiners. At least one of the two gradings should be from a university instructor who is primarily active at the Institute for Informatics at the Faculty of Mathematics and Informatics at Freie Universität Berlin.

(9) The written part of the Master's Thesis is passed if it is graded as "sufficient" (4.0) or better. The grade for the written part of the Master's Thesis is yielded from the arithmetic mean of both individual grades. If one of the examiners issues a grade of "insufficient" (5.0) or if both individual grades from the examiners differ by 2.0 or more, then the Examining Board commissions a third examiner with grading the written part of the Master's thesis. In this case, the grade for the written part of the Master's Thesis is yielded from the arithmetic mean of the grades issued by all three examiners.

(10) Approximately two to four weeks after the written part of the Master's Thesis is handed in, the results of the thesis are presented in a lecture within the university and defended in a scientific debate (approx. 30 minutes) as the oral part of the Master's Thesis. The date is scheduled by the Examining Board directly after the thesis is submitted, and the candidate is made aware of this in an appropriate manner.

(11) The colloquium with the debate will be graded separately by two commissioned examiners. These examiners should also have handled the written part of the Master's Thesis. The grade for the presentation of the Master's Thesis is yielded from the arithmetic mean of both individual grades.

(12) The grade for the oral part of the Master's Thesis amounts for a quarter and the grade for the written part amounts to three-quarters of the overall grade for the thesis.

(13) The Master's thesis will be considered to have passed if the combined grade attained for the Master's thesis is at least "sufficient" (4.0).

(14) The examining board can, upon request, recognize a successfully completed Master's thesis from another institution of higher education or in another subject in cases when the qualification is equivalent. A bound copy of the Master's Thesis and an electronic copy as per § 12 as well as evidence of the assessment and grading of the thesis should be submitted with the application.

§ 10
Repetition of examinations

(1) Examination work can be repeated three times, and the Master's thesis can be repeated once if these are not originally passed.

(2) If the first potential examination date is directly after the end of the associated course then an examination performance graded as "sufficient" (4.0) or better in the module may be repeated once for the purpose of improving a grade, which takes place by the beginning of the subsequent semester at the very latest. The better grade will be taken into account. An improvement in the grade is not possible in case of a repeated exam.

§ 11
Electronic examinations

(1) In the case of electronic examinations, performance and evaluation is carried out with digital technologies.

(2) Before an examination where digital technologies are used, the suitability of such technologies with regard to the intended examination tasks, and performance of the electronic examination, should be verified beforehand by two examiners.

(3) The authenticity of the author and the integrity of examination results should be safeguarded. The examination results, in the form of electronic data, are clearly identified to this effect and also unmistakably and permanently assigned to the student. It should be ensured that electronic data remains unchanged and complete for assessment and for verifiability.

(4) An automatically generated assessment of examination performance should be checked by an examiner if requested by the student in question.

§ 12
Submission format of written examination work

Written examination work that is not in the form of a written exam should also be submitted in electronic form in portable document format (PDF). The files in PDF format should have machine-readable text and not just contain charts; furthermore there should be no rights restrictions. Systems, such as computer programs, should be submitted in the source text.

§ 13

Studies abroad

(1) It is recommended that students participate in studies abroad. Within the framework of study abroad, credit points are acquired that count towards the Master's course of studies.

(2) Before the study abroad takes place, it should be preceded by conclusion of an agreement between the student, the representative for scholarship programs and foreign studies within the Faculty with collaboration from the chairperson of the examining board and also of the relevant body at the target university regarding the duration of the period of studies abroad, the scope of performances expected during the studies abroad, which are to be equivalent to the performance items in the master's degree program, and the credit points to be assigned to these performance items. Performance items or equivalent completed as per the agreement are then credited accordingly.

(3) It is recommended that the study abroad takes place during the second or third subject-specific semester.

§ 14
Graduation

(1) The graduation requirement for the degree program is that the scope of study performance as required by §§ 7 and 9 of these regulations has been completed.

(2) Graduation is not permitted if the student has conclusively failed to complete a required scope of performance or conclusively failed to pass required examinations or is involved in a pending examination procedure at a university in the same course of studies, or in a module that is identical or comparable to a module completion of which is required for the Master's Program and the grade for which counts towards the overall grade.

(3) The application for recognition of graduation must be accompanied by proof of satisfaction of the requirements as per Par. 1 and a statement confirming that none of the cases under Par. 2 applies to the person of the applicant. The competent Examination Committee decides on the application.

(4) The university degree Master of Science (M. Sc.) is awarded upon passing the examination. Students receive a Report of Grades and a Diploma (Annexes 2 and 3) as well as a Diploma Supplement (in English and German). A further supplement to the Report of Grades is also issued that contains information on the individual modules and their content (Transcript). An English translation of the Report of Grades and Diploma are also issued on request.

§ 15
Entry into force and transitional regulation

(1) These regulations come into force on the day following their publication in the Official Gazette of the Free University of Berlin (FU Announcements).

At the same time, the Study Regulations for the master's degree program of 24 January 2007 (FU Announcements 61/2008, p. 1338), changed on 4 November 2009 (FU Announcements 24/2010, p. 466), and the Examination Regulations of 24 January 2007 (FU Announcements 61/2008, p. 1393), changed on 4 November 2009 (FU Announcements 24/2010, p. 474) become invalid.

(3) These regulations apply to students who matriculate following their entry into force for the Master's Program at Freie Universität Berlin. Students who, before this regulation comes into force, are matriculated for the master's degree program at

Freie Universität Berlin, complete the coursework in line with the regulations as per para. 2, if they do not apply to the examining board to complete coursework as per these regulations. In the latter case, on the occasion of the transcription resulting from said application, the Examination Committee shall make a decision regarding the scope of modules begun or completed when the application was made or regarding crediting of these performance items within the framework of these regulations, whereby the principles of legitimate expectation and equal opportunity are respected. The transfer application will become effective at the beginning of the lecture period of the relevant semester. The transcription cannot be revised.

(4) The opportunity to complete the course of studies according to the Study Regulations as per Par. 2 is to be upheld until the end of the 2017 summer semester.

Annex 1: Module descriptions

Explanations:

The following module descriptions refer to every module of the Master's degree course unless reference is made to other regulations

- the designation of the module,
- those who are responsible for the module,
- requirements for admission to each module,
- content and qualification objectives of module,
- teaching and learning forms of module,
- estimated student effort requirement to complete the module,
- forms of active participation,
- examination forms,
- mandatory regular participation,
- the credit points assigned to the modules
- normal duration of module,
- frequency of course offering,
- applicability of the module

The information on time requirements refer in particular to

- active participation in on-campus study period,
- time required for completion of minor tasks related to on-campus study period,
- time for independent preparation and follow-up,
- processing of study units in online study phases,
- preparation time immediately prior to examinations,
- examination time.

The information on time requirements for self-study (including preparation and follow-up, examination preparations, etc.) are guideline values to help students organize the time required for module-related work. The information on work effort requirements corresponds to the number of credit points assigned to each module as the unit of measure for student work effort as an approximation of the work required to complete the module successfully. A credit point is equivalent to 30 hours.

To the extent the required study performance includes regular participation, this is established, as well as active participation in the teaching and learning forms and successful completion of the examination requirements of each module, as a precondition for acquiring the credit points assigned to the respective module. Regular participation compliance is when at least 85% of the on-campus study time scheduled in the teaching and learning forms of a module were attended. Even if there is no mandatory regular participation in a type of learning for a module, it is strongly recommended nonetheless. The relevant instructor cannot establish compulsory presence for types of learning for where participation is merely recommended.

Module exams - if assigned - must be taken for each module. Graded modules are completed with only one examination (module exam). The module exam must reflect the qualification objectives of the module. It tests whether the objectives of the module have been reached based on an exemplary sampling. The scope of the examination is limited to what is required to achieve this. In modules for which alternative examination forms are planned, the examination form for each semester must be determined by the responsible instructor by the first course date at the latest.

Active and - if provided - regular participation in the teaching and learning forms as well as successful completion of the examination requirements of each module, are the preconditions for acquiring the credit points assigned to each module. In modules with no module examination, active participation as well as regular participation in the teaching and learning forms are the preconditions for acquiring the credit points assigned to each module.

1. Field of study - Practical computer science

Module: Image processing			
University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics			
Persons responsible for module: Module Instructors			
Admission requirements: None			
Qualification objectives: Students can date, enhance, and amend pictures made by digital and video cameras, and make them usable for further use by people or for machine processing. They understand the underlying quality terminology and the algorithmic techniques that are used in the process.			
Contents: Fundamental image processing techniques are covered. These cover color corrections of images, Fourier transformation, smoothing, refining, edge detection, building pyramids, scale-space theory as well as fundamental procedures for pattern recognition, such as Hough transform.			
Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)
Lecture	2	Work on assigned exercises	On-campus time L 30 Preparation and follow-up L 30
Exercise	2		On-campus time E 30 Preparation and follow-up E 30 Examination preparation and examination 30
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)	
Course language:		German (English if necessary)	
Mandatory regular participation:		Participation recommended	
Total working time requirement:		150 hours	5 CP
Duration of module:		One semester	
Frequency of course offering:		Two-yearly	
Applicability:		Master's degree program in Informatics	

Module: Computer graphics

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students are aware of the problems that can arise between modeling and graphic representation. They know, using examples, how these questions can be solved in current systems in hardware or software, and they understand the geometric and physical fundamentals necessary to handle advanced computer graphics systems.

Contents:

Mathematical foundations of computer graphics, illustration of 3D scenes on computers, geometric transformations, projections on an image plane, determining visible areas, lighting models, ray-tracing, radiosity, animation.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	4	Work on assigned exercises	On-campus time L	60
			Preparation and follow-up L	60
Exercise	2		On-campus time E	30
			Preparation and follow-up E	90
			Examination preparation and examination	60
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes).		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		300 hours	10 CP	
Duration of module:		One semester		
Frequency of course offering:		Two-yearly		
Applicability:		Master's degree program in Informatics		

Module: Computer vision

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students are aware of current methods of computer vision, and can program a computer system for recognizing objects and environments (e.g. for operation of a robot).

Contents:

In contrast to pure image processing, computer vision works with a series of pictures and aims to recognize objects, as well as to construct a spatial model. Participants are made fully aware of the current state of research in this field based on current literature.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	2	Work on assigned exercises	On-campus time L	30
			Preparation and follow-up L	30
Exercise	2		On-campus time E	30
			Preparation and follow-up E	30
			Examination preparation and examination	30
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		150 hours	5 CP	
Duration of module:		One semester		
Frequency of course offering:		Two-yearly		
Applicability:		Master's degree program in Informatics		

Module: Database technology

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students master current technical procedures for efficient, secure management of data and can develop fault-tolerant, efficient database systems as well as assess their quality.

Contents:

The course covers all technical questions that arise in the context of implementing data management systems. These include access technologies and query optimization, realization of transactions, particularly synchronization processes, the technical measures that make database systems tolerant to faults. Processes for efficient management of other large databases, particularly XML documents, are covered alongside techniques used in relational systems. A focus of the event is correct implementation of transactional guarantees in data management systems.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	2	Work on assigned exercises	On-campus time L	30
			Preparation and follow-up L	30
Exercise	2		On-campus time E	30
			Preparation and follow-up E	30
			Examination preparation and examination	30
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		150 hours	5 CP	
Duration of module:		One semester		
Frequency of course offering:		Each winter semester		
Applicability:		Master's degree program in Informatics		

Module: Empirical assessment within informatics

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students understand the empirical research methods for the application situation and have an overview of the most important categories of methods and their features. They are able to assess the quality of an empirical study.

Contents:

The module initially covers the role of empirical investigations in gaining information during research and in informatics practice, then introduces the process followed within empirical investigations in generic terms (with the following phases: Definition of inquiry, selection of method(s), design of study, execution, evaluation, report/presentation). Building on this basic understanding, and based on central quality concepts (particularly internal validity) and relevance (particularly external validity) then various method classes (such as controlled experiments, quasi-experiments, surveys) are covered and illustrated based on real case studies: Suitability and contraindications; strengths and weaknesses; procedures; pitfalls. The use of software for data evaluation and a small empirical study is carried out as a project from initial design to presentation.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	2	Carrying out and presentation of an empirical study	On-campus time L	30
			Preparation and follow-up L	30
Exercise	2		On-campus time E	30
			Preparation and follow-up E	30
			Examination preparation and examination	30
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		150 hours	5 CP	
Duration of module:		One semester		
Frequency of course offering:		Each summer semester		
Applicability:		Master's degree program in Informatics		

Module: Foundations of testing software

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

The students understand the foundations of testing software and the role of testing across the entirety of the software life cycle. They know the stages and types of software tests. They can design tests in line with the state of the art, and they can apply their knowledge when tests are being performed.

Contents:

Testing is increasingly important in the development and quality assurance of software-based systems. This lecture will cover fundamental concepts in software testing and relevant practical methods for test management, test design, test specification, test generation, and test evaluation. The following topic blocks are covered:

- Foundations of testing software
- Testing within the software life cycle
- Static test
- Dynamic test
- Test design techniques
- Test management
- Test tools

Lectures are based on the ISTQB® (International Software Testing Qualification Board, www.istqb.org) Certified Tester Program, a globally recognized and standardized training system for software testers. Lectures cover the material in the ISTQB Software Tester Foundation Level as well as additional test methods and techniques. Alongside the examination for the lecture it is also possible to take an exam for the Software Tester Foundation Level certificate. This certificate is frequently asked for in job advertisements.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	2	Work on assigned exercise sheets Two oral presentations regarding the solution to a task in the exercise	On-campus time L	30
			Preparation and follow-up L	30
Exercise	2		On-campus time E	30
			Preparation and follow-up E	30
			Examination preparation and examination	30
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		150 hours	5 CP	
Duration of module:		One semester		
Frequency of course offering:		Each summer semester		
Applicability:		Master's degree program in Informatics		

Module: Artificial Intelligence

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students master the fundamental techniques, heuristics, and algorithms in the field of artificial intelligence and can apply these for symbolic and pattern recognition problems.

Contents:

Search methods for solving combinational tasks, predicate logic and its mechanization, resolution and theorem proving, knowledge-based and expert systems, diffuse logic, man-machine interfaces, pattern recognition particularly for handwriting and for spoken language

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	2	Work on assigned exercise sheets Two oral presentations regarding the solution to a task in the exercise	On-campus time L	30
			Preparation and follow-up L	30
Exercise	2		On-campus time E	30
			Preparation and follow-up E	30
			Examination preparation and examination	30
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		150 hours	5 CP	
Duration of module:		One semester		
Frequency of course offering:		Each summer semester		
Applicability:		Master's degree program in Informatics		

Module: Medical image processing

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students can assess the quality and the properties of medical image materials. They are aware of the special features of medical image material that should be taken into account when applying algorithms, and can make a problem-related selection of suitable image processing algorithms then link this to holistic solutions. They master methods of image enhancement, registration, segmentation, and classification, and can apply these independently. They can confidently evaluate the quality of image processing algorithms.

Contents:

Introduction to medical image processing, objectives of digital image processing in medicine, extraction of information from image data, object recognition (support of perception of image information, image contrast, filtering, texture recognition, segmentation) and problems in medical practice, relative location of images (alignment, 3D image reconstruction), moving images, and object tracking. Application examples: manual, interactive, and automatic methods (intensity and model-based) are covered on the basis of medical image material.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	2	Work on assigned exercises	On-campus time L	30
			Preparation and follow-up L	45
Exercise	1		On-campus time E	15
			Preparation and follow-up E	30
			Examination preparation and examination	30
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		150 hours	5 CP	
Duration of module:		One semester		
Frequency of course offering:		Each semester		
Applicability:		Master's degree program in Informatics		

Module: Model-driven software development

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students are aware of concepts, methods, and tools in model-driven software development. They can describe the dynamic and static aspects of software-intensive systems based on various modeling languages. They understand the use and application limits of model-driven software development as part of the general software development process.

Contents:

To start with, fundamental concepts of meta-modeling are covered, building on knowledge of UML that has already been acquired. The field of DSL - domain specific languages - is also covered. The design and implementation of DSLs as part of the software development process is considered, starting with motivation then covering design and moving on to code generation and implementation Approaches of model analysis are covered at a model level, such as model checking and transformation of models. In this case both model-to-model transformations such as the mapping of a platform-independent model to a specific execution platform or behavior-neutral refactoring of models as well as model-to-text transformations such as is used for generating code are taken into account. The last topic of the module focuses on the use of models covering runtime. Interpretation of behavior models is covered in greater detail, and the context between structural models and dynamic component systems is looked at more closely. The exercises are carried out in parallel and make the theoretically conveyed material clearer through practical application of the concepts and approaches that were learned.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	2	Work on assigned exercise sheets Two oral presentations regarding the solution to a task in the exercise	On-campus time L	30
			Preparation and follow-up L	30
Exercise	2		On-campus time E	30
			Preparation and follow-up E	30
			Examination preparation and examination	30
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		150 hours	5 CP	
Duration of module:		One semester		
Frequency of course offering:		Each winter semester		
Applicability:		Master's degree program in Informatics		

Module: Pattern recognition			
University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics			
Persons responsible for module: Module Instructors			
Admission requirements: None			
Qualification objectives: Students are aware of fundamental processes in pattern recognition using probabilistic and neuronal processes as well as connectionist models, and can apply these to pattern recognition problems for recognition of writing, language or objects in pictures or similar.			
Contents: Baye's method of pattern recognition, clustering, expectation maximization, neuronal networks and learning algorithms, associative networks, recurrent networks. Computer vision with neuronal networks, applications in robotics			
Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)
Lecture	2	Work on assigned exercise sheets Two oral presentations regarding the solution to a task in the exercise	On-campus time L 30 Preparation and follow-up L 30 On-campus time E 30 Preparation and follow-up E 30 Examination preparation and examination 30
Exercise	2		
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)	
Course language:		German (English if necessary)	
Mandatory regular participation:		Participation recommended	
Total working time requirement:		150 hours	5 CP
Duration of module:		One semester	
Frequency of course offering:		Each winter semester	
Applicability:		Master's degree program in Informatics	

Module: Network-based information systems

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students know the fundamentals of technologies that are necessary for constructing network-based information systems as well as understand the most important mechanisms and their contexts. They are able to classify these and show them appropriately.

Contents:

Network-based information systems provide information on a worldwide scale with the expansion of the web. The lecture provides insights into the most important technologies, problems, and solutions of such systems. The event is divided into four areas (technologies and concepts covered are noted in brackets):

- The web: How are contents represented (HTML/XML), how are they found (crawling, deep web), how can they be accessed (Internet protocols)?
- Web search: Information retrieval for the web, indexing, multimedia indexing, collaborative filtering, use of web structure when searching (PageRank, HITS), meta search engines
- Operation, design, and illustration of websites: Usage and users of websites, operating aspects of very large services, server and client-side implementation, caching in web, client-side illustration, multilingualism in web
- Semantic web: Technologies and applications

Alongside the lecture part, additional topics, such as relevant Internet and WebStandard documents are also covered in presentations in the exercise part.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	2	Work on assigned exercise sheets Two oral presentations regarding the solution to a task in the exercise	On-campus time L	30
			Preparation and follow-up L	30
Exercise	2		On-campus time E	30
			Preparation and follow-up E	30
			Examination preparation and examination	30
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		150 hours	5 CP	
Duration of module:		One semester		
Frequency of course offering:		Two-yearly		
Applicability:		Master's degree program in Informatics		

Module: Project Management

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Lecturer for the module

Admission requirements: None

Qualification objectives:

Students understand fundamental and advanced techniques in project management and are able to apply them. They can draw up a project plan and map an organizational structure with suitable personnel. They can work in management of a project and take responsibility for every aspect of project management including leading staff. They can independently manage a small project. Students can make appropriate use of the features of a project management software tool (such as MS Project) in a suitable format.

Contents:

Principles, methods, and procedures in process management based on recognized methodology (e.g. "Project Management Body of Knowledge" (PMBoK)). The event covers all topic areas relating to project management.

– Project creation, definition, and planning of project scope
– Project planning
– Project sequence monitoring and control
– Project status determination and reporting
– Sub-contracting
– Project Organization
– Integration of a project into the organization carrying it out, leading without formal power
– Project Communication
– Leading a project team
– Quality management
– Project closure
– Professional Responsibility
– Use of MS Project

This module therefore covers all fields of activity for an assistant in project management and provides the necessary knowledge for managing smaller projects.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Tuition in seminars	2	Regular contributions to discussion, a presentation, work on assigned exercises	On-campus time	60
Tuition in seminars	2		Preparation and follow-up	60
			Examination preparation and examination	30
Module exam:		Written exam (60 minutes), the written exam can also be carried out in the form of an electronic examination (60 minutes), or an oral examination (approx. 20 minutes); the module exam is not evaluated separately.		
Course language:		German		
Mandatory regular participation:		Yes		
Total working time requirement:		150 hours	5 CP	
Duration of module:		Two semesters		
Frequency of course offering:		Each winter semester		
Applicability:		Master's degree program in Informatics		

Module: Project Management - Advanced module

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Lecturer for the module

Admission requirements: Foundations of managing IT projects or equivalent knowledge

Qualification objectives:

Students fully understand the processes of project management and are able to apply them. They can define, estimate, and arrange tasks, as well as place them in a project plan. They can monitor a project that is in progress. They can appropriately use many functions of a software tool (e.g. MS Project). They can work in management of a project and take responsibility for every aspect of project management. They can independently manage a small project.

Contents:

Principles, methods, and procedures within project management that go beyond process and cost planning, and control based on recognized methodology (e.g. “Project Management Body of Knowledge” (PMBoK)). The event focuses on the topic areas of project management that are relevant alongside project planning and monitoring with regard to the process and the costs.

– Project Organization
– Integration of a project into the organization carrying it out
– Leading without formal power
– Project Communication
– Leading a project team
– Quality management
– Professional Responsibility

Planning methodology from “Foundations of Project Management” and application of MS Project is covered at a more advanced level.

Together with the “Foundations of Project Management” module, this module therefore completes all fields of activity for an assistant in project management and provides the necessary knowledge for managing smaller projects.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Tuition in seminars	2	Regular contributions to discussion, a presentation, work on assigned exercises, homework	On-campus time	30
			Preparation and follow-up	45
			Homework	45
			Examination preparation and examination	30
Module exam:		Written exam (60 minutes), the written exam can also be carried out in the form of an electronic examination (60 minutes), or an oral examination (approx. 20 minutes); the module exam is not evaluated separately.		
Course language:		German		
Mandatory regular participation:		Yes		
Total working time requirement:		150 hours	5 CP	
Duration of module:		One semester		
Frequency of course offering:		Each summer semester		
Applicability:		Master's degree program in Informatics		

Module: Computer security

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students are able to

- name typical attacks on data and IT security and also estimate their potential for damage depending on the application,
- name principles, methods, and mechanisms for protecting systems, and also describe the areas in which they are used,
- analyze systems with regard to their security features when aware of potential security issues,
- take security concerns into account when developing software even when defining the requirements and ultimately also during the whole development process
- technically implement operational security guidelines and data protection guidelines; they know the provisions of data protection law.

Contents:

Basic terminology: Protection objective, security mechanisms, implementing security requirements, system security versus network security. Societal context: Historical, political, evaluation, and certification. Typical attacks: Trojan horses, salami tactics, secret doors, viruses, worms, logic bombs, hidden leaks, exploitation of software quality issues (e.g. buffer overflow).

Access controls: Passwords, backup cards, biometry. Access protection: Memory protection, authorization of a procedure, file protection, capabilities, modeling, role-based access protection, access protection strategies, access protection in programming languages, security mechanisms in Java, application-based security systems (databases, CORBA). Monitoring systems: Auditing, Intrusion Detection.

Information flow control: Elements of information theory, information flow between objects, security classes, multi-stage security, flow-secure programs, access protection and flow control (Bell-LaPadula model, Chinese Wall model). Security mechanisms in local networks: Access control via Sun NIS, remote usage (telnet, ssh), access protection in distributed file systems. Cryptography: Basic terms, transposition encryption, substitution encryption, security of encryption processes, polyalphabetic substitution, secure block encryption, asymmetric encryption (knapsack, RSA); authentication, digital signatures, hash codes, DSS. Cryptographic protocols: Elementary protocols, key management, Diffie-Hellman, certificates, PKI, PGP, authentication services (Kerberos, Sesame). Secure end systems: Trusted Computing: TCG, TPM, Secure Booting, Pro&Contra, DRM.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	4	Regular written work on assigned exercise sheets Two oral presentations regarding the solution to an exercise	On-campus time L	60
			Preparation and follow-up L	90
Exercise	2		On-campus time E	30
			Preparation and follow-up E	60
			Examination preparation and examination	60
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		300 hours	10 CP	
Duration of module:		One semester		
Frequency of course offering:		Each winter semester		
Applicability:		Master's degree program in Informatics		

Module: Semantic business process management

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students can practically handle standards of modern semantic business process management (BPM) as well as BPM tools. They can model and implement business processes and web services. They master methods and techniques at the interface between business process management and corporate semantic web.

Contents:

Semantic business process management is a connection of corporate semantic web technologies such as rules, complex events and ontologies, along with business process management. This combination enables the search to be largely automated, the configuration and composition of suitable process components, information objects and services for specific objectives, automatic switching between various heterogeneous interfaces and abstraction levels, targeted complex requests of the process area and, in general, much more agile process management. The exercise improves knowledge of business process management (BPM) and enterprise IT service management (ITSM) with a focus on the combination of BPM with corporate semantic web (CSW) technologies (rules, ontologies). Methods of modeling, representation, and implementation technologies are covered (e.g. SOA, SOC, SWS, EDA, CEP, CSW, SBMP, EDBPM, ESB). Tools and industry standards are introduced and rehearsed in a manner relating to practice (e.g. ITIL, BS 15000, BPMN, BPDM BPEL, RuleML/RIF, PRR, SBVR, OWL).

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	2	Regular written work on assigned exercise sheets Two oral presentations regarding the solution to an exercise	On-campus time L	30
			Preparation and follow-up L	30
Exercise	2		On-campus time E	30
			Preparation and follow-up E	30
			Examination preparation and examination	30
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		150 hours	5 CP	
Duration of module:		One semester		
Frequency of course offering:		Each summer semester		
Applicability:		Master's degree program in Informatics		

Module: Software Processes

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students are aware of various process strategies and tools for different tasks and situations. They can evaluate software processes regarding suitability for stated development objectives. They can analyze software processes and make appropriate suggestions for improvement.

Contents:

Quantification in the software process: Measurements and dimensions. Typical processes such as, for example, agile processes (particularly extreme programming), processes for highly reliable software (particularly cleanroom software engineering), processes for distributed collaboration with volunteers (open source development). Error prevention strategies:

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	2	Regular written work on assigned exercise sheets Two oral presentations regarding the solution to an exercise	On-campus time L	30
			Preparation and follow-up L	30
Exercise	2		On-campus time E	30
			Preparation and follow-up E	30
			Examination preparation and examination	30
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		150 hours	5 CP	
Duration of module:		One semester		
Frequency of course offering:		Two-yearly in the winter semester		
Applicability:		Master's degree program in Informatics		

Module: Compiler construction

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students are aware of the essential phases of a compiler and have mastered the general techniques for each phase. They can use the techniques behind compiler construction in other application areas as well.

Contents:

A compiler is a program that transforms a program in one programming code into another programming code (generally machine code). Generally, compiling takes place in several phases, where the most important phases are lexical analysis, syntax analysis, semantic analysis, and code generation. The source program is transformed into a computer-based representation (abstract syntax tree) with the aid of lexical and syntactic analysis. This representation is then used as a starting point for optimization and for code generation. The process covered here is used in many areas of informatics. This is why this topic is also of interest to listeners who have no intention of writing a compiler.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	4	Regular written work on assigned exercise sheets Two oral presentations regarding the solution to an exercise	On-campus time L	60
			Preparation and follow-up L	60
Exercise	2		On-campus time E	30
			Preparation and follow-up E	90
			Examination preparation and examination	60
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		300 hours	10 CP	
Duration of module:		One semester		
Frequency of course offering:		Two-yearly		
Applicability:		Master's degree program in Informatics		

Module: Distributed systems

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students are able to

- describe the principles and architectures of distributed systems, particularly the principle of distribution abstraction,
- analyze the architecture of distributed systems and identify systems that are offered by operating systems, middleware, and distributed applications,
- describe several specific examples of middleware as well as compare them,
- name typical distributed algorithms and state where they are used,
- assess the importance of data replication with regard to applications and compare typical replication techniques,
- develop distributed applications using sockets, remote calls, and web technology.

Contents:

Introduction and overview Why distributed systems? Problem areas and solutions. Communications systems: Communication networks, services, and protocols, classification of communication services, communication services of the operating system (pipes, message queues, sockets), communication platforms (PVM, MPI). Network services in the Internet: Standard services, remote creation of procedures. Architecture of distributed systems: Data flow architecture versus client/server architecture versus distributed algorithms. Distributed algorithms: Time and causality, group communication, selection algorithms, block synchronization, probe using echoes, routing in Internet. Distributed data management: Replication, consistency (different variants), caching, distributed, virtual memory, object caching, distributed transactions. Fault tolerance: Terminology and fault classification, replication with voting, dispersed agreement, Byzantine fault. Distribution abstraction: Remote calls (principles, Java RMI, NET remoting), mobile code, mobile objects, replicated objects. Distributed directory services (NIS, DNS).

Middleware: Sun RPC, COMANDOS, COM/DCOM, CORBA, .NET, WWW, web services, message-oriented middleware (IBM MQSeries, CORBA Notification Service, Java Message Service, SIENA).

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	2	Regular written work on assigned exercise sheets Two oral presentations regarding the solution to an exercise	On-campus time L	30
			Preparation and follow-up L	30
Exercise	2		On-campus time E	30
			Preparation and follow-up E	30
			Examination preparation and examination	30
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		150 hours	5 CP	
Duration of module:		One semester		
Frequency of course offering:		Two-yearly		
Applicability:		Master's degree program in Informatics		

Module: XML technologies

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students have advanced knowledge of fundamental XML technologies. This means, in particular, that they can assess their value for the web of the future as well as their limitations.

Contents:

Extensible Markup Language (XML) is the new language of the web. Whilst it won't replace HTML, it will supplement it in one important area: Whilst HTML was developed for presentation of electronic documents (human-machine communication), XML is particularly suitable for data exchange between computers. XML enables definition of specific data exchange formats (standards) as well as simple combination and expansion of such standards. Together with widespread support from the software industry, this enables XML to be quickly spread across the web. XML applications can be found nowadays, amongst other things, in Microsoft's .NET architecture and in e-business.

The following themes are covered:

– Origins of XML
– Structuring of contents using XML
– Namespaces
– Description of documents and data (DTD and XML schema)
– Processing of XML data (DOM and SAX parser)
– Transformation of documents (XSLT)
– XML and databases
– Web services (SOAP, WSDL)
– Semantic web (RDF, RDFS)

Medium-sized examples are used to show how these technologies can be expediently used. At the same time, the knowledge acquired from the lectures are deepened via the corresponding standards.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	2	Regular written work on assigned exercise sheets Two oral presentations regarding the solution to an exercise	On-campus time L	30
			Preparation and follow-up L	30
Exercise	2		On-campus time E	30
			Preparation and follow-up E	30
			Examination preparation and examination	30
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		150 hours	5 CP	
Duration of module:		One semester		
Frequency of course offering:		Each summer semester		
Applicability:		Master's degree program in Informatics		

Module: Practices of professional software development

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students know and understand various practices and can explain the fundamental ideas and purposes behind them. They have practical skills in applying these practices and can evaluate when, and to what extent, the use of which of these practices is expedient.

Contents:

Topic of development practices: Specific features of general principles in software technology in procedures and procedure elements that could affect all task fields in the initial and continued development of software (e.g. determining requirements, specification, project planning, project monitoring and coordination, software design, implementation, optimization, documentation, testing, program understanding, re-engineering, quality management, operation). The practices can fit either largely plan-driven, largely agile, or both development styles. A range of such practices is introduced, discussed together, then tried out, practiced, and then criticized.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Method course	2	Participation in discussion	On-campus time MC	30
			Preparation and follow-up MC	30
Practical seminar	2	Presentation of own Work and results on the topic of the relevant coursework	On-campus time PS	30
			Preparation and follow-up PS	60

Module exam:	None	
Course language:	German	
Mandatory regular participation:	Yes	
Total working time requirement:	150 hours	5 CP
Duration of module:	One semester	
Frequency of course offering:	Two-yearly in the winter semester	
Applicability:	Master's degree program in Informatics	

Module: Software project - Practical computer science A

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students master shared development of complex software systems within the field of practical informatics. They can independently divide a larger project into sub-projects, define suitable interfaces, and draw up a schedule. They can organize themselves within a team and take on a leadership role. They also take gender and diversity aspects into account. From their own experience, they have an advanced understanding of quality, expense, acceptance, and success factors and also master communication techniques (oral, written) both internally for successful planning and coordination of the above activities in a project team, as well as for negotiating with an external client (as a client project). They can confidently use methods of project management and software development, particularly in the areas of design and implementation (defining requirements, specification, architecture design, module design, technology selection, implementation).

Contents:

The software project may have differing focuses. In a team, students produce a complex piece of software to solve an application or system-oriented task from the field of practical informatics, such as building a compiler, artificial intelligence (machine learning, computer vision, or pattern recognition), data management or web technologies.

The module is carried out at the same time as the module of the same name from the Bachelor's degree program. The teams consist of a mixture of Bachelors and Masters students, where Masters students take on leadership positions.

Every team goes through the phases of a software project and practices the methods and aids found within software technology, particularly the definition, coordination, and documentation of interfaces; contribution to team-driven creation of software components (if using interfaces that are not yet implemented); assessment and handling technology or larger software components that are still unfamiliar (recycling).

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)
Project seminar	2	Ongoing reports regarding the state of the project, regular presentation of interim results	On-campus time 30 Software development 240 Preparation of presentations and documentation 30

Module exam:	Presentation (ca. 15 minutes) or poster presentation (ca. 15 minutes)	
Course language:	German (English if necessary)	
Mandatory regular participation:	Yes	
Total working time requirement:	300 hours	10 CP
Duration of module:	One semester	
Frequency of course offering:	At least once per year, partly during the semester and partly during the time between terms as a block course.	
Applicability:	Master's degree program in Informatics	

Module: Software project - Practical computer science B

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students master shared development of complex software systems within the field of practical informatics. They can independently divide a larger project into sub-projects, define suitable interfaces, and draw up a schedule. They can organize themselves within a team and take on a leadership role. They also take gender and diversity aspects into account. From their own experience, they have an advanced understanding of quality, expense, acceptance, and success factors and also master communication techniques (oral, written) both internally for successful planning and coordination of the above activities in a project team, as well as for negotiating with an external client (as a client project). They can confidently apply methods from project management and software development, particularly within the field of quality assurance (testing, inspection, process management, project management, re-engineering).

Contents:

The software project may have differing focuses. In a team, students produce a complex piece of software to solve an application or system-oriented task from the field of practical informatics, such as building a compiler, artificial intelligence (machine learning, computer vision, or pattern recognition), data management or web technologies.

The module is performed at the same time as the module of the same name from the bachelor's degree program in Informatics from the Faculty of Mathematics and Informatics at Freie Universität Berlin. The teams consist of a mixture of Bachelors and Masters students, where Masters students take on leadership positions.

Every team covers the phases of a software project, and practices using the methods and tools within software technology, particularly when looking at requirements, interfaces, implementations, test cases; testing (module tests, integration tests, system tests) and version and configuration management.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)
Project seminar	2	Ongoing reports regarding the state of the project, regular presentation of interim results	On-campus time 30 Software development 240 Preparation of presentations and documentation 30

Module exam:	Presentation (ca. 15 minutes) or poster presentation (ca. 15 minutes); the module exam is not evaluated separately.	
Course language:	German (English if necessary)	
Mandatory regular participation:	Yes	
Total working time requirement:	300 hours	10 CP
Duration of module:	One semester	
Frequency of course offering:	At least once per year, partly during the semester and partly during the time between terms as a block course.	
Applicability:	Master's degree program in Informatics	

Module: Scientific work within practical informatics A

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students can independently acquaint themselves with a topic within practical informatics based on original scientific literature and, if required, gain additional background knowledge. They can also clearly convey a demanding topic in an oral presentation. In this case they can emphasize essential elements relative to less important ones, set individual statements out in relation to each other and summarize their core content. They can consciously select and use suitable forms of presentation and media. They are prepared to ask questions in case of ambiguity, can participate in a discussion regarding economic issues, and can also provide criticism in an objective manner. At the same time, students acquire more in-depth knowledge within a specific area in informatics and are prepared for research work as is required for a Master's thesis.

Contents:

The module has differing focuses within the field of practical informatics (e.g. software engineering, database systems, data management, security within information technology, artificial Intelligence, modern web technologies)

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Advanced seminar	2	Oral presentation, written summary, regular discussion contributions	On-campus time AS	30
			Preparation and follow-up AS	60
			Examination preparation and examination	60

Module exam:	Written summary (ca. 4,500 words) with oral presentation (ca. 45 minutes); the module exam is not evaluated separately.	
Course language:	German (English if necessary)	
Mandatory regular participation:	Yes	
Total working time requirement:	150 hours	5 CP
Duration of module:	One semester	
Frequency of course offering:	Each semester	
Applicability:	Master's degree program in Informatics	

Module: Scientific work within practical informatics B

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students can independently acquaint themselves with a topic within practical informatics based on original scientific literature and, if required, gain additional background knowledge. They can also clearly convey a demanding topic in an oral presentation. In this case they can emphasize essential elements relative to less important ones, set individual statements out in relation to each other and summarize their core content. They can consciously select and use suitable forms of presentation and media. They are prepared to ask questions in case of ambiguity, can participate in a discussion regarding economic issues, and can also provide criticism in an objective manner. At the same time, students acquire more in-depth knowledge within a specific area in informatics and are prepared for research work as is required for a Master's thesis.

Contents:

The module has differing focuses within the field of practical informatics (e.g. software engineering, database systems, data management, security within information technology, artificial Intelligence, modern web technologies)

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)
Advanced seminar	2	Oral presentation, written summary, regular discussion contributions	On-campus time AS 30 Preparation and follow-up AS 60 Examination preparation and examination 60
Module exam:		Written summary (ca. 4,500 words) with oral presentation (ca. 45 minutes); the module exam is not evaluated separately.	
Course language:		German (English if necessary)	
Mandatory regular participation:		Yes	
Total working time requirement:		150 hours	5 CP
Duration of module:		One semester	
Frequency of course offering:		Each semester	
Applicability:		Master's degree program in Informatics	

Module: Current research topics in practical computer science

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students can apply the main terminology and techniques of a current research area within the field of practical informatics.

Contents:

This module, with changing content, provides an insight into one of the research topics that is covered in current projects at the Institute for Informatics.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	2	Work on assigned exercise sheets Oral presentation of the solution to selected tasks in the exercise	On-campus time L	30
			Preparation and follow-up L	30
Exercise	2		On-campus time E	30
			Preparation and follow-up E	30
			Examination preparation and examination	30
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		150 hours	5 CP	
Duration of module:		One semester		
Frequency of course offering:		Alternating, generally at least every second semester		
Applicability:		Master's degree program in Informatics		

Module: Special aspects of Practical Computer Science			
University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics			
Persons responsible for module: Module Instructors			
Admission requirements: None			
Qualification objectives: Students can apply the main terminology and results of a selected field in practical informatics.			
Contents: The module provides insight into a selected field within practical informatics such as in semantic modeling or transactional systems. In addition, it also covers research questions and application areas.			
Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)
Lecture	2	Regular written work on assigned exercise sheets Two oral presentations regarding the solution to a task in the exercise	On-campus time L 30 Preparation and follow-up L 30 On-campus time E 30 Preparation and follow-up E 30 Examination preparation and examination 30
Exercise	2		
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)	
Course language:		German (English if necessary)	
Mandatory regular participation:		Participation recommended	
Total working time requirement:		150 hours	5 CP
Duration of module:		One semester	
Frequency of course offering:		Two-yearly	
Applicability:		Master's degree program in Informatics	

Module: Special aspects of data management

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students can apply the main terminology and results of a selected field in practical informatics within the field of data management.

Contents:

The module provides an insight into a selected area of data management, such as in spatial databases, location-based services, information retrieval, XML data management, data mining and text mining, or transaction processing. In addition, it also covers research questions and application areas.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	2	Regular written work on assigned exercise sheets Two oral presentations regarding the solution to a task in the exercise	On-campus time L	30
			Preparation and follow-up L	30
Exercise	2		On-campus time E	30
			Preparation and follow-up E	30
			Examination preparation and examination	30
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		150 hours	5 CP	
Duration of module:		One semester		
Frequency of course offering:		Two-yearly		
Applicability:		Master's degree program in Informatics		

Module: Special aspects of software development			
University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics			
Persons responsible for module: Module Instructors			
Admission requirements: None			
Qualification objectives: Students can apply the main terminology and results of a selected field in practical informatics within the field of software engineering.			
Contents: The module provides insight into a selected field within software technology, such as in model-driven software development, software processes, system software, or open-source software development. In addition, it also covers research questions and application areas.			
Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)
Lecture	2	Regular written work on assigned exercise sheets Two oral presentations regarding the solution to a task in the exercise	On-campus time L 30 Preparation and follow-up L 30 On-campus time E 30 Preparation and follow-up E 30 Examination preparation and examination 30
Exercise	2		
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)	
Course language:		German (English if necessary)	
Mandatory regular participation:		Participation recommended	
Total working time requirement:		150 hours	5 CP
Duration of module:		One semester	
Frequency of course offering:		Two-yearly	
Applicability:		Master's degree program in Informatics	

Module: Selected topics in Practical Computer Science

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students know the fundamentals in a special area or an application area of practical informatics. They can safely apply what they have learned.

Contents:

Changing contents, e.g. advanced aspects of programming languages, of operating systems, of databases, or of software technology.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	4	Work on assigned exercise sheets Oral presentation of the solution to selected tasks	On-campus time L	60
			Preparation and follow-up L	60
Exercise	2		On-campus time E	30
			Preparation and follow-up E	60
			Examination preparation and examination	30
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		300 hours	10 CP	
Duration of module:		One semester		
Frequency of course offering:		Two-yearly		
Applicability:		Master's degree program in Informatics		

2. Field of study - Theoretical computer science

<table>
<tr><td colspan="4">Module: Higher algorithmics</td></tr>
<tr><td colspan="4">University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics</td></tr>
<tr><td colspan="4">Persons responsible for module: Module Instructors</td></tr>
<tr><td colspan="4">Admission requirements: None</td></tr>
<tr><td colspan="4">Qualification objectives:
Students master common design techniques for algorithms and can design algorithms using them. They can analyze algorithms with regard to their runtime and memory requirements, and also use advanced analytical methods. They understand the theory of NP-completeness. They know current complexity classes and can assign simple problems with regard to complexity.</td></tr>
<tr><td colspan="4">Contents:
Topics such as:
– path and flow problems in graphs,
– string matching,
– randomized algorithms,
– amortized analysis,
– the “master theory” for analysis of divide and rule recursive equations,
– NP-completeness,
– Approximation algorithms for severe problems,
– Number-theoretical algorithms (including RSA cryptosystem),
– Arithmetic algorithms and circuits are covered as well as quick Fourier transforms.</td></tr>
<tr><td>Forms of teaching and learning</td><td>On-campus studies
(hours per semester week = SWH)</td><td>Forms of active participation</td><td>Work effort
(hours)</td></tr>
<tr><td>Lecture</td><td>4</td><td rowspan="2">Work on assigned exercise sheets
Two oral presentations regarding the solution to a task in the exercise</td><td rowspan="2">On-campus time L 60
Preparation and follow-up L 70
On-campus time E 30
Preparation and follow-up E 80
Examination preparation and examination 60</td></tr>
<tr><td>Exercise</td><td>2</td></tr>
<tr><td colspan="2">Module exam:</td><td colspan="2">Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)</td></tr>
<tr><td colspan="2">Course language:</td><td colspan="2">German (English if necessary)</td></tr>
<tr><td colspan="2">Mandatory regular participation:</td><td colspan="2">Participation recommended</td></tr>
<tr><td colspan="2">Total working time requirement:</td><td>300 hours</td><td>10 CP</td></tr>
<tr><td colspan="2">Duration of module:</td><td colspan="2">One semester</td></tr>
<tr><td colspan="2">Frequency of course offering:</td><td colspan="2">Each winter semester</td></tr>
<tr><td colspan="2">Applicability:</td><td colspan="2">Master's degree program in Informatics</td></tr>
</table>

Module: Model checking

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: Successful conclusion of the Higher Algorithmics module

Qualification objectives:

Students can independently model systems, protocols, and distributed algorithms, formalize requirements in temporal logic, develop real-time models, and formulate real-time requirements. They are able to find suitable abstractions for the requirements and demonstrate the specifications with the aid of a model checker.

Contents:

– Difference between programming and modeling

– Modeling reactive systems in SPIN and Promela

– Specification of requirements in temporal logic

– Automatic theoretical models of systems and specifications

– Decision-making process for temporal logic

– Symbolic model checking and binary decision-making charts

– Model checking with NuSMV

– Automatic models with time

– Model checking timed machines with Uppaal

– Formal methods of abstraction and evidence of the resulting features.

Mini project: A non-sequential system or a non-sequential algorithm should be independently modeled, its requirements should be formalized, then the model should be verified with regard to its requirements with the aid of suitable model checkers. This is documented by submission of the models and a written report.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	2	Work on assigned exercises and work on a mini-project	On-campus time L	30
			Preparation and follow-up L	30
Exercise	2		On-campus time E	30
			Preparation and follow-up E	30
Project seminar	2		On-campus time PrS	30
			Preparation and follow-up PrS	30
			Examination preparation and examination	120
Module exam:		Project report (approx. 20 pages) with oral presentation (approx. 15 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		300 hours	10 CP	
Duration of module:		One semester		
Frequency of course offering:		Each winter semester		
Applicability:		Master's degree program in Informatics		

<table>
<tr><td colspan="4">Module: Current research topics in theoretical computer science</td></tr>
<tr><td colspan="4">University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics</td></tr>
<tr><td colspan="4">Persons responsible for module: Module Instructors</td></tr>
<tr><td colspan="4">Admission requirements: None</td></tr>
<tr><td colspan="4">Qualification objectives:
Students can apply the main terminology and techniques of a current research area within he field of theoretical informatics.</td></tr>
<tr><td colspan="4">Contents:
This module, with changing content, provides an insight into one of the research topics that is covered in current projects at the Institute for Informatics.</td></tr>
<tr><td>Forms of teaching and learning</td><td>On-campus studies
(hours per semester week = SWH)</td><td>Forms of active participation</td><td>Work effort
(hours)</td></tr>
<tr><td>Lecture</td><td>2</td><td rowspan="2">Work on assigned exercise sheets
Oral presentation of the solution to selected tasks in the exercise</td><td rowspan="2">On-campus time L 30
Preparation and follow-up L 30
On-campus time E 30
Preparation and follow-up E 30
Examination preparation and examination 30</td></tr>
<tr><td>Exercise</td><td>2</td></tr>
<tr><td colspan="2">Module exam:</td><td colspan="2">Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)</td></tr>
<tr><td colspan="2">Course language:</td><td colspan="2">German (English if necessary)</td></tr>
<tr><td colspan="2">Mandatory regular participation:</td><td colspan="2">Participation recommended</td></tr>
<tr><td colspan="2">Total working time requirement:</td><td>150 hours</td><td>5 CP</td></tr>
<tr><td colspan="2">Duration of module:</td><td colspan="2">One semester</td></tr>
<tr><td colspan="2">Frequency of course offering:</td><td colspan="2">Alternating, generally at least every second semester</td></tr>
<tr><td colspan="2">Applicability:</td><td colspan="2">Master's degree program in Informatics</td></tr>
</table>

Module: Algorithmic geometry

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: Successful conclusion of the Higher Algorithmics module

Qualification objectives:

Students can analyze the fundamentals of algorithmic geometry and geometric problems, as well as apply algorithmic methods to practical problems with a geometric background.

Contents:

Efficient algorithms for geometric problems, such as finding the convex hull of a set of points, Voronoi diagrams, geometrical data structures, such as for finding a point in a level sub-division. Applications in computer graphics, pattern and form recognition, geographical information systems, CAD, etc.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	4	Written work on assigned exercise sheets Oral presentation of the solution to selected tasks in the exercise	On-campus time L	60
			Preparation and follow-up L	60
Exercise	2		On-campus time E	30
			Preparation and follow-up E	90
			Examination preparation and examination	60
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		300 hours	10 CP	
Duration of module:		One semester		
Frequency of course offering:		Two-yearly		
Applicability:		Master's degree program in Informatics		

<table>
<tr><td colspan="4">Module: Selected topics in Theoretical Computer Science</td></tr>
<tr><td colspan="4">University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics</td></tr>
<tr><td colspan="4">Persons responsible for module: Module Instructors</td></tr>
<tr><td colspan="4">Admission requirements: None</td></tr>
<tr><td colspan="4">Qualification objectives:
Students know the fundamentals in a special area or an application area of theoretical informatics, and algorithmics in particular. They can safely apply what they have learned.</td></tr>
<tr><td colspan="4">Contents:
Changing contents, e.g.
– Data compression
– External algorithms and data structures
– Online algorithms</td></tr>
<tr><td>Forms of teaching and learning</td><td>On-campus studies
(hours per semester week = SWH)</td><td>Forms of active participation</td><td>Work effort
(hours)</td></tr>
<tr><td>Lecture</td><td>4</td><td rowspan="2">Work on assigned exercise sheets, oral presentation of the solution to selected tasks in the exercise</td><td rowspan="2">On-campus time L 60
Preparation and follow-up L 60
On-campus time E 30
Preparation and follow-up E 90
Examination preparation and examination 60</td></tr>
<tr><td>Exercise</td><td>2</td></tr>
<tr><td colspan="2">Module exam:</td><td colspan="2">Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)</td></tr>
<tr><td colspan="2">Course language:</td><td colspan="2">German (English if necessary)</td></tr>
<tr><td colspan="2">Mandatory regular participation:</td><td colspan="2">Participation recommended</td></tr>
<tr><td colspan="2">Total working time requirement:</td><td>300 hours</td><td>10 CP</td></tr>
<tr><td colspan="2">Duration of module:</td><td colspan="2">One semester</td></tr>
<tr><td colspan="2">Frequency of course offering:</td><td colspan="2">Two-yearly</td></tr>
<tr><td colspan="2">Applicability:</td><td colspan="2">Master's degree program in Informatics</td></tr>
</table>

Module: Advanced topics in Theoretical Computer Science

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students are aware of advanced methods and terminology in a field of theoretical informatics and can apply these.

Contents:

Changing contents, e.g.

– Approximation algorithms
– External algorithms and data structures
– Advanced data structures
– Graph algorithms
– Combinatorial optimization
– Randomized algorithms

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	4	Work on assigned exercise sheets, oral presentation of the solution to selected tasks in the exercise	On-campus time L	60
			Preparation and follow-up L	60
Exercise	2		On-campus time E	30
			Preparation and follow-up E	90
			Examination preparation and examination	60

Module exam:	Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)	
Course language:	German (English if necessary)	
Mandatory regular participation:	Participation recommended	
Total working time requirement:	300 hours	10 CP
Duration of module:	One semester	
Frequency of course offering:	Two-yearly	
Applicability:	Master's degree program in Informatics	

<table>
<tr><td colspan="4">Module: Special aspects of Theoretical Computer Science</td></tr>
<tr><td colspan="4">University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics</td></tr>
<tr><td colspan="4">Persons responsible for module: Module Instructors</td></tr>
<tr><td colspan="4">Admission requirements: None</td></tr>
<tr><td colspan="4">Qualification objectives:
Students can apply the main terminology and results of a selected field in theoretical informatics.</td></tr>
<tr><td colspan="4">Contents:
The module provides an insight into a selected area of theoretical informatics, such as into advanced aspects of complexity theory, algorithmics, or the theory of programming languages. In addition, it also covers research questions and application areas.</td></tr>
<tr><td>Forms of teaching and learning</td><td>On-campus studies
(hours per semester week = SWH)</td><td>Forms of active participation</td><td>Work effort
(hours)</td></tr>
<tr><td>Lecture</td><td>2</td><td rowspan="2">Regular written work on assigned exercise sheets
Two oral presentations regarding the solution to a task in the exercise</td><td rowspan="2">On-campus time L 30
Preparation and follow-up L 30
On-campus time E 30
Preparation and follow-up E 30
Examination preparation and examination 30</td></tr>
<tr><td>Exercise</td><td>2</td></tr>
<tr><td colspan="2">Module exam:</td><td colspan="2">Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)</td></tr>
<tr><td colspan="2">Course language:</td><td colspan="2">German (English if necessary)</td></tr>
<tr><td colspan="2">Mandatory regular participation:</td><td colspan="2">Participation recommended</td></tr>
<tr><td colspan="2">Total working time requirement:</td><td>150 hours</td><td>5 CP</td></tr>
<tr><td colspan="2">Duration of module:</td><td colspan="2">One semester</td></tr>
<tr><td colspan="2">Frequency of course offering:</td><td colspan="2">Two-yearly</td></tr>
<tr><td colspan="2">Applicability:</td><td colspan="2">Master's degree program in Informatics</td></tr>
</table>

Module: Cryptology and security in distributed systems

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students are aware of the fundamentals of modern cryptology, cryptographic protocols and their application for securing distributed systems. They recognize and understand weak points in the design and application of cryptological primitives that could compromise the integrity, confidentiality, and availability of information.

Contents:

The module is an introduction to cryptography and cryptographic key management, as well as to cryptographic protocols: and their application in the field of security in distributed systems. Mathematical tools are developed in the required scope that is appropriate for an introductory session. In addition, awareness is enhanced for the importance of implementation details for system security.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	4	Work on assigned exercise sheets, two oral presentations regarding the solution to a task in the exercise	On-campus time L	60
			Preparation and follow-up L	70
Exercise	2		On-campus time E	30
			Preparation and follow-up E	80
			Examination preparation and examination	60
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		300 hours	10 CP	
Duration of module:		One semester		
Frequency of course offering:		Each winter semester		
Applicability:		Master's degree program in Informatics		

Module: Semantics of programming languages

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students formalize informal descriptions of program language-related concepts in an appropriate manner and can confidently handle such formalizations.

Contents:

The module covers techniques for the formalization of semantics (meaningful contents) of programming languages. Initially, various formalization approaches (operational, denotational, and axiomatic semantics) are introduced and discussed. The mathematical theory of the semantic areas that is applied in the denotational method is then covered. Afterwards, a comprehensive, imperative programming language is gradually developed and the semantics of individual language elements is denotationally specified. In this case continuation semantics will be systematically explained and used. Finally, applications of these techniques is covered, particularly as part of building compilers and as the foundation for developing functional programming languages. In this case, the special role of verifying program features and transformations that retain semantics is emphasized.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	2	Regular written work on assigned exercise sheets Two oral presentations regarding the solution to a task in the exercise	On-campus time L	30
			Preparation and follow-up L	30
Exercise	2		On-campus time E	30
			Preparation and follow-up E	30
			Examination preparation and examination	30
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		150 hours	5 CP	
Duration of module:		One semester		
Frequency of course offering:		Two-yearly		
Applicability:		Master's degree program in Informatics		

Module: Software project - Theoretical computer science A

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students master shared development of complex software systems within the field of theoretical informatics. They can independently divide a larger project into sub-projects, define suitable interfaces, and draw up a schedule. They can organize themselves within a team and take on a leadership role. They also take gender and diversity aspects into account. From their own experience, they have an advanced understanding of quality, expense, acceptance, and success factors and also master communication techniques (oral, written) both internally for successful planning and coordination of the above activities in a project team, as well as for negotiating with an external client. They can confidently use methods of project management and software development, particularly in the areas of design and implementation (defining requirements, specification, architecture design, module design, technology selection, implementation).

Contents:

The software project may have differing focuses. In a team, students produce a complex piece of software to solve an application or system-oriented task from the field of theoretical informatics, such as practical application of algorithms (geometric tasks, computer graphics, pattern recognition, computer vision, data compression).

The module is carried out at the same time as the module of the same name from the Bachelor's degree program. The teams consist of a mixture of Bachelors and Masters students, where Masters students take on leadership positions.

Every team goes through the phases of a software project and practices the methods and aids found within software technology, particularly the definition, coordination, and documentation of interfaces; contribution to team-driven creation of software components (if using interfaces that are not yet implemented); assessment and handling technology or larger software components that are still unfamiliar (recycling).

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)
Project seminar	2	Ongoing reports regarding the state of the project, regular presentation of interim results	On-campus time 30 Software development 240 Preparation of presentations and documentation 30
Module exam:		Presentation (ca. 15 minutes) or poster presentation (ca. 15 minutes)	
Course language:		German (English if necessary)	
Mandatory regular participation:		Yes	
Total working time requirement:		300 hours	10 CP
Duration of module:		One semester	
Frequency of course offering:		At least once per year, partly during the semester and partly during the time between terms as a block course.	
Applicability:		Master's degree program in Informatics	

Module: Software project - Theoretical computer science B

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students master shared development of complex software systems within the field of theoretical informatics. They can independently divide a larger project into sub-projects, define suitable interfaces, and draw up a schedule. They can organize themselves within a team and take on a leadership role. They also take gender and diversity aspects into account. From their own experience, they have an advanced understanding of quality, expense, acceptance, and success factors and also master communication techniques (oral, written) both internally for successful planning and coordination of the above activities in a project team, as well as for negotiating with an external client. They can confidently apply methods from project management and software development, particularly within the field of quality assurance (testing, inspection, process management, project management, re-engineering).

Contents:

The software project may have differing focuses. In a team, students produce a complex piece of software to solve an application or system-oriented task from the field of theoretical informatics, such as practical application of algorithms (geometric tasks, computer graphics, pattern recognition, computer vision, data compression).

The module is carried out at the same time as the module of the same name from the Bachelor's degree program. The teams consist of a mixture of Bachelors and Masters students, where Masters students take on leadership positions.

Every team covers the phases of a software project, and practices using the methods and tools within software technology, particularly when looking at requirements, interfaces, implementations, test cases, as well as testing (module tests, integration tests, system tests) and version and configuration management.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)
Project seminar	2	Ongoing reports regarding the state of the project, regular presentation of interim results	On-campus time 30 Software development 240 Preparation of presentations and documentation 30
Module exam:		Presentation (ca. 15 minutes) or poster presentation (ca. 15 minutes); the module exam is not evaluated separately.	
Course language:		German (English if necessary)	
Mandatory regular participation:		Yes	
Total working time requirement:		300 hours	10 CP
Duration of module:		One semester	
Frequency of course offering:		Regularly, alternating with the other software projects, partially during the semester and partially in the time between terms as a block course	
Applicability:		Master's degree program in Informatics	

Module: Scientific work within theoretical informatics A

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students can independently acquaint themselves with a topic within theoretical informatics based on original scientific literature and, if required, gain additional background knowledge. They can also clearly convey a demanding topic in an oral presentation. In this case they can emphasize essential elements relative to less important ones, set individual statements out in relation to each other and summarize their core content. They can consciously select and use suitable forms of presentation and media. They are prepared to ask questions in case of ambiguity, can participate in a discussion regarding economic issues, and can also provide criticism in an objective manner. At the same time, students acquire more in-depth knowledge within a specific area in informatics and are prepared for research work as is required for a Master's thesis.

Contents:

The module has differing focuses within the field of theoretical informatics (e.g. algorithms, complexity, theory of programming languages).

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Advanced seminar	2	Oral presentation, written summary, regular discussion contributions	On-campus time AS Preparation and follow-up Examination preparation and examination	30 60 60
Module exam:		Written summary (ca. 4,500 words) with oral presentation (ca. 45 minutes); the module exam is not evaluated separately.		
Course language:		German (English if necessary)		
Mandatory regular participation:		Yes		
Total working time requirement:		150 hours		5 CP
Duration of module:		One semester		
Frequency of course offering:		Each semester		
Applicability:		Master's degree program in Informatics		

Module: Scientific work within theoretical informatics B

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students can independently acquaint themselves with a topic within theoretical informatics based on original scientific literature and, if required, gain additional background knowledge.

They can also clearly convey a demanding topic in an oral presentation. In this case they can emphasize essential elements relative to less important ones, set individual statements out in relation to each other and summarize their core content. They can consciously select and use suitable forms of presentation and media. They are prepared to ask questions in case of ambiguity, can participate in a discussion regarding economic issues, and can also provide criticism in an objective manner. At the same time, students acquire more in-depth knowledge within a specific area in informatics and are prepared for research work as is required for a Master's thesis.

Contents:

The module has differing focuses within the field of theoretical informatics (e.g. algorithms, complexity, theory of programming languages).

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)
Advanced seminar	2	Oral presentation, written summary, regular discussion contributions	On-campus time AS 30 Preparation and follow-up 60 Examination preparation and examination 60
Module exam:		Written summary (ca. 4,500 words) and oral presentation (ca. 45 minutes); the module exam is not evaluated separately.	
Course language:		German (English if necessary)	
Mandatory regular participation:		Yes	
Total working time requirement:		150 hours	5 CP
Duration of module:		One semester	
Frequency of course offering:		Each semester	
Applicability:		Master's degree program in Informatics	

3. Field of study - Technical computer science

Module: Operating systems

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students can describe principles, architecture, and functions of operating systems as well as carry out amendments of moderate difficulty on operating systems where the source code is available. They are able to proficiently use typical services as they are offered in current operating systems at the system interface, use these for the development of system software, and assess the usage options of operating systems for various applications. They are aware of current research trends and can estimate development trends in operating systems.

Contents:

Introduction: Operating modes, resource management, history, architecture.

System services: Process management, address space management, input/output system, interprocess communication, file management. Process management: Process descriptors, process switching, sequence control, synchronization, interrupt handling, communication. Device driver: Tasks, integration, task buffering, error handling, task control. Memory management: Address space management, process rearrangement, segmentation, virtual memory, segmented processes in virtual memory. File management: Interface of file system, illustration of files on hard disks, implementation of file management (block buffers, buffer descriptors), access protection, files as segments, persistent virtual memories. In/output: Device use, asynchronous serial interfaces, graphic display. Distributed operating systems: Distributed virtual memories, distributed file systems, mobile processes. State of the art: selected examples from current research.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	4	Work on assigned exercise sheets Two oral presentations regarding the solution to a task in the exercise	On-campus time L	60
			Preparation and follow-up L	60
Exercise	2		On-campus time E	30
			Preparation and follow-up E	90
			Examination preparation and examination	60
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		300 hours	10 CP	
Duration of module:		One semester		
Frequency of course offering:		Two-yearly		
Applicability:		Master's degree program in Informatics		

Module: Microprocessor internship

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students are able to use modern micro-controller development environments, to carry out integrated programming in Assembler and C, to process procedures whilst using the Interrupt and DMA systems, and to program different communication modules. They have mastered suitable documentation techniques.

Contents:

The overwhelming majority of future computer systems will be characterized by integrated systems that communicate with each other. These can be found in machine controls, household devices, heavy-goods vehicles, airplanes, intelligent buildings, and in the future will be increasingly integrated in networks such as the Internet. The internship will cover the systems integrated within the architecture and the differences compared to traditional PC architectures (e.g. real-time capability, interaction with environment) based on practical examples. The internship is based on 16 or 32-bit micro-controller systems. Main aspects of the internship, which is split up into individual attempts, are: Registry structures, memory organization, integrated assembler and high-level language programming, I/O system and timer programming, interrupt system, watchdog logic, analog interfaces, bus system connection of components, communication (USART, WLAN, Ethernet, ISM radio and USB), monitoring models and use of various sensor technologies.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Internship	3	Work on assigned tasks including programming, protocols with written presentation of results	On-campus time I	45
			Preparation and follow-up I	195
			Examination preparation and examination	60
Module exam:		Written summary (approx. 5 pages)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		300 hours		10 CP
Duration of module:		One semester		
Frequency of course offering:		Every winter semester		
Applicability:		Master's degree program in Informatics		

Module: Mobile communication

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students understand the differences between classic fixed networks and mobile, wireless networks, and their effects on all protocol layers. They can understand the effects, particularly of the lower layers, on protocols and applications. They access and compare new systems independently based on current systems and recognizable convergences

Contents:

The mobile communication module covers examples of all aspects of mobile and wireless communication, which currently is the strongest growth market and is becoming apparent in more aspects of society. During the whole lecture, great emphasis is placed on the system view and various cross-references are made to real systems, international standards, and current research results. Topics to be covered are: Technical fundamentals of wireless transmission: Frequencies, signals, antennas, signal dispersion, multiplex, modulation, spread spectrum, cell-based systems; media access: SDMA, FDMA, TDMA, CDMA; wireless telecommunications systems: GSM, DECT, TETRA, UMTS, IMT- 2000; satellite systems: GEO, MEO, LEO, handover; broadcast systems: Digital Audio Broadcasting, Digital Video Broadcasting; wireless local networks: Infrastructure/ad hoc, IEEE 802. 11/15, Bluetooth; mobile network layer: Mobile IP, DHCP, ad-hoc networks; mobile transport layer: traditional TCP, amended TCP variants, further mechanisms, mobility support: File systems, databases, WWW, Wireless Application Protocol, Wireless Markup Language, i-mode; outlook: 4th generation mobile networks.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)
Lecture	2	Active participation in lectures and discussions	On-campus time L 30 Preparation and follow-up L 80 Examination preparation and examination 40
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)	
Course language:		English or German	
Mandatory regular participation:		Participation recommended	
Total working time requirement:		150 hours	5 CP
Duration of module:		One semester	
Frequency of course offering:		Each summer semester	
Applicability:		Master's degree program in Informatics	

<table>
<tr><td colspan="4">Module: Robotics</td></tr>
<tr><td colspan="4">University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics</td></tr>
<tr><td colspan="4">Persons responsible for module: Module Instructors</td></tr>
<tr><td colspan="4">Admission requirements: None</td></tr>
<tr><td colspan="4">Qualification objectives:
Students master the fundamentals of robotics and are aware of selected methods for controlling robots and for autonomous learning.</td></tr>
<tr><td colspan="4">Contents:
Foundations of robotics, including: Computer vision (local, global), mechanics, energy supply, electronics, communication, control, and independent learning by robots.</td></tr>
<tr><td>Forms of teaching and learning</td><td>On-campus studies
(hours per semester week = SWH)</td><td>Forms of active participation</td><td>Work effort
(hours)</td></tr>
<tr><td>Lecture</td><td>2</td><td rowspan="2">Regular work on assigned exercises</td><td rowspan="2">On-campus time L 30
Preparation and follow-up L 30
On-campus time E 30
Preparation and follow-up E 30
Examination preparation and examination 30</td></tr>
<tr><td>Exercise</td><td>2</td></tr>
<tr><td colspan="2">Module exam:</td><td colspan="2">Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)</td></tr>
<tr><td colspan="2">Course language:</td><td colspan="2">German (English if necessary)</td></tr>
<tr><td colspan="2">Mandatory regular participation:</td><td colspan="2">Participation recommended</td></tr>
<tr><td colspan="2">Total working time requirement:</td><td>150 hours</td><td>5 CP</td></tr>
<tr><td colspan="2">Duration of module:</td><td colspan="2">One semester</td></tr>
<tr><td colspan="2">Frequency of course offering:</td><td colspan="2">Two-yearly in the winter semester (in even years)</td></tr>
<tr><td colspan="2">Applicability:</td><td colspan="2">Master's degree program in Informatics</td></tr>
</table>

Module: Telematics

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students understand the construction of communication systems both on a smaller and a larger scale. They master classic as well as new Internet technologies and can use these in practice. They can classify the problems regarding the performance and security of current communication systems, and understand communication from the application right to the electro-technical foundations.

Contents:

Telematics is telecommunication with the aid of informatics and covers themes of technical message transmission, computer networks, Internet technologies, WWW, and network security. Topics covered include, amongst others, the following: Overall bases: Protocols, services, models, standards, data access, communication engineering fundamentals: Signals, coding, modulation, media; data link layer: Data back-up, media access; local networks: IEEE standards, Ethernet, bridges; network layer: Path selection, router, Internet protocol (IPv4, IPv6); transport layer: Service quality, flow control, congestion control, TCP, Internet: Protocol family around TCP/IP; applications: WWW, security services, network management; convergence of networks: new services, service quality on Internet, multimedia.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Lecture	4	Regular written work on assigned exercise sheets Two oral presentations regarding the solution to an exercise	On-campus time L	60
			Preparation and follow-up L	60
Exercise	2		On-campus time E	30
			Preparation and follow-up E	90
			Examination preparation and examination	60
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)		
Course language:		German (English if necessary)		
Mandatory regular participation:		Participation recommended		
Total working time requirement:		300 hours	10 CP	
Duration of module:		One semester		
Frequency of course offering:		Each winter semester		
Applicability:		Master's degree program in Informatics		

Module: Software project - Technical computer science A

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students master shared development of complex software systems within the field of technical informatics. They can independently divide a larger project into sub-projects, define suitable interfaces, and draw up a schedule. They can organize themselves within a team and take on a leadership role. They also take gender and diversity aspects into account. From their own experience, they have an advanced understanding of quality, expense, acceptance, and success factors and also master communication techniques (oral, written) both internally for successful planning and coordination of the above activities in a project team, as well as for negotiating with an external client. They can confidently use methods of project management and software development, particularly in the areas of design and implementation (defining requirements, specification, architecture design, module design, technology selection, implementation).

Contents:

The software project may have differing focuses. In a team, students produce a complex piece of software to solve an application, hardware, or system-oriented task from the field of technical informatics, such as telematics, mobile communication, or robotics. The module is carried out at the same time as the module of the same name from the Bachelor's degree program. The teams consist of a mixture of Bachelors and Masters students, where Masters students take on leadership positions. Every team goes through the phases of a software project and practices the methods and aids found within software technology, particularly the definition, coordination, and documentation of interfaces; contribution to team-driven creation of software components (if using interfaces that are not yet implemented); assessment and handling technology or larger software components that are still unfamiliar (recycling).

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)
Project seminar	2	Ongoing reports regarding the state of the project, regular presentation and documentation of results	On-campus time PrjS 30 Software development 240 Preparation of presentations and documentation 30

Module exam:	Presentation (ca. 15 minutes) or poster presentation (ca. 15 minutes)	
Course language:	German (English if necessary)	
Mandatory regular participation:	Yes	
Total working time requirement:	300 hours	10 CP
Duration of module:	One semester	
Frequency of course offering:	At least once per year, partly during the semester and partly during the time between terms as a block course	
Applicability:	Master's degree program in Informatics	

Module: Software project - Technical computer science B

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students master shared development of complex software systems within the field of technical informatics. They can independently divide a larger project into sub-projects, define suitable interfaces, and draw up a schedule. They can organize themselves within a team and take on a leadership role. They also take gender and diversity aspects into account. From their own experience, they have an advanced understanding of quality, expense, acceptance, and success factors and also master communication techniques (oral, written) both internally for successful planning and coordination of the above activities in a project team, as well as for negotiating with an external client. They can confidently apply methods from project management and software development, particularly within the field of quality assurance (testing, inspection, process management, project management, re-engineering).

Contents:

The software project may have differing focuses. In a team, students produce a complex piece of software to solve an application, hardware, or system-oriented task from the field of technical informatics, such as telematics, mobile communication, or robotics. The module is performed at the same time as the module of the same name from the bachelor's degree program in Informatics from the Faculty of Mathematics and Informatics at Freie Universität Berlin. The teams consist of a mixture of Bachelors and Masters students, where Masters students take on leadership positions. Every team covers the phases of a software project, and practices using the methods and tools within software technology, particularly when looking at requirements, interfaces, implementations, test cases; testing (module tests, integration tests, system tests) and version and configuration management.

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)
Project seminar	2	Ongoing reports regarding the state of the project, regular presentation of interim results	On-campus time PrjS 30 Software development 240 Preparation of presentations and documentation 30

Module exam:	Presentation (ca. 15 minutes) or poster presentation (ca. 15 minutes); the module exam is not evaluated separately.	
Course language:	German (English if necessary)	
Mandatory regular participation:	Yes	
Total working time requirement:	300 hours	10 CP
Duration of module:	One semester	
Frequency of course offering:	At least once per year, partly during the semester and partly during the time between terms as a block course	
Applicability:	Master's degree program in Informatics	

Module: Scientific work within technical informatics A

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students can independently acquaint themselves with a topic within technical informatics based on original scientific literature and, if required, gain additional background knowledge. They can also clearly convey a demanding topic in an oral presentation. In this case they can emphasize essential elements relative to less important ones, set individual statements out in relation to each other and summarize their core content. They can consciously select and use suitable forms of presentation and media. They are prepared to ask questions in case of ambiguity, can participate in a discussion regarding economic issues, and can also provide criticism in an objective manner. At the same time, students acquire more in-depth knowledge within a specific area in informatics and are prepared for research work as is required for a Master's thesis.

Contents:

The module has differing focuses within the field of technical informatics (e.g. mobile communication).

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)
Advanced seminar	2	Oral presentation, written summary, regular discussion contributions	On-campus time AS 30 Preparation and follow-up 60 Examination preparation and examination 60
Module exam:		Written summary (ca. 4,500 words) with oral presentation (ca. 45 minutes); the module exam is not evaluated separately.	
Course language:		German (English if necessary)	
Mandatory regular participation:		Yes	
Total working time requirement:		150 hours	5 CP
Duration of module:		One semester	
Frequency of course offering:		Each semester	
Applicability:		Master's degree program in Informatics	

Module: Scientific work within technical informatics B

University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics

Persons responsible for module: Module Instructors

Admission requirements: None

Qualification objectives:

Students can independently acquaint themselves with a topic within technical informatics based on original scientific literature and, if required, gain additional background knowledge. They can also clearly convey a demanding topic in an oral presentation. In this case they can emphasize essential elements relative to less important ones, set individual statements out in relation to each other and summarize their core content. They can consciously select and use suitable forms of presentation and media. They are prepared to ask questions in case of ambiguity, can participate in a discussion regarding economic issues, and can also provide criticism in an objective manner. At the same time, students acquire more in-depth knowledge within a specific area in informatics and are prepared for research work as is required for a Master's thesis.

Contents:

The module has differing focuses within the field of technical informatics (e.g. mobile communication).

Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)	
Advanced seminar	2	Oral presentation, written summary, regular discussion contributions	On-campus time AS	30
			Preparation and follow-up	60
			Examination preparation and examination	60
Module exam:		Written summary (ca. 4,500 words) with oral presentation (ca. 45 minutes); the module exam is not evaluated separately.		
Course language:		German (English if necessary)		
Mandatory regular participation:		Yes		
Total working time requirement:		150 hours	5 CP	
Duration of module:		One semester		
Frequency of course offering:		Each semester		
Applicability:		Master's degree program in Informatics		

<table>
<tr><td colspan="4">Module: Current research topics in technical computer science</td></tr>
<tr><td colspan="4">University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics</td></tr>
<tr><td colspan="4">Persons responsible for module: Module Instructors</td></tr>
<tr><td colspan="4">Admission requirements: None</td></tr>
<tr><td colspan="4">Qualification objectives:
Students can apply the main terminology and techniques of a current research area within he field of technical informatics.</td></tr>
<tr><td colspan="4">Contents:
This module, with changing content, provides an insight into one of the research topics that is covered in current projects at the Institute for Informatics.</td></tr>
<tr><td>Forms of teaching and learning</td><td>On-campus studies
(hours per semester week = SWH)</td><td>Forms of active participation</td><td>Work effort
(hours)</td></tr>
<tr><td>Lecture</td><td>2</td><td rowspan="2">Work on assigned exercise sheets
Oral presentation of the solution to selected tasks in the exercise</td><td rowspan="2">On-campus time L 30
Preparation and follow-up L 30
On-campus time E 30
Preparation and follow-up E 30
Examination preparation and examination 30</td></tr>
<tr><td>Exercise</td><td>2</td></tr>
<tr><td colspan="2">Module exam:</td><td colspan="2">Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)</td></tr>
<tr><td colspan="2">Course language:</td><td colspan="2">German (English if necessary)</td></tr>
<tr><td colspan="2">Mandatory regular participation:</td><td colspan="2">Participation recommended</td></tr>
<tr><td colspan="2">Total working time requirement:</td><td>150 hours</td><td>5 CP</td></tr>
<tr><td colspan="2">Duration of module:</td><td colspan="2">One semester</td></tr>
<tr><td colspan="2">Frequency of course offering:</td><td colspan="2">Irregular</td></tr>
<tr><td colspan="2">Applicability:</td><td colspan="2">Master's degree program in Informatics</td></tr>
</table>

Module: Special aspects of Technical Computer Science			
University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics			
Persons responsible for module: Module Instructors			
Admission requirements: None			
Qualification objectives: Students are aware of the main terminology and results of a selected field in technical informatics and are capable of applying these.			
Contents: The module gives an insight into a selected area of technical informatics, such as mobile systems, sensor networks, or advanced aspects of distributed systems, autonomous systems, or robotics.			
Forms of teaching and learning	**On-campus studies** (hours per semester week = SWH)	**Forms of active participation**	**Work effort** (hours)
Lecture	2	Regular written work on assigned exercise sheets Two oral presentations regarding the solution to a task in the exercise	On-campus time L 30 Preparation and follow-up L 30 On-campus time E 30 Preparation and follow-up E 30 Examination preparation and examination 30
Exercise	2		
Module exam:		Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)	
Course language:		German (English if necessary)	
Mandatory regular participation:		Participation recommended	
Total working time requirement:		150 hours	5 CP
Duration of module:		One semester	
Frequency of course offering:		Two-yearly	
Applicability:		Master's degree program in Informatics	

<table>
<tr><td colspan="4">Module: Selected topics in Technical Computer Science</td></tr>
<tr><td colspan="4">University/Faculty/Institute: Free University of Berlin/Mathematics and Informatics/Informatics</td></tr>
<tr><td colspan="4">Persons responsible for module: Module Instructors</td></tr>
<tr><td colspan="4">Admission requirements: None</td></tr>
<tr><td colspan="4">Qualification objectives:
Students know the fundamentals in a special area or an application area of technical informatics. They can safely apply what they have learned.</td></tr>
<tr><td colspan="4">Contents:
Changing contents, e.g. real time systems, integrated systems, or advanced aspects of computer networks and operating systems.</td></tr>
<tr><td>Forms of teaching and learning</td><td>On-campus studies
(hours per semester week = SWH)</td><td>Forms of active participation</td><td>Work effort
(hours)</td></tr>
<tr><td>Lecture</td><td>4</td><td rowspan="2">Work on assigned exercise sheets
Oral presentation of the solution to selected tasks</td><td rowspan="2">On-campus time L 60
Preparation and follow-up L 60
On-campus time E 30
Preparation and follow-up E 90
Examination preparation and examination 60</td></tr>
<tr><td>Exercise</td><td>2</td></tr>
<tr><td colspan="2">Module exam:</td><td colspan="2">Written exam (90 minutes), the written exam can also be carried out in the form of an electronic examination (90 minutes), or an oral examination (20 to 25 minutes)</td></tr>
<tr><td colspan="2">Course language:</td><td colspan="2">German (English if necessary)</td></tr>
<tr><td colspan="2">Mandatory regular participation:</td><td colspan="2">Participation recommended</td></tr>
<tr><td colspan="2">Total working time requirement:</td><td>300 hours</td><td>10 CP</td></tr>
<tr><td colspan="2">Duration of module:</td><td colspan="2">One semester</td></tr>
<tr><td colspan="2">Frequency of course offering:</td><td colspan="2">Two-yearly</td></tr>
<tr><td colspan="2">Applicability:</td><td colspan="2">Master's degree program in Informatics</td></tr>
</table>

Annex 2: Example of course of studies

Semester	Area of informatics			Application area and elective part
1. FS 30 CP	Selected module from the Practical Informatics (10 CP) study area	Selected module from the Theoretical Informatics (10 CP) study area	Selected module from the Technical Informatics (10 CP) study area	
2. FS 30 CP	Software project module - practical Informatics B (10 CP)	Selected module in advanced study area (5 CP)	Selected module in scientific work (5 CP)	Selected module in application area (10 CP)
3. FS 30 CP	Scientific work module in advanced study area (5 CP)	Software project A module in advanced study area (10 CP)	Selected module (5 CP)	Selected module in elective part (10 CP)
4. FS 30 CP	Master's thesis with presentation of results (30 CP)			

Annex 3: Report of Grades (sample)

Free University of Berlin
Faculty of Mathematics and Informatics

Report of Grades

Ms./Mr. [first name/last name]

Date of birth [day/month/year] in [place of birth]

has successfully completed the Master's Program in

Informatics

on the basis of the Examination Regulations of 16 July 2014 (FU Announcements 35/2015) with the overall grade

[grade as number and text]

and earned the required number of 120 credits.

Evaluation of examination results:

Field(s) of study	Credit points	Grade
Informatics	[70-80] (…)	n,n
Application area	[10-20] (…)	n,n
Master's Thesis	30 (30)	n,n

The them of the Master's Thesis was: [XX]

Berlin, this day of [day/month/year] (seal)

Dean Chairman of the Examination Committee

Grading scale: 1.0 – 1.5 very good; 1.6 – 2.5 good; 2.6 – 3.5 satisfactory; 3.6 – 4.0 sufficient; 4.1 – 5.0 insufficient
Grades not evaluated separately: BE – passed; NB – not passed
The credit points are in accordance with the European Credit Transfer and Accumulation System (ECTS).
Some study work is not graded; the credit points in parentheses reflect the scope of graded performance levels that impact the overall grade.

Annex 4: Diploma (sample)

Free University of Berlin
Faculty of Mathematics and Informatics

Certificate

Ms./Mr. [first name/last name]

Date of birth [day/month/year] in [place of birth]

has successfully completed the Master's Program in

Informatics

.

Based on the Examination Regulations of 16 July 2014 (FU Announcements No. 35/2014)

the university degree

Master of Science (M. Sc.)

is awarded.

Berlin, this day of [day/month/year] (seal)

Dean Chairman of the Examination Committee

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