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Subject Examination Regulations (FPO-M) for the subject

Computer Science

in the Master‘s program

at the University of Siegen

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This document is a partial, inofficial translation of the Examination Regulations published in German as „Amtliche Mitteilung” No. 30/2022, No. 43/2023, No. 56/2023, No. 42/2024, No. 83/2024, and No. 25/2025.

It also also includes the amendments approved by the Faculty Council of Faculty IV on January 7, 2026, and June 3, 2026, but which have not yet been officially published!

Only the original German document is legally binding!

Article 1

Scope

(1) These subject examination regulations, together with the Framework Examination Regulations (RPO-M) for the Master's program at the University of Siegen dated February 28, 2019 (Official Notice 5/2019) in the respectively applicable version, regulate the study program in Computer Science (INF).

(2) Computer Science can be studied as a 1-subject program or as a partial course of study in the teaching profession.

(3) Article 2 contains regulations for the study of the subject Computer Science as a 1-subject course of study Computer Science. Article 4 contains regulations for the study of the subject Computer Science as a partial course of study Computer Science in the teaching profession.

Article 2

Regulations for the 1-subject program Computer Science

§ 1

Study model

(1) The Master's degree in Computer Science is studied as a 1-subject program.

(2) The program is studied in one of the four specializations Embedded Systems, Visual Computing, Complex and Intelligent Software Systems and Medical Informatics. The choice of specialization is made upon enrollment in the program.

§ 2

Aims of the study

(1) The consecutive Master's program in Computer Science is research-oriented. It provides in-depth knowledge of the scientific principles and methods of the field of computer science. The study program deepens core topics of computer science and imparts the ability to (further) develop methods and procedures for solving problems in the field of computer science and to apply them appropriately. A further goal is to impart key qualifications such as communication and teamwork skills, presentation and moderation skills.

(2) The Master's degree program in Computer Science is a scientific degree program. The orientation of the subject content and the advanced courses for the acquisition of key qualifications are aimed in particular at qualifying students for scientific work in research and development and for the responsible assumption of management positions in software and hardware development projects. The professional field of graduates of the Master's program in Computer Science includes all types of work fields that deal with the research of fundamental issues or the development, operation and maintenance of complex information processing systems. This includes the areas of software engineering, information systems, embedded systems, visual computing, knowledge based systems, communication and security as well as algorithms and programming in a wide variety of application fields.

§ 3

Master's degree

Upon successful completion of the program, the university awards the degree "Master of Science" (M.Sc.).

§ 4

Special access requirements

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(1) Supplementary to § 4 RPO-M, the prerequisite for admission to the Master's program in Computer Science is, in addition to proof of a first university degree qualifying for a profession in the Bachelor's program in Computer Science or Dual Studies in Computer Science at the University of Siegen or a comparable Bachelor's program, proof of the following competencies for the respective specialization:

1. Embedded Systems: Theory and practice in the areas of electrical engineering fundamentals, digital technology, computer architectures and real-time systems amounting to at least 18 LP[1].
2. Visual Computing: theory and practice in computer graphics, image processing, and machine learning totaling at least 18 LP.
3. Complex and Intelligent Software Systems: theory and practice in software engineering, programming, and machine learning totaling at least 18 LP.
4. Medical Informatics: Fundamentals of medicine as well as fundamentals of medical informatics and the health care system totaling at least 24 LP.

(2) The comparable Bachelor's degree program must have provided competencies in the following areas to the minimum extent indicated:

Area	**Minimum Extent**
Mathematical Foundations	20 LP
Fundamentals of Computer Science and Programming	30 LP
Theoretical Computer Science	10 LP
Practical Computer Science / Computer Systems	20 LP
Computer Engineering	15 LP
Project Work (including Bachelor‘s Thesis)	10 LP

(3) If the required minimum scope according to paragraph 1 or paragraph 2 is not achieved, admission is only possible under corresponding obligations according to § 4 paragraph 4 RPO-M and/or only for certain specializations.

(4) A prerequisite for admission to the Computer Science program is also proof of English language proficiency at the B2 level according to the Common European Framework of Reference for Languages (CEFR) or at the level of a TOEFL iBT of at least 88 or an IELTS 6.5.

(5) Applicants who have not acquired their entrance requirements at a German-speaking institution must also provide evidence of German language skills. Further details are set forth in the Regulations for the German Language Examination for University Admission (DSH) at the University of Siegen, as currently in effect. If no German language skills are proven, only the specializations "Embedded Systems", "Visual Computing" and „Complex and Intelligent Software Systems“ can be studied and only English-language courses can be taken.

(6) Enrollment is to be denied if the applicant has definitively failed an examination required by these examination regulations in a degree program with a significant content-related proximity to this degree program.

§ 5

Stays abroad and internships

(1) Stays abroad and internships are not mandatory.

(2) Voluntary stays abroad are only recommended from the 2nd semester onwards. In order to be credited as a "module abroad" within the framework of the elective "specialization modules", a learning agreement must be concluded before the stay abroad, which ensures the creditability of the achievements abroad in advance.

§ 6

[1] LP = ETCS credit point

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Examination Board

(1) For the tasks specified in § 8 RPO-M and in this article, the Faculty IV - Faculty of Science and Technology forms a Subject Examination Board for Computer Science for the 1-subject Bachelor's degree program in Computer Science, the 1-subject Dual Bachelor's degree program in Computer Science and the 1-subject Master's degree program in Computer Science. The examination board can delegate tasks to the examination office for computer science.

(2) The Subject Examination Board consists of

1. five members from the group of university professors,
2. one member from the group of academic staff and
3. two members from the group of students.

(3) The term of office of the members from the group of university teachers and the member from the group of academic staff is three years. The term of office of the members from the group of students is one year.

(4) In the event that a member is prevented from attending, at least one alternate shall be elected from each of the groups referred to in paragraph 2, whose term of office shall be governed by paragraph 3.

§ 7

Examiners and assessors

(1) The examination authority is based on § 9 RPO-M.

(2) Only those who hold a diploma or Master's degree in Computer Science or a comparable degree may be assessors in oral examinations.

§ 8

Scope and structure of the study program

(1) For successful completion of the master's program, 120 credit points must be earned in the consecutive Master's program in Computer Science.

(2) It is possible to study full-time or part-time. The standard period of study is 4 semesters for the full-time degree program and 8 semesters for the part-time degree program.

(3) The study program consists of a compulsory area (30 credit points, modules 4INFMA001 to 4INFMA003), the compulsory elective area "Core Modules" (24 credit points, cf. paragraph 10 in conjunction with Annex 4), a compulsory elective area "Specialization Modules" (36 credit points, cf. paragraphs 6 to 9 in conjunction with Annex 4) and the Master's thesis in Computer Science (30 credit points, 4INFMA004).

(4) Upon enrollment, the student selects one of the following specializations:

1. Embedded Systems
2. Visual Computing
3. Complex and Intelligent Software Systems
4. Medical Informatics

(5) The choice of the specialization can be changed once by a written application to the chairperson of the examination board. The application can only be approved if the requirements according to § 4 paragraph 1 and paragraph 5 are fulfilled for the new specialization. If necessary, new or different obligations may be imposed. Attempts for study achievements or examinations that have already been passed or started will be transferred, provided that the corresponding modules can be selected in the new specialization. The change of the specialization only becomes effective at the beginning of the following semester with the enrollment in the new specialization. Enrollment in the new specialization must be applied for at the Student Services Department after approval by the Examination Board.

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(6) In the specialization **"Embedded Systems",** four modules with a total of 24 LP must be selected from the module catalog "Embedded Systems" and two additional modules with a total of 12 LP must be studied from the module catalogs "Embedded Systems", "Visual Computing", "Complex and Intelligent Software Systems", "Medical Informatics" and “Core modules”.

(7) In the specialization "**Visual Computing"** four modules with a total of 24 LP have to be chosen from the module catalog "Visual Computing" and two further modules with a total of 12 LP have to be studied from the module catalogs "Embedded Systems", "Visual Computing", "Complex and Intelligent Software Systems", "Medical Informatics" and “Core modules”.

(8) In the specialization "**Complex and Intelligent Software Systems",** three modules with a total of 18 LP must be selected from the module catalog "Complex and Intelligent Software Systems" and additional modules with a total of 18 LP must be studied from the module catalogs "Embedded Systems", "Visual Computing", "Complex and Intelligent Software Systems", "Medical Informatics" and “Core modules”.

(9) In the specialization **"Medical Informatics"**, the module 4DBHSBA02 "Human Function II" from the module catalog "Medical Informatics" with 9 LP is mandatory to study in the elective area "Specialization Modules". A further 27 LP must be studied in total, at least 15 LP from the module catalog "Medical Informatics" and the remaining LP from the module catalogs "Embedded Systems", "Visual Computing", "Complex and Intelligent Software Systems", "Medical Informatics" and “Core modules”.

(10) In the compulsory elective area **"Core Modules",** four modules of 6 LP with a total of 24 credit points from the corresponding catalog in Annex 4 must be studied. In the specialization "Visual Computing", the module 4INFMA021 "Modeling and Animation" from the compulsory elective area "Core Modules" must be studied. In the specialization “Complex and Intelligent Software Systems” the modules 4INFMA020 “Software Engineering II” and 4INFMA029 “Database Systems II” must be studied [only for students who started their studies in winter term 2024/25 or later].

(11) A module selected in the compulsory elective area "Core modules" cannot be selected again as a module in the compulsory elective area "Specialization modules".

(12) A module that has already been completed in the previous Bachelor's degree program cannot be selected as a compulsory elective module. If the module in question is a module that must be chosen in accordance with paragraph 9 or paragraph 10, another module from the same catalog must be chosen as a substitute.

(13) The choice of a compulsory elective module is made by registering for the corresponding study or examination achievement. The choice of a compulsory elective module that includes an examination cannot be canceled once the first attempt for the examination has begun. Paragraph 5 and § 10 paragraph 4 remain unaffected.

(14) Module Overview:

No.	Module	SL[1]	PL[2]	LP[3]	P/ WP[4]	Module description in
4INFMA001	Scientific Working	1	1	9	P	Annex 7
4INFMA002	Cutting Edge Research	2	0	6	P	Annex 7
4INFMA003	Project Work	1	1	15	P	Annex 7
4INFMA004	Master Thesis in Computer Science	0	1	30	P	Annex 7
	Elective Area Core Modules 4 modules à 6 LP	0-4	4	24	WP	Annex 4
	Elective Area Specialization Modules (Module Catalogs "Embedded Systems", "Visual Computing", "Complex and Intelligent Software Systems" and "Medical Informatics")	0-6	0-6	36	WP	Annex 4

[1] SL = Study achievements („*Studienleistungen*“)
[2] PL = Examination („*Prüfungsleistung*“)
[3] LP = Credit points („*Leistungspunkte*“)
[4] P = Compulsory module („*Pflichtmodul*“) / WP = Elective module („*Wahlpflichtmodul*“)

The recommended semester is shown in the study plan (Annex 1).

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(15) Possible teaching forms are: Lecture, exercises, lecture and exercises, seminar, laboratory and project work. The specific teaching form can be found in the module description.

(16) The courses are held in German or English. The teaching language is specified in the module description. If the language of instruction is not uniquely specified, the lecturers will announce the language of instruction no later than two weeks after the start of the respective course.

(17) The examination board appoints a mentor for each specialization from § 8 paragraph 4, who advises the students of this specialization in their personal study planning. At least once a year, each student shall discuss with the mentor the course of studies so far and any problems that may have arisen, and prepare a plan for the coming academic year. The mentor advises on the modules that can be reasonably combined in compulsory elective areas, taking into account the student's individual prior knowledge and focal points of interest.

§ 9

Study achievements and examinations

(1) In addition to § 10 Paragraph 1 and § 11 Paragraph 6 RPO-M, the following forms are provided for study achievements and examinations:

1. Study achievements

   a) Seminar presentation (15-20 minutes) with term paper (5 - 15 pages).

      The following interrelated achievements must be provided:

      i. Giving a talk on a given topic in German or English.

      ii. Preparation of a written paper on the contents of the lecture in German or English. The paper has to be handed in to the instructor before the talk.

      iii. Participation in the other talks of the seminar and active participation in the discussion on the lecture topics.

      The lecture topics and the lecture dates, as well as the deadline and the form of the paper will be announced by the instructors no later than two weeks after the start of the respective course. The duration of the talk and the extent of the term paper are specified in the respective module description.

   b) Successful completion of exercise or project assignments (1 - 12 assignments, total time required 10 - 135 hours).

      In doing so, given exercises or project tasks must be worked on as homework and the solutions must be presented to the instructor in due time. The solution can be presented in written or electronic form and/or by a short oral presentation (5 - 15 minutes). The exact form of the submission and/or presentation will be determined by the instructor and announced at the beginning of the course. The number, type and scope of the tasks can be found in the respective module description.

   c) Active and regular participation.

      The course must be attended on a certain number of compulsory dates. The number of compulsory dates is shown in the module manual. Active participation is demonstrated by the production/acceptance of software or files, experimental setups, experimental protocols, reports, short presentations, or tests.

      i. Software or files: creation of computer programs or other files, possibly with the help of appropriate software tools.

      ii. Experimental setups: Set-up and execution of an experiment (usually hardware set-up, with configuration if necessary).

      iii. Experimental protocols: written documentation of an experiment with regard to preparation, procedure and result.

      iv. Report: factual reproduction, representation, communication of an event or fact in oral form.

      v. Short presentation: elaborated essay on a specific topic.

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vi. Test: short electronic test (usually using the answer choice procedure) on the content of the course.

The type and scope of the respective partial performances are determined by the instructor and announced at the beginning of the course.

d) Project reports (total length 60 - 120 minutes).

Regular oral short reports on the progress of a project. The frequency and scope of the reports are determined by the instructor and announced at the beginning of the course.

e) Term paper (5-20 pages)

Preparation of a written paper in German or English on a topic or question of the respective course.

f) Practical test (10-20 minutes)

Practical diagnostics for a selected clinical picture. Type and extent of the respective partial performances will be announced by the lecturer before the course.

g) Lecture / Presentation with discussion (20 - 30 minutes)

h) Group presentation (10 - 20 minutes)

i) Participation in the laboratory

j) Laboratory practical (20 - 40 minutes)

All experiments of the laboratory practical must be completed. In addition, written laboratory reports (5 - 15 pages per experiment) must be prepared and submitted to the instructor. The results are presented in a colloquium or final discussion (15 - 30 min. per experiment).

k) Test (20 - 30 minutes)

Short test (if necessary electronically and/or using the answer choice procedure) on the contents of the course.

l) Written test (90 - 120 minutes)

m) Oral test (20 - 40 minutes)

n) Presentation or term paper (programming)

2. Examinations

a) Project Work (450 hours).

Carrying out a project on a given topic with written project presentation and documentation as well as oral project presentation, as the case may be also as group work. The permissible group size as well as the duration and scope of the project presentation and documentation result from the respective module description.

b) Seminar presentation (60-90 minutes).

Giving a lecture on a given topic in German or English. The lecture topics and the lecture dates are announced by the instructors no later than two weeks after the start of the respective course. The duration of the lecture results from the respective module description.

c) Seminar presentation (30 minutes) with term paper (5,000 words).

Giving a lecture on a given topic and preparing a written paper on the contents of the lecture in German or English. The paper has to be handed in to the instructor before the presentation.

The lecture topics and the lecture dates, as well as the deadline and the form of the paper will be announced by the instructors no later than two weeks after the start of the respective course. The duration of the lecture and the extent of the term paper result from the respective module description.

d) Term paper (final report) (20 pages).

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Preparation of a written paper in German or English on a topic or question of the respective course.

(2) Study achievements and examinations can only be taken by students who are enrolled in a Master's degree program. Students who have already completed at least 150 LP in the Bachelor's degree program and have already registered the Bachelor's thesis may, upon application, complete course and examination credits amounting to a maximum of 30 LP. The application must be submitted to the Examination Committee via the Examination Office for Computer Science. Sentence 1 does not apply to modules that can be studied in accordance with the regulations in an FPO-B for the completion of a Bachelor's degree program.

(3) Prerequisite for admission to the examination achievement in the modules

- Modeling and Animation (4INFMA021)
- Computer Architectures II (4INFMA023)
- Development of Embedded Systems using FPGAs (4INFMA100)
- Storage Technologies (4INFMA102)
- Rendering (4INFMA200)
- GPU Programming (4INFMA201)
- Scientific Visualization (4INFMA202)
- Deep Learning (4INFMA204)
- Optimization for Machine Learning (4INFMA206/2)
- Numerical Methods for Visual Computing (4INFMA207)
- Virtual Reality (4INFMA210)
- Visual Analytics (4INFMA213)
- 3D Machine Learning (4INFMA214)
- Computational Imaging (4ETMA250)
- Signals and Systems I (4ETMA200)
- Signals and Systems II (4ETMA201)
- Digital IC Design (4ETMA303)

is the successful completion of coursework in these modules.

(4) In deviation from § 11 Paragraph 4 RPO-M, withdrawal from examination dates that have not been organized and announced via the campus management system or the examination board, but have been agreed individually with the examiner, can be made via the examination office at the latest 7 days before the start of the examination or the agreed submission date.

(5) On request, students may complete further coursework and examinations (additional achievements). Additional acheivements can be coursework and examinations from modules not selected for this degree program or another Bachelor's or Master's degree program. Additional achievements are not taken into account when determining the final grade; no credit points are awarded for additional achievements in this degree program. Passed additional achievements are generally listed in the transcript of records; upon application, additional achievements are not listed. The application must be submitted to the Examination Office at the latest before the announcement of the examination result of the last examination of this degree program. A module that has been completed and listed as an additional achievement can no longer be booked and listed as an achievement in the compulsory elective area.

§ 10

Repetition of examinations

(1) Dates for repeating failed examinations are offered in the following semester.

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(2) In the case of examinations in the form of written examinations, the last possible examination attempt is usually in the form of an oral examination; at the request of the student, repetition in written form is also possible, provided that the examination is offered in written form.

(3) For modules imported from other subject examination regulations, deviations from paragraphs 1- 2 may occur.

(4) If a compulsory elective module is definitively not passed, another module can be chosen twice as a substitute, provided that the conditions from § 8 paragraph 6 to 11 are met. If this is not or no longer possible, the choice of specialization must be changed according to § 8 paragraph 5.

§ 10a

Free trial

A maximum of 3 examinations that have not yet been repeated in accordance with § 12 Paragraph 5 RPO-M and which have been taken within the standard period of study can, on application, be evaluated as a free attempt and repeated. Sentence 1 does not apply to the Master's thesis or to imported modules whose module description does not provide for a repeated examination to improve the grade or a free attempt. If a better grade is achieved in the repetition than in the previous attempt, the previous attempt shall be deemed not to have been taken and shall be replaced by the repetition as an examination attempt. If the same or a lower grade is achieved on the retake, the grade from the previous attempt will stand. An oral examination must be repeated within six months, all other examinations at the next possible date, otherwise the right to the free attempt is forfeited. A second free attempt for the same examination achievement is excluded. An examination that has been declared failed due to irregular behavior, in particular attempted cheating, cannot be counted as a free attempt.

§ 11

Master‘s thesis

(1) The Master's thesis accounts for 30 credit points of the Master's program.

(2) The application for admission to the Master's thesis must be submitted in writing to the Examination Board via the responsible examination office. Admission to the Master's thesis is governed by § 13 RPO-M.

(3) Admission to the Master's thesis can only be granted if the candidate has acquired at least 60 credit points and there is no module that still has to be completed and has just one examination attempt left.

(4) Students have the opportunity to suggest the reviewers and the topic of the Master's thesis.

(5) The processing time is 26 weeks for the full-time degree program and 52 weeks for the part-time degree program. The length of the Master‘s thesis should not exceed 120 pages. The topic of the Master‘s thesis can only be returned once within the first 4 weeks.

(6) The Master's thesis can also be admitted in the form of a group work by two students if the contribution to be assessed by the individual is clearly distinguishable and assessable on the basis of the specification of sections, page numbers or other objective criteria that allow a clear delimitation and this contribution fulfills the requirements according to § 14 paragraph 1 RPO-M. The length of the thesis increases accordingly in this case.

(7) The Master's thesis must be submitted in duplicate in printed, bound form and additionally in electronically searchable form to the Examination Board via the Computer Science Examination Office. If, in addition to the written work, further components created as part of the Master's thesis (e.g. program code, models, technical drawings) are also to be assessed, these must also be submitted in suitable electronic form. The electronic form can be used to check individual authorship using plagiarism checking software.

(8) When handing in the Master's thesis, the candidate must assure in writing that he or she has written his or her thesis - in the case of a group thesis, his or her correspondingly marked part of the thesis - independently and has not used any sources and aids other than those indicated and has marked citations.

(9) The Master's thesis is defended in a colloquium (approx. 20-minute presentation followed by a 10

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to 20-minute discussion). The result of the colloquium is 25% of the grade of the Master‘s thesis.

§ 12

Evaluation, formation of grades

The evaluation and the formation of grades are based on § 21 RPO-M.

§ 13

Application and transitional provisions

(1) These subject examination regulations apply to all students enrolled in this Master's program at the University of Siegen for the first time as of the winter semester 2021/2022.

(2) The examination regulations for the Master's program in Computer Science of the Faculty of Science and Technology of the University of Siegen dated April 9, 2013 (Official Notice 27/2013), last amended by the Sixth Regulation for the Amendment of the Examination Regulations for the Master's program in Computer Science of the Faculty of Science and Technology of the University of Siegen dated March 28, 2019 (Official Notice 10/2019), will expire on March 31, 2024. Students who were enrolled in the Master's program in Computer Science prior to the winter semester 2021/2022 can still complete their studies according to these examination regulations until that date.

(3) Students who were already enrolled in the Master's program in Computer Science prior to the winter semester 2021/2022 have the option, upon application, to complete their studies according to the provisions of the Framework Examination Regulations (RPO-M) for the Master's program at the University of Siegen dated February 28, 2019 (Official Notice 5/2019) and these Subject Examination Regulations. The application is to be addressed to the respective responsible Examination Board and cannot be revoked.

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Attachments

Curriculum

Annex 1: Study plans according to study model in the 1-subject study program for Article 2

Start of study in winter semester (full-time)

Semester	*LP*	*Module*	*SL*	*PL*	*LP*	*SWS*
1.	*33*	4INFMA002 "Cutting Edge Research"	2	0	6	2
		By choice "Core Modules I - III“	0-3	3	18	
		By choice "Specialization Module“	0-1	0-1	6	
		4INFMA001 "Scientific Working" (Lecture)	1	0	3	1
2.	*27*	4INFMA001 "Scientific Working“ (Seminar)	0	1	6	2
		4INFMA003 "Project Work" (Part 1)	1	0	9	0
		By choice "Core Module IV“	0-1	1	6	
		By choice "Specialization Module“	0-1	0-1	6	
3.	*30*	4INFMA003 "Project Work" (Part 2)	0	1	6	0
		By choice "Specialization Modules“	0-4	0-4	24	
4.	*30*	4INFMA004 "Master Thesis in Computer Science"	0	1	30	0

Start of study in summer semester (full-time)

Semester	*LP*	*Module*	*SL*	*PL*	*LP*	*SWS*
1.	*30*	By choice "Core modules I - III“	0-3	3	18	
		By choice "Specialization Modules“	0-2	0-2	12	
2.	*30*	4INFMA002 "Cutting Edge Research"	2	0	6	2
		By choice "Core Module IV“	0-1	1	6	
		4INFMA001 “Scientific Working" (Lecture)	1	0	3	1
		4INFMA003 "Project Work" (Part 1)	1	0	9	0
		By choice "Specialization Modules“	0-1	0-1	6	
3.	*30*	4INFMA001 "Scientific Working“ (Seminar)	0	1	6	3
		4INFMA003 "Project Work" (Part 2)	0	1	6	0
		By choice "Specialization Modules“	0-3	0-3	18	
4.	*30*	4INFMA004 "Master Thesis in Computer Science"	0	1	30	0

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Start of study in winter semester (part-time)

Semester	*LP*	*Module*	*SL*	*PL*	*LP*	*SWS*
1.	*18*	4INFMA002 „Cutting Edge Research“	2	0	6	2
		By choice „Core Modules I - II“	0-2	2	12	
2.	*12*	By choice „Core Modules III - IV“	0-2	2	12	
3.	*15*	4INFMA001 „Scientific Working" (Lecture)	1	0	3	1
		By choice „Specialization Modules“	0-2	0-2	12	
4.	*12*	4INFMA001 „Scientific Working“ (Seminar)	0	1	6	2
		By choice „Specialization Module“	0-1	0-1	6	
5.	*15*	4INFMA003 „Project Work" (Part 1)	1	0	9	0
		By choice „ Specialization Module“	0-1	0-1	6	
6.	*18*	4INFMA003 „Project Work" (Part 2)	0	1	6	0
		By choice „Specialization Modules“	0-2	0-2	12	
7.	*15*	4INFMA004 „Master Thesis in Computer Science“	0	1	30	0
8.	*15*					

Start of study in summer semester (part-time)

Semester	*LP*	*Module*	*SL*	*PL*	*LP*	*SWS*
1.	*12*	By choice „Core Modules I - II“	0-2	2	12	
2.	*15*	4INFMA002 „Cutting Edge Research“	2	0	6	2
		By choice „Core Module III“	0-1	1	6	
		4INFMA001 „Scientific Working" (Lecture)	1	0	3	1
3.	*18*	By choice „Core Module IV“	0-1	1	6	
		4INFMA001 „Scientific Working" (Seminar)	0	1	6	2
		By choice „Specialization Module“	0-1	0-1	6	
4.	*12*	By choice „Specialization Modules“	0-2	0-2	12	
5.	*15*	4INFMA003 „Project Work" (Part 1)	1	0	9	0
		By choice „Specialization Module“	0-1	0-1	6	
6.	*18*	4INFMA003 „Project Work" (Part 2)	0	1	6	0
		By choice „Specialization Modules“	0-2	0-2	12	
7.	*15*	4INFMA004 „Master Thesis in Computer Science“	0	1	30	0
8.	*15*					

Elective Modules

Annex 4: List of elective modules according to Article 2 § 8 paragraphs 6 to 10

Nr.	Module	SL	PL	LP	Reference to module description
	Elective Area „Core Modules“				
4INFMA020	Software Engineering II	0	1	6	Annex 7
4INFMA021	Modeling and Animation	1	1	6	Annex 7
4INFBA022/2	Introduction to Embedded Systems	1	1	6	FPO-B Informatik
4INFMA023	Computer Architectures II	1	1	6	Annex 7
4INFMA024	Parallel Processing	1	1	6	Annex 7
4INFMA025	Computer Networks II (German)	0	1	6	Annex 7
4INFMA026	Advanced Logic	0	1	6	Annex 7
4INFMA028	Algorithmics I	1	1	6	Annex 7
4INFMA029	Database Systems II II	0	1	6	Annex 7
	Elective Area „Specialization Modules“				
	Module Catalog „Embedded Systems“				
4INFMA100	Development of Embedded System using FPGAs	1	1	6	Annex 7
4INFMA101	Ubiquitous Systems Lab	0	1	6	Annex 7
4INFMA102	Storage Technologies	1	1	6	Annex 7
4INFMA103	StartUp Entrepreneurship	0	1	6	Annex 7
4INFMA104	Selected Topics in Processor Architecture	0	1	6	Annex 7
4DMTBA19	Telematics - Multimedia	0	1	6	FPO-B DBHS
4DBHSBA10	Telematics – Technologies and Applications	0	1	6	FPO-B DBHS
4ETMA263	Selected Topics in Wireless Technologies	1	1	6	FPO-M ET
4ETMA200	Signals and Systems I	1	1	6	FPO-M ET
4ETMA201	Signals and Systems II	1	1	6	FPO-M ET
4ETMA160/2	Reliability of Technical Systems	0	1	6	FPO-M ET
4ETMA159	Assembly and Connection Technology (German)	0	1	6	FPO-M ET
4ETMA303	Digital IC Design	1	1	6	FPO-M ET
4ETMA355	Microsystem Fabrication & Test	0	1	6	FPO-M ET
4MBMA052	Condition Monitoring	0	1	6	FPO-M MB
4ETMA167	Data Science for Dynamical Systems	1	1	6	FPO-M-ET
4INFMA197	Foreign module Embedded Systems I			6	Annex 7
4INFMA198	Foreign module Embedded Systems II			6	Annex 7
4INFMA199	Foreign module Embedded Systems III			6	Annex 7
	Module Catalog „Visual Computing“				
4INFMA200	Rendering	1	1	6	Annex 7
4INFMA201	GPU Programming	1	1	6	Annex 7
4INFMA202	Scientific Visualization	1	1	6	Annex 7
4INFMA203	Statistical Learning Theory	0	1	6	Annex 7
4INFMA204	Deep Learning	1	1	6	Annex 7
4INFMA205	Recent Advances in Machine Learning	1	0	6	Annex 7
4INFMA206	Optimization for Machine Learning	1	1	6	Annex 7
4INFMA207	Numerical Methods for Visual Computing	1	1	6	Annex 7
4INFMA208	Machine Vision	0	1	6	Annex 7
4INFBA033	Computer Graphics Lab	1	0	6	FPO-B Informatik
4INFMA210	Virtual Reality	1	1	6	Annex 7
4INFMA211	Higher Level Computer Vision	0	1	6	Annex 7
4INFMA212	Unsupervised Learning	0	1	6	Annex 7
4INFMA213	Visual Analytics	1	1	6	Annex 7
4INFMA214	3D Machine Learning	1	1	6	Annex 7
4INFMA215	Automated Machine Learning	1	1	6	Annex 7
4ETMA250	Computational Imaging	1	1	6	FPO-M ET
4ETMA252	Topics in Computational Imaging	0	1	6	FPO-M ET
4ETMA257	Introduction to Compressive Sensing	0	1	6	FPO-M ET

Non-official version

Nr.	Module	SL	PL	LP	Reference to module description
4INFMA297	Foreign module Visual Computing I			6	Annex 7
4INFMA298	Foreign module Visual Computing II			6	Annex 7
4INFMA299	Foreign module Visual Computing III			6	Annex 7
	Module Catalog „Complex and Intelligent Software Systems“				
4INFMA300	Algorithmics II (German)	1	1	6	Annex 7
4INFMA301	Model Checking	0	1	6	Annex 7
4INFBA302	Complexity Theory I	1	1	6	FPO-B Informatik
4INFMA304	Complexity Theory II	1	1	6	Annex 7
4INFMA305	Ubiquitous Computing	0	1	6	Annex 7
4INFMA307/2	Advanced Programming in C++	0	1	6	Annex 7
4INFMA308	Theoretical Computer Science (German)	0	1	6	Annex 7
4INFMA310	Recent Advances in Operating Systems and Distributed Systems	1	1	6	Annex 7
4INFMA312	Recommender Systems	1	1	6	Annex 7
4INFMA313	Quantum Complexity Theory	1	1	6	Annex 7
4ETMA168	Reinforcement Learning	0	1	6	FPO-M ET
4QSMAEX01	Introduction to Quantum Theory and Quantum Computing	2	1	12	FPO-M Quantum Science
4INFMA397	Foreign Module Complex and Intelligent Software Systems I			6	Annex 7
4INFMA398	Foreign Module Complex and Intelligent Software Systems II			6	Annex 7
4INFMA399	Foreign Module Complex and Intelligent Software Systems III			6	Annex 7
	Module Catalog „Medical Informatics“				
4DBHSBA02	Human Function II (German)	1	1	9	FPO-B DBHS
4DBHSBAEX02	Clinical Internship (German)	1	0	3	FPO-B DBHS
5BMTBA18	Immunology (German)	1	1	6	FPO-B DBHS
2PSYBA08	General Psychology II (German)	2	1	9	FPO-B Psychologie
4DMTBA04	Medical Technology (German)	1	1	6	FPO-B DBHS
4MDSMA02	Medical Technology Specialization (German)	1	1	9	FPO-M MDS
4DMTBA09	Security in Medical Applications(in German)	1	1	9	FPO-B DBHS
4DBHSBA15	Data Science in Medicine (in German)	1	1	6	FPO-B DBHS
3HCIMA001	Humans & Technology	0	1	9	FPO-M HCI
4INFMA497	Foreign module Medical Informatics I			6	Annex 7
4INFMA498	Foreign Module Medical Informatics II			6	Annex 7
4INFMA499	Foreign Module Medical Informatics III			6	Annex 7

Non-official version

Module Descriptions

Annex 7: Module descriptions for articles 2 and 4

If the module is used in different (partial) study programs, the status "compulsory" or "elective" of the module may vary depending on the (partial) study program. The information in the module overview in § 8 or in the appendix "Wahlpflichtmodule" of the respective FPO is binding.

No.	4INFMA001		
Module title	Scientific Working		
Compulsory/elective	P		
Module duration	1-2 semesters		
Offering frequency	Lecture: every winter term; Seminar: every semester		
Teaching language	German/English		
LP	9		
SWS	3		
Classroom study	45 h		
Self-study	225 h		
Workload	270 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Scientific Working	60	1
Seminar	Master Seminar	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Overall examination consisting of the examination elements: Seminar lecture (50 %) with Elaboration (50 %)	 30 min 5000 words	
Study achievements	Term paper (for the lecture part) or test (for the lecture part), both ungraded	5-10 pages 20-30 min	
Qualification goals	Students can • use literature databases and other sources to develop material on a given topic, • Read, understand, analyze, and prepare original English-language literature, • design a lecture on a complex scientific topic (i.e. also design it didactically correctly) and deliver it in front of a professional audience using common media, • critically question or defend facts in a factual discussion, • Prepare texts explaining technical/scientific issues, 10-20 pages in length, • follow the principles of good scientific practice, • Assess the visibility of a scientific paper and scientific organs (journals, proceedings, etc.), • Reflect the basic outline of the process of creating a scientific publication including the reviewing and publishing process. Since, in addition to technical competence, the ability to make scientific presentations and engage in discussions is to be learned and practiced, regular on-site attendance is mandatory.		
Contents	In the module element "Scientific Work", the basic features of (self-) organization in scientific work itself, as well as in connection with researching the state of the art of research, preparing a publication, and submitting and reviewing it are discussed. In addition, the principles of good scientific practice will be covered. In the module element "Master's Seminar", changing specialist topics that build on teaching materials from the previous subject semesters are developed by the students, prepared in writing and presented in a lecture. The subject-related content is secondary to the targeted methodological competencies and key qualifications and can, if necessary, complement a focus selected in the elective area.		

Final version

Applicability in the following courses of study	MA Computer Science
Requirements for participation	---
Prerequisites for the award of LP	Passed examination and passed study achievement.

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

Non-official version

No.	4INFMA002		
Module title	Cutting Edge Research		
Compulsory/elective	P		
Module duration	1 semester		
Offering frequency	Every winter term		
Teaching language	English		
LP	6		
SWS	2		
Classroom study	30 h		
Self-study	150 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Cutting Edge Research	60	2
Achievements	**Form**	**Duration/Scope**	
Examinations	---		
Study achievements	Two course credits (ungraded): Active and regular participation and Term paper or Oral presentation with discussion	At least 75% of the dates 5-10 pages 15+15 min.	
Qualification goals	Upon completion of this module, students will be able to understand the fundamentals and basic concepts of the research presented to the extent that they can actively and successfully participate in its evaluation or further development in the context of a seminar, project work, or master's thesis. In addition, the ability to engage in scientific discussion is to be learned and practiced, which makes regular on-site attendance mandatory.		
Contents	The Cutting Edge Research module is offered in the form of a lecture series. Within the framework of weekly lectures, professors and staff members of computer science present the basic concepts, ideas and results of current research projects at the University of Siegen, whereby, if necessary, their theoretical, conceptual and practical foundations are also conveyed. In the course of a subsequent discussion, the students explore open questions and problems of the respective lecture topic and discuss application potentials, further development possibilities and limits of the presented techniques and solutions. For a selected part of the lecture topics, the students work out a summarizing and evaluating written paper, which is to be submitted after the end of the lecture series in the lecture-free period.		
Applicability in the following courses of study	MA Computer Science		
Requirements for participation	---		
Prerequisites for the award of LP	Passed academic performance		

Draft version

No.	4INFMA003		
Module title	Project Work		
Compulsory/elective	P		
Module duration	2 semesters		
Offering frequency	Every semester		
Teaching language	German/English		
LP	15		
SWS	0		
Classroom study	0 h		
Self-study	450 h		
Workload	450 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Project work	Project work	1-8	
Achievements	**Form**	**Duration/Scope**	
Examinations	Project work	450 h	
Study achievements	Project reports, ungraded	60-120 min	
Qualification goals	Professional qualification • Students will be able to analyze and evaluate in-depth and specific technical topics of the assignment and design and evaluate their own solutions based on their acquired knowledge. Key skills • Ability to work in a team; as a rule, the tasks of a project can only be fulfilled with a division of labor. Those involved in the project must divide up the work on their own responsibility, regularly monitor and discuss the progress of the work, plan the further procedure, prepare appropriate protocols and use organizational techniques, recognize and rectify any faults and problems that may occur. • Communication with users: in many cases, the task is to realize a system for real users who are not engineers, who do not know the relevant technical terms, and who cannot assess the technologies. • The ability to use literature databases and other sources to develop material on a given topic. • Ability to read and understand challenging original English literature, if applicable. • The ability to design a lecture on a non-trivial scientific topic in front of a specialized audience (i.e. also to design it didactically correctly) and to deliver it using common media • The ability to work in a group to write a report of approximately 30 - 200 pages (depending on the number of participants) outlining the results of the project work.		
Contents	The participants of a project work on a complex task that is relevant to their course of study and usually originates from a research project of the organizer. The work is done in a team consisting of students and, if applicable, researchers of the organizing chair. The problem is concretely described by the organizer in a project description, which is handed out to the participants before the start of the project work. Above all, the project description specifies the minimum goal to be achieved for the successful completion of the project group. With regard to the motivation of the participants, the problem should be as relevant to reality as possible; interdisciplinary topics are permitted; an external product or deadline constraint must be excluded.		
Applicability in the following courses of study	MA Computer Science		
Requirements for participation	---		
Prerequisites for the award of LP	Passed examination and passed study achievement.		

Unofficial version

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

Non-official version

No.	4INFMA004		
Module title	Master thesis Computer Science		
Compulsory/elective	P		
Module duration	1 semester		
Offering frequency	Every semester		
Teaching language	German/English		
LP	30		
SWS	0		
Classroom study	0 h		
Self-study	900 h		
Workload	900 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Achievements	**Form**	**Duration/Scope**	
Examinations	Overall examination consisting of the examination elements: Master thesis (75 %) and Colloquium (25 %) (presentation followed by discussion)	 26 weeks, max. 120 pages 20 min + 10-20 min	
Study achievements	---		
Qualification goals	Students can, within a given time frame, • independently conduct a literature search on a given scientific topic using literature databases and other sources, • Read, understand, and evaluate challenging original English-language literature in relation to the assignment, • Analyze, evaluate, plan and/or implement extensive software and/or hardware systems in a project-oriented manner, • design a lecture on a challenging scientific topic (i.e. also design it didactically correctly) and deliver it in front of a professional audience using common media, • Prepare a text explaining technical/scientific issues, 60-120 pages in length.		
Contents	In the final thesis, the candidate must independently work on a challenging problem in his or her field of study within a given period of time using scientific methods and present it orally and in writing.		
Applicability in the following courses of study	MA Computer Science		
Requirements for participation	Content: / Formal: Attainment of at least 60 LP; no examination with only one retake attempt left		
Prerequisites for the award of LP	Passed Examination.		

Non-official version

No.	4INFMA020		
Module title	Software engineering II		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every summer term		
Teaching language	German/English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-Size**	**SWS**
Lecture	Software engineering II	60	2
Exercise	Software engineering II	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral exam or written exam The form of the examination will be announced no later than four weeks after the start of the course.	20-40 min. 120 min.	
Study achievements	---		
Qualification goals	Upon completion of the module, students will be able to - Be able to appropriately select, explain and apply procedures and tools for systematic quality assurance, - Select, evaluate and apply concepts, methods and tools for model-based software development in practice, - Understand, explain, maintain, and enhance existing complex software systems through the use of appropriate techniques and tools.		
Contents	Building on the Software Engineering I module, the module focuses on the development as well as the maintenance and quality assurance of complex and safety-critical software systems. The focal points include: - Quality assurance with a focus on testing, - Model-based software design and model-driven software development (metamodeling and model transformations, domain-specific languages), - Reengineering, reverse engineering, refactoring, reuse - Design and architecture patterns, software product lines, - Semantics of modeling languages.		
Applicability in the following courses of study	MA Computer Science in Teaching for HRSGe MA Computer Science in the teaching profession for GymGe MA Computer Science in the teaching profession for BK-A MA Computer Science MA Business Informatics MA Digital Engineering – Mechanical Engineering MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: The Module 4INFBA007 “Software Engineering I” should have been successfully completed or equivalent knowledge should be available. Formal: /		
Prerequisites for the award of LP	Passed examination		

Trial version

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**						
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

Non-official version

No.	4INFMA021		
Module title	Modeling and Animation		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	every winter term		
Teaching language	English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Modeling and Animation	60	2
Exercise	Modeling and Animation	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Written exam	120 min.	
Study achievements	Successful completion of exercise or project tasks	approx. 12 tasks, approx. 45 h	
Qualification goals	The student understands modeling and animation techniques for computer graphics, can evaluate them and use and implement them in simple programs.		
Contents	Freeform curves and surfaces, subdivision surfaces, modeling techniques, keyframe and spline animation, skeletal animation, procedural animation, collision detection.		
Applicability in the following courses of study	BA Computer Science BA Dual Study Computer Science BA Digital Engineering – Electrical Engineering MA Computer Science MA Mathematics MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: The modules 4INFBA020 "Introduction to Visual Computing" and 4INFBA200 "Computer Graphics" should have been successfully completed or corresponding knowledge should be available. Formal: Admission to the examination requires passing the study achievement in this module.		
Prerequisites for the award of LP	Passed examination and passed study achievement.		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

Non-official version

No.	4INFMA023		
Module title	Computer Architectures II		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Annual winter term		
Teaching language	English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Computer Architectures II	60	2
Exercise	Computer Architectures II	30	1
Seminar	Computer Architectures II	30	1
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral exam or written exam The form and scope of the examination will be announced no later than four weeks after the start of the course.	20-40 min. 60 min.	
Study achievements	Seminar presentation with elaboration	15 min, 2500 words	
Qualification goals	In the lecture part, the students receive an overview of different architectures for special requirements. Based on this knowledge, the students should be able to determine an architecture that corresponds to the task. In the seminar, students will use the knowledge they have gained to independently develop new architectural features based on current publications.		
Contents	Architecture development of general-purpose processors, instruction sets, performance-enhancing processing, parallel processing, advanced arithmetic, architectures for special requirements, e.g., graphics processing, digital signal processing, and automotive.		
Applicability in the following courses of study	MA Computer Science MA Electrical Engineering MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: The module 4INFBA010 "Computer Architectures I" should have been successfully completed or corresponding knowledge should be available. Formal: Admission to the examination requires passing the study achievement in this module.		
Prerequisites for the award of LP	Passed examination and passed study achievement.		

Draft version

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

Non-official version

No.	4INFMA024		
Module title	Parallel Processing		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every winter term		
Teaching language	German/English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Parallel processing	60	2
Laboratory	Parallel processing	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination or Written exam The form of the examination will be announced no later than four weeks after the start of the course.	20-40 min 60 min.	
Study achievements	Successful completion of exercise or project tasks	approx. 8 tasks, approx. 45 h	
Qualification goals	Students can apply the various techniques of parallel processing and assess their specific strengths and weaknesses. They can solve practical problems with relevant standards, libraries and tools. They can assess for given applications whether parallelization makes sense and which techniques should be used, if any. They are able to identify the parts in existing sequential programs that can be parallelized and to construct parallel code for these parts. Students will be able to correctly apply relevant methods in the design of parallel programs, especially in performance estimation, problem partitioning and the actual parallelization.		
Contents	Parallel processing is a fundamental technique for increasing the performance or throughput of hardware and software. The course provides theoretical and practical knowledge about the different techniques of parallel processing, with an emphasis on practical application. The module includes a practical course in which the participants independently parallelize smaller programs using different techniques. Specifically, the following topics are covered: • Basics: parallelism, parallel computer architectures, parallelization strategies, data dependencies • Parallel programming with memory coupling: threads, OpenMP, parallel libraries and languages • Parallel programming with message coupling: MPI		
Applicability in the following courses of study	MA Computer Science MA Business Informatics MA Mathematics MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: The modules 4INFBA003 "Algorithms and Data Structures", 4INFBA004 "Object Orientation and Functional Programming", 4INFBA011 "Operating Systems and Concurrent Programming" and 4INFBA010 "Computer Architectures I" should have been successfully completed or corresponding knowledge should be available. Formal: /		
Prerequisites for the award of LP	Passed examination and passed study achievement.		

Draft version

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

Non-official version

No.	4INFMA025		
Module title	Computer Networks II		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every summer term		
Teaching language	German		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Computer Networks II	60	2
Exercise	Computer Networks II	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 min.	
Study achievements	---		
Qualification goals	Upon completion of the module, students will be able to - Explain and evaluate the operation of common network technologies, including wireless networks in particular. - Explain the tasks and functionality of the protocols used on the Internet (in particular multicast, routing and multimedia protocols) and mechanisms (in particular congestion avoidance and QoS) and analyze problems that arise and their solutions. - Create simple programs for network communication - Assess the strengths and weaknesses of various network technologies, evaluate them against given requirements or applications, and select appropriate techniques.		
Contents	The module provides an in-depth insight into important and current network technologies and protocols, with a focus on Ethernet, wireless networks and the Internet protocol family. Topics covered include WAN technologies, WLAN, Bluetooth, advanced IP routing (e.g. multicast, MPLS), IP security, congestion control and avoidance, QoS, network programming and multimedia protocols. Furthermore, outlooks into more specific and current topics are given, e.g. SDN, real-time Ethernet or wireless sensor networks.		
Applicability in the following courses of study	MA Computer Science in Teaching for HRSGe MA Computer Science in the teaching profession for GymGe MA Computer Science in the teaching profession for BK-A MA Computer Science MA Business Informatics MA Digital Engineering – Mechanical Engineering MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: The module 4INFBA012 "Computer Networks I" should have been successfully completed or equivalent knowledge should be available. Formal: /		
Prerequisites for the award of LP	Passed examination		

Draft version

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

Non-official version

No.	4INFMA026		
Module title	Advanced Logic		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every summer term		
Teaching language	German/English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Advanced Logic	60	2
Exercise	Advanced Logic	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 minutes	
Study achievements	---		
Qualification goals	The students * understand the basic limitations of formal methods, * master basic techniques for deciding logical theories, * understand the relationship between logic and automata		
Contents	* Undecidability of satisfiability for predicate logic (Theorem of Church) * Trakhtenbrot's theorem on finite satisfiability * Undecidability of arithmetic * Gödel's incompleteness theorem * Automatic structures * Decidability of Presburger arithmetic * Decidability of real arithmetic * Monadic second-order logic (MSO) * Büchi's theorem (equivalence of finite automata and MSO)		
Applicability in the following courses of study	MA Computer Science MA Mathematics		
Requirements for participation	Content: The modules 4INFBA005 "Formal Languages and Automata" and 4INFBA006 "Computability and Logic" should have been successfully completed or corresponding knowledge should be available. Formal: /		
Prerequisites for the award of LP	Passed examination		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

Non-official version

No.	4INFMA028		
Module title	Algorithmics I		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every winter term		
Teaching language	German/English		
LP	6		
SWS	3		
Classroom study	45 h		
Self-study	135 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Algorithmics I	60	2
Exercise	Algorithmics I	30	1
Achievements	**Form**	**Duration/Scope**	
Examinations	Written exam	60 minutes	
Study achievements	Successful completion of exercise or project tasks	1 task, approx. 10h	
Qualification goals	Students will master basic analysis techniques and design principles and can apply these to concrete algorithmic problems.		
Contents	* Divide-and-conquer algorithms * Greedy algorithms * Dynamic programming * Algorithms for words, trees and graphs * Sorting algorithms * basic data structures (e.g. binary search trees)		
Applicability in the following courses of study	MA Computer Science in Teaching for HRSGe MA Computer Science in the teaching profession for GymGe MA Computer Science in the teaching profession for BK-A MA Computer Science MA Mathematics MA Medical Data Science MA Digital Engineering – Mechanical Engineering MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: The modules 4INFBA003 “Algorithms and Data Structures” and 4MATHBAEX11 “Discrete Mathematics for Computer Scientists” should have been successfully completed or corresponding knowledge should be available. Formal: /		
Prerequisites for the award of LP	Passed examination and passed study achievement		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**	**X***	**After each attempt:**				
			After the last attempt:				**X**
	No:						
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students who enrolled in a degree program whose FPO contains a corresponding regulation (for a supplementary oral examination or for free attempts/grade improvement).**						

Non-binding version

No.	4INFMA029		
Module title	Database systems II		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every summer term		
Teaching language	German/English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Database systems II	60	2
Exercise	Database systems II	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral exam or written exam The form of the examination will be announced no later than four weeks after the start of the course.	20-40 min 120 min.	
Study achievements	---		
Qualification goals	Upon completion of the module, students will be able to • Understand and apply the concepts of graph databases (GDB), • Be able to evaluate and assess the application areas of GDB, • formulate simple queries and transformation rules on GDB, • Explain implementation techniques for GDB and be able to apply them to simple examples.		
Contents	By way of introduction, the limitations of relational database systems are discussed and compared with the basic concepts of graph databases (GDB). The following topics are then covered in more depth: • GDB: Data definition with RDF, LPG • GDB: Requests Neo4J/Cypher, SPARQL		
Applicability in the following courses of study	MA Computer Science MA Computer Science in Teaching for HRSGe MA Computer Science in the teaching profession for GymGe MA Computer Science in the teaching profession for BK-A MA Business Informatics MA Medical Data Science MA Digital Engineering – Mechanical Engineering MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: The module 4INFBA008 "Database Systems I" should have been successfully completed or corresponding knowledge should be available. Formal: /		
Prerequisites for the award of LP	Passed examination		

Draft version

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**	**X***	**After each attempt:**				
			After the last attempt:				**X**
	No:						
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Only applies to students who are enrolled in a degree program whose FPO contains a corresponding regulation (for a supplementary oral examination or for free attempts/grade improvement).**						

Non-official version

No.	4INFMA100		
Module title	Development of Embedded Systems using FPGAs		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every winter term		
Teaching language	English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Development of Embedded Systems using FPGAs	60	2
Exercise	Development of Embedded Systems using FPGAs	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral exam or written exam The form of the examination will be announced no later than four weeks after the start of the course.	20-40 min. 120 min.	
Study achievements	Successful completion of exercise or project tasks	approx. 12 tasks, approx. 30 h	
Qualification goals	This course provides students with the ability to design embedded systems using field programmable gate arrays. The goal of this module is to enable students to identify requirements and design the hardware and software architecture. In addition, students will learn how to simulate the design, implement and validate the functionality of embedded systems.		
Contents	• Introduction (what are embedded systems, properties of such systems, what is an FPGA). • Processing units (what is a processor, hardcore vs. softcore, ARM processors, softcore processors). • Memory (non-volatile memory: Flash, SD card, volatile memory: SRAM, BRAM, DDR, cache memory, DMAs) • Communication systems (off-chip and on-chip solutions, buses and NoCs, AMBA bus (AXI), OCP, shared memory) • Man-machine interfaces (timers and counters, keyboards, LEDs, displays, barcode readers) • Embedded software (what is BSP? Bare metal application, • Hardware/software co-design (state machines, introduction to Verilog). • Validation and debugging (debugging techniques, error injection)		
Applicability in the following courses of study	BA Computer Science BA Dual Study Computer Science BA Digital Engineering – Electrical Engineering MA Computer Science MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: The modules 4INFBA009 "Digital Technology" and 4INFBA010 "Computer Architectures I" should have been successfully completed or corresponding knowledge should be available. Formal: Admission to the examination requires passing the study achievement in this module.		
Prerequisites for the award of LP	Passed examination and passed study achievement.		

Draft version

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

Non-official version

No.	4INFMA101		
Module title	Laboratory Ubiquitous Systems		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every semester		
Teaching language	English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Laboratory Ubiquitous Systems	60	1
Laboratory	Laboratory Ubiquitous Systems	30	3
Achievements	**Form**	**Duration/Scope**	
Examinations	Term paper (final report)	20 pages	
Study achievements	---		
Qualification goals	Students develop an understanding of efficiency in the field of embedded systems and become familiar with the design, development and implementation of efficient software. They are able to create structured and hardware-oriented programs and master the handling of complex data sheets and manuals.		
Contents	Hardware-oriented programming in C of energy-efficient ultra-low power microcontrollers. Core topics covered include signal input and output, polling and interrupts, timers, and power management.		
Applicability in the following courses of study	BA Computer Science BA Dual Study Computer Science BA Digital Engineering – Electrical Engineering MA Computer Science in Teaching for HRSGe MA Computer Science in the teaching profession for GymGe MA Computer Science in the teaching profession for BK-A MA Computer Science MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: Knowledge of the C programming language. Formal: /		
Prerequisites for the award of LP	Passed examination		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

Non-official version

No.	4INFMA102		
Module title	Storage Technologies		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every summer term		
Teaching language	English/German		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Storage Technologies	60	2
Exercise	Storage Technologies	30	1
Seminar	Storage Technologies	30	1
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 min.	
Study achievements	Seminar presentation with elaboration	20 min, 5 pages	
Qualification goals	After completion of the module - know the memory pyramid from register, cache, main memory and mass storage to archive systems, - have gained an overview of the various methods for storage on rotating media, with a view to the future also being essential, - have understood where the limits of storage density on hard disks are, - Are able to explain volatile and non-volatile memory and explain the technologies and - have learned to distinguish well between values that are possible in the ideal case and those that occur in practice, e.g. for interfaces.		
Contents	Rotating memory: - Basics of data storage - Writing and reading methods and their performance limits - Interfaces Solid state storage: - Methods for storing individual bits, such as SRAM, DRAM, FeRAM,... - Semiconductor memory architectures - Interfaces		
Applicability in the following courses of study	MA Computer Science MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: The modules 4INFBA009 "Digital Technology" and 4INFBA010 "Computer Architectures I" should have been successfully completed or corresponding knowledge should be available. Formal: Admission to the examination requires passing the study achievement in this module.		
Prerequisites for the award of LP	Passed examination and passed study achievement.		

Official version

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

Non-official version

No.	4INFMA103		
Module title	StartUp Entrepreneurship		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	irregular		
Teaching language	English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	StartUp Entrepreneurship	60	2
Exercise	StartUp Entrepreneurship	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Overall examination consisting of the examination elements: Seminar lecture (50 %) with term paper (50 %)	 30 min 5000 words	
Study achievements	---		
Qualification goals	Teaching ability, analysis techniques and presentation to start a business. Successful processing and creation of: • Business Model Canvas • Business plan • Business pitches		
Contents	This course is aimed at all students who have already thought about starting their own company or are actually planning to do so. Also students with an idea who already or not yet know how to market their product will get their money's worth in this course. It will be shown how easy it is to start a business nowadays. The university gives founders the support they need. Within the framework of a cross-faculty university-wide association of institutions, interested parties are provided with simple tools for a possible business start-up. These include working out a business plan on their own, preparing pitches, as well as providing funding and support before, during and after the startup. You will learn exciting stories of founders and start-ups around the university and if you are further interested after the course, you can apply for the incubator program "One Small Step". Here you can set the course for your career as a company founder. The topics of the course are: • Business Idea / Innovation • Business Model / Team • Market and Competitor Analysis • Start-up Ecosystem in Siegen • Financing Options / The Proposal • Prototyping / Incubator • IP/ forms of enterprise/corporate law • The perfect pitch		
Applicability in the following courses of study	BA Computer Science BA Dual Study Computer Science MA Computer Science MA EMINENT		
Requirements for participation	Content: / Formal: /		
Prerequisites for the award of LP	Passed examination		

Draft version

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

Non-official version

No.	4INFMA104		
Module title	Selected Topics in Processor Architecture		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Irregular		
Teaching language	German/English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Selected Topics in Processor Architecture	60	2
Exercise	Selected Topics in Processor Architecture	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 min.	
Study achievements	---		
Qualification goals	The students have in-depth knowledge in selected topics of processor architectures. They are able to work on corresponding hardware design issues and efficient applications based on processor architectures using specific methods.		
Contents	• Presentation of in-depth questions and methods in the field of processor architectures • Properties of the presented processor architectures		
Applicability in the following courses of study	MA Computer Science BA Digital Engineering – Electrical Engineering MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: Module 4INFBA010 “Computer Architectures I” should have been successfully completed or corresponding knowledge should be available. Formal: /		
Prerequisites for the award of LP	Passed examination		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

Non-official version

No.	4INFMA197		
Module title	Foreign module Embedded Systems I		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Irregular		
Teaching language	country-specific		
LP	6		
SWS			
Classroom study			
Self-study			
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
According to host university			
Achievements	**Form**	**Duration/Scope**	
Examinations	According to host university		
Study achievements	According to host university		
Qualification goals	Students acquire advanced qualifications at a foreign university that enable them to understand and apply concepts, methods and tools in the field of embedded systems that are not taught at the University of Siegen or not taught to the corresponding extent.		
Contents	The concrete contents of this module depend on the receiving university. They are to be determined prior to the stay abroad, whereby a substantial overlapping of content with other modules is to be excluded. The subsequent recognition of the work performed abroad must be ensured in advance by means of a learning agreement.		
Applicability in the following courses of study	MA Computer Science MA Digital Engineering – Electrical Engineering		
Requirements for participation	---		
Prerequisites for the award of LP	Passing the module at the receiving university. Learning Agreement for creditability of services.		

Non-official version

No.	4INFMA198		
Module title	Foreign module Embedded Systems II		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Irregular		
Teaching language	country-specific		
LP	6		
SWS			
Classroom study			
Self-study			
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
According to host university			
Achievements	**Form**	**Duration/Scope**	
Examinations	According to host university		
Study achievements	According to host university		
Qualification goals	Students acquire advanced qualifications at a foreign university that enable them to understand and apply concepts, methods and tools in the field of embedded systems that are not taught at the University of Siegen or not taught to the corresponding extent.		
Contents	The concrete contents of this module depend on the receiving university. They are to be determined prior to the stay abroad, whereby a substantial overlapping of content with other modules is to be excluded. The subsequent recognition of the work performed abroad must be ensured in advance by means of a learning agreement.		
Applicability in the following courses of study	MA Computer Science MA Digital Engineering – Electrical Engineering		
Requirements for participation	---		
Prerequisites for the award of LP	Passing the module at the receiving university. Learning Agreement for creditability of services.		

Non-official version

No.	4INFMA199		
Module title	Foreign module Embedded Systems III		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Irregular		
Teaching language	country-specific		
LP	6		
SWS			
Classroom study			
Self-study			
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
According to host university			
Achievements	**Form**	**Duration/Scope**	
Examinations	According to host university		
Study achievements	According to host university		
Qualification goals	Students acquire further qualifications at a foreign university that enable them to understand and apply concepts, methods and tools in the field of embedded systems that are not taught at the University of Siegen or not to the corresponding extent.		
Contents	The concrete contents of this module depend on the receiving university. They are to be determined prior to the stay abroad, whereby a substantial overlapping of content with other modules is to be excluded. The subsequent recognition of the work performed abroad must be ensured in advance by means of a learning agreement.		
Applicability in the following courses of study	MA Computer Science MA Digital Engineering – Electrical Engineering		
Requirements for participation	---		
Prerequisites for the award of LP	Passing the module at the receiving university. Learning Agreement for creditability of services.		

Non-official version

No.	4INFMA200		
Module title	Rendering		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	summer term		
Teaching language	English		
LP	6		
SWS	3		
Classroom study	45 h		
Self-study	135 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Rendering	60	2
Exercise	Rendering	30	1
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 min.	
Study achievements	Successful completion of exercise or project tasks	1 task, approx. 30 h	
Qualification goals	Students can describe methods and concepts of physically based rendering using global illumination using path tracing (rendering equation, Monte Carlo-based sampling, bidirectional reflectance distribution function (BRDF) and specific visual effects such as caustics and soft shadows), evaluate their applicability in given situations and use and implement them in simple use cases.		
Contents	Physically based rendering, complex material models and BRDFs, global illumination, Monte-Carlo methods, image based rendering, point based rendering.		
Applicability in the following courses of study	BA Computer Science BA Dual Study Computer Science BA Digital Engineering - Electrical engineering MA Computer Science MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: The modules 4INFBA020 "Introduction to Visual Computing" and 4INFBA200 "Computer Graphics" should have been successfully completed or corresponding knowledge should be available. Formal: Admission to the examination requires passing the study achievement in this module.		
Prerequisites for the award of LP	Passed examination and passed study achievement.		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

Non-binding version

No.	4INFMA201		
Module title	GPU Programming		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	irregular		
Teaching language	English		
LP	6		
SWS	3		
Classroom study	45 h		
Self-study	135 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	GPU Programming	60	1
Laboratory	GPU Programming	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 min.	
Study achievements	Successful completion of exercise or project tasks	1 task, approx. 30 h	
Qualification goals	The student understands concepts of graphics processing units as well as selected algorithms, can describe and evaluate them and use and implement them in simple programs.		
Contents	Concepts of Graphics Processing Units (GPUs), GPU resource management and execution model, thread cooperation, memory models, selected algorithms, advanced GPU features, GPU programming interface		
Applicability in the following courses of study	MA Computer Science		
Requirements for participation	Content: / Formal: Admission to the examination requires passing the study achievement in this module.		
Prerequisites for the award of LP	Passed examination and passed study achievement.		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

No.	4INFMA202		
Module title	Scientific Visualization		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	every winter term		
Teaching language	English		
LP	6		
SWS	3		
Classroom study	45 h		
Self-study	135 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Scientific Visualization	60	2
Exercise	Scientific Visualization	30	1
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 min.	
Study achievements	Successful completion of exercise or project tasks	1 task, approx. 30 h	
Qualification goals	The student understands visualization methods, can describe and evaluate them and use and implement them in simple programs.		
Contents	Grids and interpolation, triangulation, 2D scalar fields, 2D vector fields, 3D vector fields, indirect and direct volume visualization		
Applicability in the following courses of study	BA Computer Science BA Dual Study Computer Science BA Digital Engineering - Electrical engineering MA Computer Science MA Engineering of Hydro-Environmental Extremes MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: The module 4INFBA020 "Introduction to Visual Computing" should have been successfully completed or corresponding knowledge should be available. Formal: Admission to the examination requires passing the study achievement in this module.		
Prerequisites for the award of LP	Passed examination and passed study achievement.		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

No.	4INFMA203		
Module title	Statistical Learning Theory		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every summer term		
Teaching language	English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Statistical Learning Theory	60	2
Exercise	Statistical Learning Theory	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20 - 40 min.	
Study achievements	---		
Qualification goals	The lecture broadens and deepens the knowledge from the lecture Introduction to Machine Learning. Students develop a more mathematically sound understanding of the learning problem and become familiar with methods that are more theoretically motivated. Nevertheless, the lecture remains application-oriented: only methods and concepts that are of practical relevance and which, together with those from the Introduction to Machine Learning lecture, are part of the basic repertoire of modern AI are covered. Intuitive understanding and the ability to make judgments are at the forefront of all lecture content.		

Contents	The lecture starts with some basic considerations on learning theory, a general formulation in terms of risk minimization and VC dimension, followed by a selection of the most important learning methods of supervised and unsupervised learning, as far as they have not already been covered in *Introduction to Machine Learning*:
	• Algorithm-independent properties: Curse of Dimensionality, No-free-lunch Theorem
	• Risk Minimization, VC Dimension, Support Vector Machines, Kernel Methods
	• Neural Networks revisited:
	  ○ Transfer Learning
	  ○ Long Short Term Memory LSTM
	  ○ Current developments
	• Density Estimation, Clustering Methods
	• Gaussian Mixture Models
	• Hidden Markov Models
	• Graphical Models, Bayes Networks, Decision Trees
	• Application examples from different areas		

Applicability in the following courses of study	BA Computer Science BA Dual Study Computer Science MA Computer Science MA Mathematics MA Quantum Science BA Digital Engineering – Electrical Engineering MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: The module 4INFBA013 "Introduction to Machine Learning" should have been successfully completed or corresponding knowledge should be available.		

	Formal: /
Prerequisites for the award of LP	Passed examination

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

No.	4INFMA204		
Module title	Deep Learning		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every winter term		
Teaching language	English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Deep Learning	60	2
Exercise	Deep Learning	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Written exam	90 min.	
Study achievements	Successful completion of exercise or project tasks	approx. 12 tasks, approx. 45 h	
Qualification goals	Upon completion of this module, students understand the basic concepts of deep learning. They can analyze the chain rule for nested functions with several variables and are able to implement the gradient descent algorithm for simple networks from scratch. Students are familiar with a deep learning framework and can implement architectures for regression and classification problems on their own. Students are familiar with different design patterns for the architecture of neural networks, and can explain crucial steps for the successful training and generalization of neural networks.		
Contents	The following topics will be covered in this module: - Supervised machine learning as a function approximation problem - Simple network architectures: Fully connected layers, activation functions - Gradient descent for nested functions: The chain rule and its implementation via backpropagation - Stochastic gradient descent on large data sets, accelerations - Training, testing, and validation data sets - Strategies for successful training and generalization - State-of-the-art architecture design - Practical experience in numerical implementations		
Applicability in the following courses of study	BA Digital Engineering – Electrical Engineering MA Computer Science MA Mathematics MA Mechanical Engineering MA Electrical Engineering MA Industrial Engineering MA Medical Data Science MA Mechatronics MA Quantum Science MA Engineering of Hydro-Environmental Extremes MA EMINENT MA Digital Engineering – Mechanical Engineering MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: Machine Learning knowledge at the level of an introductory course is assumed, as well as knowledge of Linear Algebra and Analysis. Formal: Admission to the examination requires passing the study achievement in this module.		
Prerequisites for the award of LP	Passed examination and passed study achievement.		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**	**X***	**After each attempt:**				
			After the last attempt:			**X**	
	No:						
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Only applies to students who are enrolled in a degree program whose FPO contains a corresponding regulation (for a supplementary oral examination or for free attempts/grade improvement).**						

No.	4INFMA205		
Module title	Recent Advances in Machine Learning		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every summer term		
Teaching language	English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Recent Advances in Machine Learning	60	2
Project work	Recent Advances in Machine Learning	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	---		
Study achievements	Seminar presentation with elaboration	20 min., 5 pages	
Qualification goals	Upon completion of this module, students have an understanding of some exemplary state-of-the-art research papers on machine learning. They are able to explain their main ideas and concepts. Students are familiar with at least one machine learning framework and are able to implement machine learning problems on their own. Additionally, each student specializes in one research paper for which she/he is able to understand, explain, analyze and evaluate the discussed technique. The students are able to run practical experiments for the studied method.		
Contents	This module presents recent advances in machine learning in different fields of data sciences, e.g. imaging, vision, graphics, mechatronics, and sensorics. It addresses advanced techniques in the fields of machine learning, deep learning and artificial intelligence, with a particular focus on recent research papers, novel application areas and open questions in the aforementioned fields. Based on basic prior knowledge gained in other courses, this module specifically focuses on the state-of-the-art in machine learning by introducing recent publications from the leading international conferences on machine learning, computer vision, or their application in fields like computer graphics, 3D reconstruction, robotics, navigation, medicine, or body-worn sensorics. After covering the theory of such works, a project phase will ask every student to implement and apply one of the discussed techniques.		
Applicability in the following courses of study	MA Computer Science MA Mathematics MA Medical Data Science MA Quantum Science MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: knowledge of machine learning is assumed. Formal: /		
Prerequisites for the award of LP	Passed academic performance		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**	**X***	**After each attempt:**				
			After the last attempt:			**X**	
	No:						
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Only applies to students who are enrolled in a degree program whose FPO contains a corresponding regulation (for a supplementary oral examination or for free attempts/grade improvement).**						

No.	4INFMA206/2		
Module title	Optimization for Machine Learning		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every summer term		
Teaching language	English		
LP	6		
SWS	5		
Classroom study	75 h		
Self-study	105 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Optimization for Machine Learning	60	3
Exercise	Optimization for Machine Learning	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 min.	
Study achievements	Successful completion of exercise or project tasks	approx. 12 tasks, approx. 30 h	
Qualification goals	Upon completion of this module, students will be proficient in the relevant aspects of optimization. They are able to understand, apply and implement different numerical methods for nonlinear optimization problems, including problems involving constraints and non-differentiable functions. The students will understand the convergence analysis of common nonlinear optimization algorithms along with their sufficient conditions. Students will be able to implement optimization algorithms arising from different machine learning problems on their own.		
Contents	Optimization algorithms for machine learning. First order methods, second order methods, handling of constraints and non-differentiability, conditions for convergence. Practical algorithmic aspects and strategies beyond provable convergence. Practical implementations.		
Applicability in the following courses of study	MA Computer Science MA Business Analytics MA Quantum Science MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: Solid knowledge of linear algebra and calculus is assumed. The ability to program in MATLAB or Python is also required. Formal: Admission to the examination requires passing the study achievement in this module.		
Prerequisites for the award of LP	Passed examination and passed study achievement.		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

No.	4INFMA207		
Module title	Numerical Methods for Visual Computing		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every winter term		
Teaching language	English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Numerical Methods for Visual Computing	60	2
Exercise	Numerical Methods for Visual Computing	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 min.	
Study achievements	Successful completion of exercise or project tasks	approx. 12 tasks, approx. 45 h	
Qualification goals	Upon completion of this module, students understand, are able to apply and implement numerical methods for basic tasks arising in data sciences. They understand sources of errors in their computations and are aware of the condition of algorithms. Students can reduce exemplary visual computing problems to more abstract mathematical problems and solve them with suitable algorithms.		
Contents	The following topics will be covered in this module: - Error analysis, rounding errors, error amplification, catastrophic cancellation - Gaussian normal equation, minimal-norm solutions - Solving linear equations exactly as well as iteratively - Numerical methods for computing eigenvectors and eigenvalues - Fixed-point iterations for solving nonlinear equations - Solving interpolation problems - Numerical integration - Practical implementation of the above numerical methods for the example applications		
Applicability in the following courses of study	BA Computer Science BA Dual Study Computer Science MA Computer Science MA Electrical engineering MA Engineering of Hydro-Environmental Extremes MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: Knowledge of linear algebra and calculus is assumed. Formal: Admission to the examination requires passing the study achievement in this module.		
Prerequisites for the award of LP	Passed examination and passed study achievement.		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

No.	4INFMA208		
Module title	Machine Vision		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	summer term		
Teaching language	English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Machine Vision	60	2
Exercise	Machine Vision	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 min.	
Study achievements	---		
Qualification goals	The lecture provides a deeper understanding of the *problem of* vision and the underlying mechanisms of image formation and image analysis. It avoids any *black boxes* as solution approaches and thus positions itself as an antithesis to many statistical procedures of pattern recognition. Students learn not only to know the basic procedures, but also to analyze and evaluate them in terms of theoretical and practical advantages and disadvantages. Students apply the simpler of the procedures themselves in the context of practice by implementing example programs. They develop an understanding of the historical development of the research field and become sensitized to the challenges of machine vision, its opportunities and current limitations.		
Contents	The lecture covers two classical problems of machine vision: the inference of 3D structure from 2D image data, and automatic face recognition. • Theories of vision, vision as inverse optics, • Brief summary of edge and feature detectors • Camera models, homogeneous coordinates, calibration • Depth sensors (time-of-flight methods, triangulation) Stereo algorithms, correspondence problem, epipolar geometry, fundamental matrix, multi-view geometry. • Image rectification, use of the pseudo inverses • Overview of personal identification procedures • Eigenfaces, PCA • Deformable models in 2D and 3D: Active Appearance Models, Morphable Models • Evaluation criteria for classification procedures, ROC curves		
Applicability in the following courses of study	MA Computer Science MA Mathematics MA Medical Data Science MA Mechatronics BA Digital Engineering – Electrical Engineering MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: Basic mathematical knowledge at the level of a Bachelor's module is required. Formal: ---		
Prerequisites for the award of LP	Passed examination		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**	**X***	**After each attempt:**				
			After the last attempt:			**X**	
	No:						
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Only applies to students who are enrolled in a degree program whose FPO contains a corresponding regulation (for a supplementary oral examination or for free attempts/grade improvement).**						

No.	4INFMA210		
Module title	Virtual Reality		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	every summer term		
Teaching language	English		
LP	6		
SWS	3		
Classroom study	45 h		
Self-study	135 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Virtual Reality	60	1
Laboratory	Virtual Reality	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 min.	
Study achievements	Successful completion of exercise or project tasks	1 task, approx. 30 h	
Qualification goals	The student understands concepts and techniques of Virtual Reality, can evaluate them and use and implement them in simple programs.		
Contents	Human perception, VR hardware, VR software frameworks, level of detail techniques, interaction/selection/manipulation/navigation, aspects of Augmented Reality.		
Applicability in the following courses of study	MA Computer Science MA Engineering of Hydro-Environmental Extremes		
Requirements for participation	Content: The module 4INFBA020 "Introduction to Visual Computing" should have been successfully completed or corresponding knowledge should be available. Formal: Admission to the examination requires passing the study achievement in this module.		
Prerequisites for the award of LP	Passed examination and passed study achievement.		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

No.	4INFMA211		
Module title	Higher Level Computer Vision		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	irregular		
Teaching language	English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Higher Level Computer Vision	60	2
Exercise	Higher Level Computer Vision	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 min.	
Study achievements	---		
Qualification goals	• Deep understanding of current computer vision methods for image classification, object detection, image segmentation, image generation, and domain transfer. • Understand, apply, and evaluate current approaches. • Understanding of the technical principles of computer vision methods. • Evaluation and discussion of new computer vision problems and methods.		
Contents	Current issues, methods and datasets in computer vision for image classification, object detection, image segmentation, image generation and domain transfer.		
Applicability in the following courses of study	MA Computer Science MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: Basic knowledge of linear algebra and python is assumed. Formal: /		
Prerequisites for the award of LP	Passed examination		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

No.	4INFMA212		
Module title	Unsupervised Learning		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	every winter term		
Teaching language	English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Unsupervised Learning	60	2
Exercise	Unsupervised Learning	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 min.	
Study achievements	---		
Qualification goals	• Deep understanding of current methods of unsupervised learning of image and text representations, self-supervised learning, representation learning, generative models. • Understand, apply, and evaluate current approaches. • Understanding the technical underpinnings of unsupervised learning methods. • Evaluate and discuss new learning problems and unsupervised and self-supervised methods.		
Contents	Current issues, methods, and datasets of unsupervised learning in image and text processing, including LSTMs, transformers, generative models.		
Applicability in the following courses of study	MA Computer Science MA Mechatronics MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: Basic knowledge of linear algebra and python is assumed. Formal: /		
Prerequisites for the award of LP	Passed examination		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

No.	4INFMA213		
Module title	Visual Analytics		
Compulsory/elective	WP		
Module duration	1 Semester		
Offering frequency	every summer term		
Teaching language	Englisch		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Visual Analytics	30	2
Lab	Visual Analytics	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 Min.	
Study achievements	Successful completion of exercise or project tasks	Weekly assigments or 1 project task	
Qualification goals			
Upon completion of this module, students understand the basic concepts of visual analytics. Students can explain visualization methods and automated algorithms used in the context of visual analytics. They can justify decisions on which techniques to use for specific problems. Students are familiar with different algorithms and visual representations for explorative data visualization, can apply the algorithms and interpret the results. They can combine the techniques to develop visual analytics solutions for new datasets.			
Contents			
Data types, visual encodings for different data types (tabular data, multivariate data, graphs), interaction techniques, unsupervised learning algorithms for visualization (dimensionality reduction, hierarchical clustering)			
Applicability in the following courses of study	MA Computer Science BA Informatik BA Informatik dual		
Requirements for participation	Content: Knowledge from the module 4INFBA013 „Introduction to Machine Learning“ should be available. Formal: Admission to the examination requires passing the study achievement in this module.		
Prerequisites for the award of LP	Passed examination and passed study achievement.		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**	**X***	**After each attempt:**				
			After the last attempt:			**X**	
	No:						
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students who are enrolled in a degree program whose FPO contains a corresponding regulation (for a supplementary oral examination or for free attempts/grade improvement).**						

No.	4INFMA214		
Module title	3D Machine Learning		
Compulsory/elective	WP		
Module duration	1 Semester		
Offering frequency	every winter term		
Teaching language	Englisch		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	3D Machine Learning		2
Lab	3D Machine Learning		2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 Min.	
Study achievements	Successful completion of exercise or project tasks	Weekly assigments or 1 project task	
Qualification goals			
Upon completion of this module, students understand the basic concepts of 3D machine learning. Students are familiar with 3D representations and can partially implement and train architectures for 3D image synthesis problems on their own. Students are familiar with different approaches to learn 3D representations, and can explains crucial steps for the successful training and can evaluate different concepts. They can explain, analyze and evaluate the discussed techniques for 3D machine learning.			
Contents			
Deep learning (concepts and architectures) and 3D primer; learning on 3D representations (volumes, points, meshes); learning-based 3D image synthesis differentiable rendering, neural radiance fields, Gaussian splatting); recently topics related to 3D machine Learning from a graphics perspective			
Applicability in the following courses of study	MA Computer Science		
Requirements for participation	Content: Knowledge from the modules 4INFBA020 „Introduction to Visual Computing“ and 4INFBA013 „Introduction to Machine Learning“ should be available. Formal: Admission to the examination requires passing the study achievement in this module.		
Prerequisites for the award of LP	Passed examination and passed study achievement.		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**	**X***	**After each attempt:**				
			After the last attempt:			**X**	
	No:						
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students who are enrolled in a degree program whose FPO contains a corresponding regulation (for a supplementary oral examination or for free attempts/grade improvement).**						

No.	4INFMA215		
Module title	Automated Machine Learning		
Compulsory/elective	WP		
Module duration	1 Semester		
Offering frequency	every summer term		
Teaching language	Englisch		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Automated Machine Learning		2
Exercise	Automated Machine Learning		2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 Min.	
Study achievements	Successful completion of a project task	45 h	
Qualification goals			
After successfully completing the lecture, students will be able to - explain the basic concepts of automated machine learning, - understand and critically evaluate the entire AutoML process - compare different AutoML frameworks and assess their areas of application, - select and apply appropriate AutoML strategies for different problems (e.g., classification, regression). - implement, configure, and evaluate AutoML systems in practice.			
Contents			
The following topics will be covered in this module: - Evaluation of Machine Learning and Automated Machine Learning - Hyperparameter Optimization - Neural Architecture Search - AutoML in practice - Current research and trends			
Applicability in the following courses of study	MA Computer Science		
Requirements for participation	Content: At least one of the modules 4INFMA212 “Unsupervised Learning“ or 4INFMA204 „Deep Learning” should have been successfully passed or the corresponding knowledge should be available. Basic knowledge of machine learning, practical experience with deep learning, and Python programming skills are required.		
Prerequisites for the award of LP	Passed examination and passed study achievement.		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**	**X***	**After each attempt:**				
			After the last attempt:			**X**	
	No:						
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Repeat examination for free attempt possible	**Yes:**	**X**					
	No:						
Special features	*** Applies only to students who are enrolled in a degree program whose FPO contains a corresponding regulation (for a supplementary oral examination or for free attempts/grade improvement).**						

No.	4INFMA297		
Module title	Foreign module Visual Computing I		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Irregular		
Teaching language	country-specific		
LP	6		
SWS			
Classroom study			
Self-study			
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
According to host university			
Achievements	**Form**	**Duration/Scope**	
Examinations	According to host university		
Study achievements	According to host university		
Qualification goals	Students acquire advanced qualifications at a foreign university that enable them to understand and apply concepts, methods, and tools in the field of visual computing that are not taught at the University of Siegen or not taught to the corresponding extent.		
Contents	The concrete contents of this module depend on the receiving university. They are to be determined prior to the stay abroad, whereby a substantial overlapping of content with other modules is to be excluded. The subsequent recognition of the work performed abroad must be ensured in advance by means of a learning agreement.		
Applicability in the following courses of study	MA Computer Science MA Digital Engineering – Mechanical Engineering MA Digital Engineering – Electrical Engineering		
Requirements for participation	---		
Prerequisites for the award of LP	Passing the module at the receiving university. Learning Agreement for creditability of services.		

No.	4INFMA298		
Module title	Foreign Module Visual Computing II		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Irregular		
Teaching language	country-specific		
LP	6		
SWS			
Classroom study			
Self-study			
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
According to host university			
Achievements	**Form**	**Duration/Scope**	
Examinations	According to host university		
Study achievements	According to host university		
Qualification goals	Students acquire advanced qualifications at a foreign university that enable them to understand and apply concepts, methods, and tools in the field of visual computing that are not taught at the University of Siegen or not taught to the corresponding extent.		
Contents	The concrete contents of this module depend on the receiving university. They are to be determined prior to the stay abroad, whereby a substantial overlapping of content with other modules is to be excluded. The subsequent recognition of the work performed abroad must be ensured in advance by means of a learning agreement.		
Applicability in the following courses of study	MA Computer Science MA Digital Engineering – Mechanical Engineering MA Digital Engineering – Electrical Engineering		
Requirements for participation	---		
Prerequisites for the award of LP	Passing the module at the receiving university. Learning Agreement for creditability of services.		

No.	4INFMA299		
Module title	Foreign Module Visual Computing III		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Irregular		
Teaching language	country-specific		
LP	6		
SWS			
Classroom study			
Self-study			
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
According to host university			
Achievements	**Form**	**Duration/Scope**	
Examinations	According to host university		
Study achievements	According to host university		
Qualification goals	Students acquire advanced qualifications at a foreign university that enable them to understand and apply concepts, methods, and tools in the field of visual computing that are not taught at the University of Siegen or not taught to the corresponding extent.		
Contents	The concrete contents of this module depend on the receiving university. They are to be determined prior to the stay abroad, whereby a substantial overlapping of content with other modules is to be excluded. The subsequent recognition of the work performed abroad must be ensured in advance by means of a learning agreement.		
Applicability in the following courses of study	MA Computer Science MA Digital Engineering – Mechanical Engineering MA Digital Engineering – Electrical Engineering		
Requirements for participation	---		
Prerequisites for the award of LP	Passing the module at the receiving university. Learning Agreement for creditability of services.		

No.	4INFMA300		
Module title	Algorithmics II		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every summer term		
Teaching language	German/English		
LP	6		
SWS	3		
Classroom study	45 h		
Self-study	135 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Algorithmics II	60	2
Exercise	Algorithmics II	30	1
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 min.	
Study achievements	Successful completion of exercise or project tasks	1 task, approx. 10h	
Qualification goals	Students will master advanced algorithmic techniques and data structures, and can apply them to concrete problems.		
Contents	* Advanced data structures (e.g. union-find structures, Fibonacci heaps, compact data structures). * Randomized algorithms * Parallel algorithms * Algorithms for data streams * Number theoretic algorithms		
Applicability in the following courses of study	MA Computer Science MA Mathematics MA Digital Engineering – Mechanical Engineering MA Digital Engineering – Electrical Engineering		
Requirements for participation	Content: The module 4INFMA028 "Algorithmics I" should have been successfully completed. Formal: /		
Prerequisites for the award of LP	Passed examination and passed study achievement		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

No.	4INFMA301		
Module title	Model Checking		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every winter term		
Teaching language	German/English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Model Checking	60	3
Exercise	Model Checking	30	1
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral exam or written exam The form of the examination will be announced no later than four weeks after the start of the course.	20-40 min. 90 min.	
Study achievements	---		
Qualification goals	Learning basic techniques and tools for the formal specification and verification of hardware and software systems. After completing the module, students should be able to select, evaluate and apply suitable techniques for concrete problems. In particular, they should learn how system properties can be expressed by formal languages such as temporal logics.		
Contents	- Process algebra and process equivalence - Linear Temporal Logic (LTL) and LTL Model Checking - Computation Tree Logic (CTL) and CTL Model Checking - Selected special topics		
Applicability in the following courses of study	BA Computer Science BA Dual Study Computer Science MA Computer Science		
Requirements for participation	Content: The modules 4MATHBAEX11 "Discrete Mathematics", 4INFBA005 "Formal Languages and Automata" and 4INFBA006 "Computability and Logic" should have been successfully completed or corresponding knowledge should be available. Formal: /		
Prerequisites for the award of LP	Passed examination		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

No.	4INFMA304		
Module title	Complexity Theory II		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Irregular		
Teaching language	German/English		
LP	6		
SWS	3		
Classroom study	45 h		
Self-study	135 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Complexity theory II	60	2
Exercise	Complexity theory II	30	1
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 min.	
Study achievements	Successful completion of exercise or project tasks	1 task, approx. 10h	
Qualification goals	Students will understand advanced techniques for analyzing the difficulty of algorithmic problems, and can apply the techniques to concrete problems.		
Contents	* Relativized complexity classes * Randomized complexity classes * Interactive proof systems * Circuit complexity * Communication complexity		
Applicability in the following courses of study	MA Computer Science MA Mathematics		
Requirements for participation	Content: The module 4INFBA302 "Complexity Theory I" should have been successfully completed or corresponding knowledge should be available. Formal: /		
Prerequisites for the award of LP	Passed examination and passed study achievement		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

No.	4INFMA305		
Module title	Ubiquitous Computing		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every semester		
Teaching language	German/English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Ubiquitous Computing	60	2
Exercise	Ubiquitous Computing	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral exam or written exam The form of the examination is announced no later than four weeks after the start of the course.	20-40 min. 60 min.	
Study achievements	---		
Qualification goals	Students deepen their familiarity with basic concepts in the field of ubiquitous computing and, after participation, are able to identify the new computing systems and apply relevant tools and terms from the fields of wearable computing and wireless sensor networks. In the exercises, they will learn to develop software and user interface for wearables and sensor nodes and conduct user studies independently.		
Contents	The term "ubiquitous computing" refers to the ubiquity of tiny, interconnected wireless computers that can be built into or attached to any everyday object. Equipped with sensors, they can sense the object's environment or endow it with information processing and communication capabilities, giving objects a new, additional quality. On the one hand, the lecture gives an overview of the relevant concepts and basic technologies (e.g. wireless sensor networks, embedded systems, wearable computing), but on the other hand it also addresses more specific topics (e.g. context awareness, activity recognition, privacy and security issues, "Ubicomp" research methods).		
Applicability in the following courses of study	MA Computer Science MA Mechanical Engineering MA Medical Data Science MA Digital Engineering – Mechanical Engineering MA Digital Engineering – Electrical Engineering		
Requirements for participation	---		
Prerequisites for the award of LP	Passed examination		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**	**X***	**After each attempt:**				
			After the last attempt:			**X**	
	No:						
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students who are enrolled in a degree program whose FPO contains a corresponding regulation (for a supplementary oral examination or for free attempts/grade improvement).**						

No.	4INFMA307/2		
Module title	Advanced Programming in C++		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every summer term		
Teaching language	English		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Advanced Programming in C++	50	2
Exercise	Advanced Programming in C++	50	2
Achievements	**Form**	**Duration/Scope**	
Examinations	The overall exam consists of 5 graded exercise sheets, which are to be completed independently on paper during the practice sessions at two-week intervals. An alternate date is provided in the event of illness. The grade is determined based on the total number of points, with the following weightings for the worksheets: 15%, 15%, 15%, 15%, and 40%.	5 exercise sheets with 60 min each.	
Study achievements	none		
Qualification goals	In this course, students design and analyze C++ software using key object-oriented principles such as inheritance, polymorphism, abstract methods, design patterns, and interfaces. They learn advanced C++ concepts, including the Standard Template Library (STL), smart pointers, and the non-virtual interface (NVI) idiom. Particular emphasis is placed on best practices for code correctness, including move semantics, const correctness, and the Rule of Five. In addition, students will develop a fundamental understanding of abstraction, modularization, and build systems, as well as how compilers and linkers work. The course also covers current C++ standards and their modern language features to enable contemporary and efficient software development. By the end of the course, students will be able to: develop robust and maintainable C++ software using modern language features; implement efficient memory management with smart pointers and move semantics; use the STL and design patterns effectively to create high-performance programs; and apply modern C++ standards and leverage their benefits.		
Contents	This course provides comprehensive knowledge of modern C++ programming and prepares students to develop complex software projects efficiently and robustly. The focus is on modern C++ standards and proven design patterns. Advanced Object-Oriented Programming • Inheritance and polymorphism in practice • Abstract classes, interfaces, and virtual methods • Design patterns (e.g., Factory, Singleton, Observer) Memory Management and Resource Handling • Smart pointers (unique_ptr, shared_ptr, weak_ptr) • Move semantics, Rule of Five		

	Standard Template Library (STL) • Containers (vector, list, map, etc.) and algorithms (sort, find, transform, etc.) • Iterators and ranges • Functors and lambda functions Modern C++ features and current standards • constexpr, auto, decltype, and type deduction
Applicability in the following courses of study	MA Mechatronics MA Computer Science MA Business Informatics MA Mathematics MA HCI MA Mechanical Engineering MA Medical Data Science
Requirements for participation	Content: Basic knowledge of programming with C++ is required. Formal: -
Prerequisites for the award of LP	Passed examination.

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**	**X***	**After each attempt:**				
			After the last attempt:			**X**	
	No:						
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students who are enrolled in a degree program whose FPO contains a corresponding regulation (for a supplementary oral examination or for free attempts/grade improvement).**						

No.	4INFMA308		
Module title	Theoretical computer science		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every winter term		
Teaching language	German		
LP	6		
SWS	2		
Classroom study	30 h		
Self-study	150 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Seminar	Theoretical computer science	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Seminar lecture	60-90 min.	
Study achievements	---		
Qualification goals	Independent development and presentation of an advanced topic from theoretical computer science.		
Contents	The seminar deals with current topics in theoretical computer science. Different emphases are set.		
Applicability in the following courses of study	MA Computer Science BA Computer Science BA Computer Science dual		
Requirements for participation	Content: The modules 4INFBA005 "Formal Languages and Automata" and 4INFBA006 "Computability and Logic" should have been successfully completed or corresponding knowledge should be available. Formal: /		
Prerequisites for the award of LP	Passed examination		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

No.	4INFMA310		
Module title	Recent Advances in Operating Systems and Distributed Systems		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Irregular		
Teaching language	German/English		
LP	6		
SWS	2		
Classroom study	30		
Self-study	150		
Workload	180		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Recent Advances in Operating Systems and Distributed Systems	60	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 min	
Study achievements	Active and regular participation	At least 80% of the dates	
Qualification goals	After completing this module, students will be able to understand selected *state-of-the-art* research papers in the area of operating systems, virtual machines, networks, or distributed systems - if applicable, based on original publications - and to explain their main ideas and concepts in discussion with peers, to identify their merits and problems, and to compare and contrast different solution approaches. In addition to technical competence, the ability to engage in scientific discussion is also to be deepened. Therefore, regular attendance on site is mandatory.		
Contents	This module presents recent advances in the areas of operating systems, virtual machines, networks, or distributed systems, with a particular focus on recent research, new application areas, and open questions in the above areas. Based on the basic prior knowledge from other modules, this module focuses specifically on the state of the art by using original publications to present and actively discuss with the participants* the latest research results from leading international conferences and journals.		
Applicability in the following courses of study	MA Computer Science		
Requirements for participation	Content: Good prior knowledge of operating systems, computer networks, and distributed systems is required. Formal: /		
Prerequisites for the award of LP	Passed examination and passed study achievement.		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

No.	4INFMA312		
Module title	Recommender Systems		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every winter term		
Teaching language	German		
LP	6		
SWS	4		
Classroom study	60 h		
Self-study	120 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Recommender Systems	60	2
Exercise	Recommender Systems	30	2
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination or Written exam The form of the examination is announced no later than four weeks after the start of the course.	20-40 min 120 min.	
Study achievements	Successful completion of exercise or project tasks	1 task, approx. 40h	
Qualification goals	Students who successfully complete this module will understand the purpose of recommender systems; be able to make key design decisions and implement recommender algorithms and entire recommender systems; be able to conduct thorough evaluations; and be able to critically analyze evaluations conducted by others.		
Contents	Introduction to recommender systems with topics such as: - Goals and benefits of recommendation systems - Basic concepts (content-based filtering, collaborative filtering, ...) - Types of recommender systems (personalization vs. user modeling) - The recommendation ecosystem (stakeholders, software libraries, data sets, ...) Recommendation algorithms with topics such as: - Matrix factorization (SVD, SVD++, NMF, ...) - Neighborhood algorithms (kNN and clustering) - Popularity based recommendations - Content-based methods (term weighting and text similarity) - Knowledge & graph-based recommendations (e.g. KGAT). - Hybrid algorithms Evaluation of recommender systems with topics such as: - Evaluation methods (offline vs. online evaluations) - Evaluation Metrics - Ground Truth and Baselines Further in-depth with topics such as: - User interfaces for recommender systems - Context - Privacy - Multicriteria learning - Fairness, diversity, bias		
Applicability in the following courses of study	MA Computer Science BA Computer Science BA Computer Science dual		
Requirements for participation	Content: basic knowledge of machine learning and/or information retrieval; basic knowledge of programming, ideally Python. Formal: /		

Prerequisites for the award of LP	Passed examination and passed study achievement.

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

No.	4INFMA313		
Module title	Quantum Complexity Theory		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Every summer term		
Teaching language	English		
LP	6		
SWS	3		
Classroom study	45 h		
Self-study	135 h		
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
Lecture	Quantum Complexity Theory	60	2
Exercise	Quantum Complexity Theory	30	1
Achievements	**Form**	**Duration/Scope**	
Examinations	Oral examination	20-40 min	
Study achievements	Successful completion of exercise or project tasks	1 task, approx. 10h	
Qualification goals	Students understand the function of quantum algorithms and know important quantum complexity classes and their relationships. Students are able to analyze the quantum complexity of algorithmic problems.		
Contents	- Introduction to Quantum Computing - Bounded error quantum polynomial time (BQP) - BQP complete problems - Quantum Merlin Arthur (QMA) - Quantum Cook-Levin Theorem - Quantum Interactive Protocols		
Applicability in the following courses of study	MA Computer Science MA Mathematics MA Quantum Science		
Requirements for participation	Content: The module 4INFBA302 "Complexity Theory I" should have been successfully completed or corresponding knowledge must be available. Formal: /		
Prerequisites for the award of LP	Passed examination and passed study achievement		

Examination-legal peculiarities to the above-mentioned module description when used in several study programs

Repeatability of the examination(s) (number / scheduling)	**Repeat dates for failed examinations are offered in the following semester.**						
Supplementary oral examination possible	**Yes:**		**After each attempt:**				
			After the last attempt:				
	No:	**X**					
Repeat examination for grade improvement possible	**Yes:**	**X***					
	No:						
Special features	*** Applies only to students enrolled in a degree program whose FPO includes a provision for free attempts.**						

No.	4INFMA397		
Module title	Foreign Module Complex and intelligent Software Systems I		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Irregular		
Teaching language	country-specific		
LP	6		
SWS			
Classroom study			
Self-study			
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
According to host university			
Achievements	**Form**	**Duration/Scope**	
Examinations	According to host university		
Study achievements	According to host university		
Qualification goals	Students acquire advanced qualifications at a foreign university that enable them to understand and apply concepts, methods, and tools in the field of Complex and intelligent Software Systems that are not taught at the University of Siegen or not taught to the corresponding extent.		
Contents	The concrete contents of this module depend on the receiving university. They are to be determined prior to the stay abroad, whereby a substantial overlapping of content with other modules is to be excluded. The subsequent recognition of the work performed abroad must be ensured in advance by means of a learning agreement.		
Applicability in the following courses of study	MA Computer Science		
Requirements for participation	---		
Prerequisites for the award of LP	Passing the module at the receiving university. Learning Agreement for creditability of services.		

No.	4INFMA398		
Module title	Foreign Module Complex and intelligent Software Systems II		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Irregular		
Teaching language	country-specific		
LP	6		
SWS			
Classroom study			
Self-study			
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
According to host university			
Achievements	**Form**	**Duration/Scope**	
Examinations	According to host university		
Study achievements	According to host university		
Qualification goals	Students acquire advanced qualifications at a foreign university that enable them to understand and apply concepts, methods, and tools in the field of Complex and intelligent Software Systems that are not taught at the University of Siegen or not taught to the corresponding extent.		
Contents	The concrete contents of this module depend on the receiving university. They are to be determined prior to the stay abroad, whereby a substantial overlapping of content with other modules is to be excluded. The subsequent recognition of the work performed abroad must be ensured in advance by means of a learning agreement.		
Applicability in the following courses of study	MA Computer Science		
Requirements for participation	---		
Prerequisites for the award of LP	Passing the module at the receiving university. Learning Agreement for creditability of services.		

No.	4INFMA399		
Module title	Foreign Module Complex and intelligent Software Systems III		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Irregular		
Teaching language	country-specific		
LP	6		
SWS			
Classroom study			
Self-study			
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
According to host university			
Achievements	**Form**	**Duration/Scope**	
Examinations	According to host university		
Study achievements	According to host university		
Qualification goals	Students acquire advanced qualifications at a foreign university that enable them to understand and apply concepts, methods, and tools in the field of Complex and intelligent Software Systems that are not taught at the University of Siegen or not taught to the corresponding extent.		
Contents	The concrete contents of this module depend on the receiving university. They are to be determined prior to the stay abroad, whereby a substantial overlapping of content with other modules is to be excluded. The subsequent recognition of the work performed abroad must be ensured in advance by means of a learning agreement.		
Applicability in the following courses of study	MA Computer Science		
Requirements for participation	---		
Prerequisites for the award of LP	Passing the module at the receiving university. Learning Agreement for creditability of services.		

No.	4INFMA497		
Module title	Foreign module Medical Informatics I		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Irregular		
Teaching language	country-specific		
LP	6		
SWS			
Classroom study			
Self-study			
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
According to host university			
Achievements	**Form**	**Duration/Scope**	
Examinations	According to host university		
Study achievements	According to host university		
Qualification goals	Students acquire advanced qualifications at a foreign university that enable them to understand and apply concepts, methods and tools in the field of medical informatics that are not taught at the University of Siegen or not taught to the corresponding extent.		
Contents	The concrete contents of this module depend on the receiving university. They are to be determined prior to the stay abroad, whereby a substantial overlapping of content with other modules is to be excluded. The subsequent recognition of the work performed abroad must be ensured in advance by means of a learning agreement.		
Applicability in the following courses of study	MA Computer Science		
Requirements for participation	---		
Prerequisites for the award of LP	Passing the module at the receiving university. Learning Agreement for creditability of services.		

No.	4INFMA498		
Module title	Foreign Module Medical Informatics II		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Irregular		
Teaching language	country-specific		
LP	6		
SWS			
Classroom study			
Self-study			
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
According to host university			
Achievements	**Form**	**Duration/Scope**	
Examinations	According to host university		
Study achievements	According to host university		
Qualification goals	Students acquire advanced qualifications at a foreign university that enable them to understand and apply concepts, methods and tools in the field of medical informatics that are not taught at the University of Siegen or not taught to the corresponding extent.		
Contents	The concrete contents of this module depend on the receiving university. They are to be determined prior to the stay abroad, whereby a substantial overlapping of content with other modules is to be excluded. The subsequent recognition of the work performed abroad must be ensured in advance by means of a learning agreement.		
Applicability in the following courses of study	MA Computer Science		
Requirements for participation	---		
Prerequisites for the award of LP	Passing the module at the receiving university. Learning Agreement for creditability of services.		

No.	4INFMA499		
Module title	Foreign Module Medical Informatics III		
Compulsory/elective	WP		
Module duration	1 semester		
Offering frequency	Irregular		
Teaching language	country-specific		
LP	6		
SWS			
Classroom study			
Self-study			
Workload	180 h		
Teaching and learning form	**Events/module elements, if applicable**	**Group-size**	**SWS**
According to host university			
Achievements	**Form**	**Duration/Scope**	
Examinations	According to host university		
Study achievements	According to host university		
Qualification goals	Students acquire advanced qualifications at a foreign university that enable them to understand and apply concepts, methods and tools in the field of medical informatics that are not taught at the University of Siegen or not taught to the corresponding extent.		
Contents	The concrete contents of this module depend on the receiving university. They are to be determined prior to the stay abroad, whereby a substantial overlapping of content with other modules is to be excluded. The subsequent recognition of the work performed abroad must be ensured in advance by means of a learning agreement.		
Applicability in the following courses of study	MA Computer Science		
Requirements for participation	---		
Prerequisites for the award of LP	Passing the module at the receiving university. Learning Agreement for creditability of services.		